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THE

Street Railway Journal.

INDEX TO VOLUME XV.

1899.

Street Railway Publishing Co.,
120 Liberty Street,
New York.

73789

TF
701
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Abbreviations: * illustrated, c correspondence, a American edition only, i international edition only.

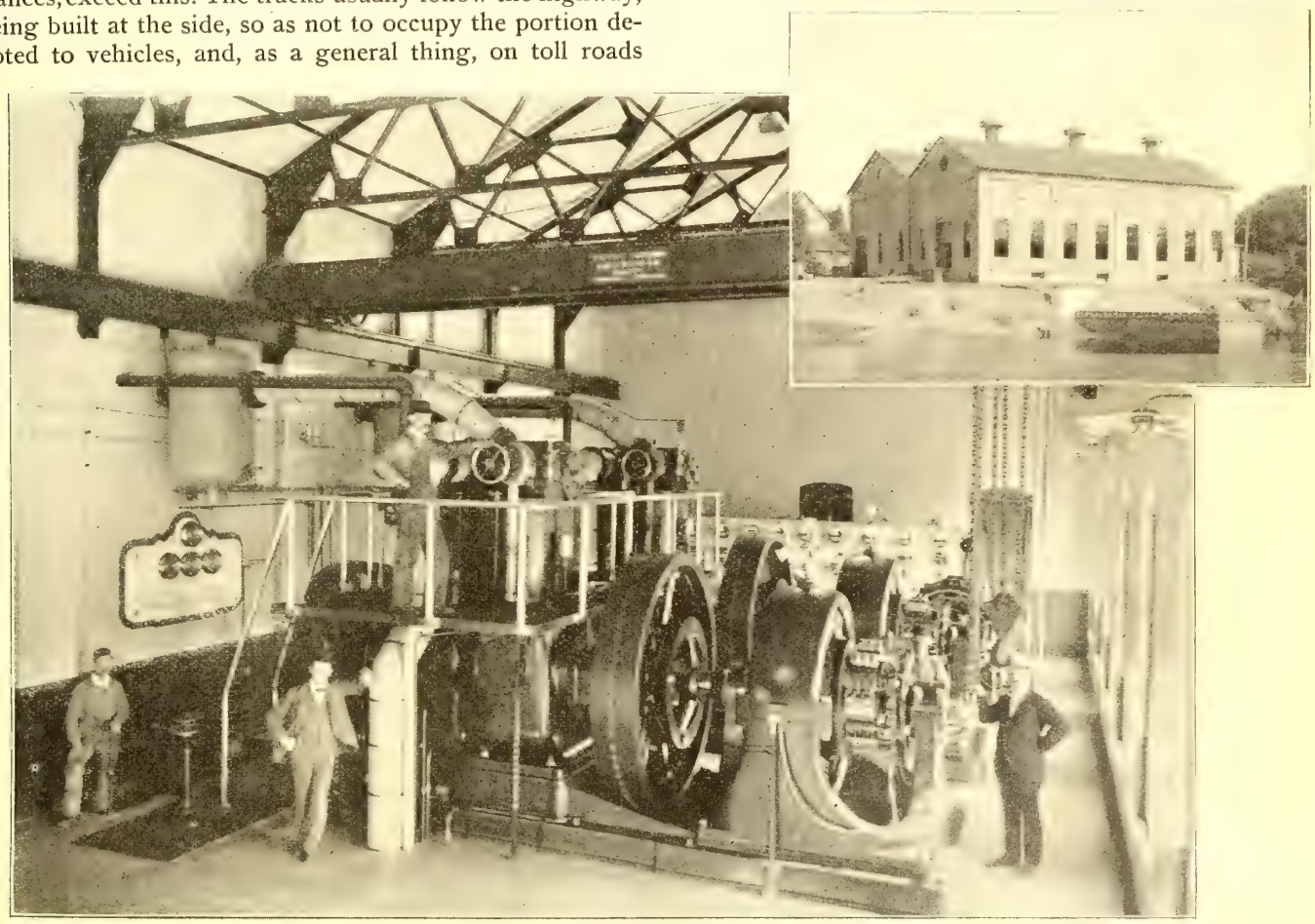
Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, JANUARY, 1899. No. 1.

THE INTERURBAN ELECTRIC RAILWAYS AROUND DETROIT

The interurban electric railway system around Detroit is more extensive than that in the neighborhood of any other city in this country, with the possible exception of Cleveland. There are no less than six interurban lines reaching out from the city in all directions, except where limited by the Detroit River, and of lengths varying from 20 to 40 miles. The cars are nearly all of the long double truck type; when outside of the city limits they run at schedule speeds of from 30 to 40 miles an hour and, in some instances, exceed this. The tracks usually follow the highway, being built at the side, so as not to occupy the portion devoted to vehicles, and, as a general thing, on toll roads during the last year, and, while the owners of all the lines prefer not to make public any financial statements of the operation of the roads, it is apparent that most of them are doing a good business, and practically all the companies are planning important extensions in the early future.

The headway on most of the lines is thirty minutes, and the cars run on regular published timetables, giving a service more closely resembling that of steam railroads than that of ordinary city electric railways. All the companies



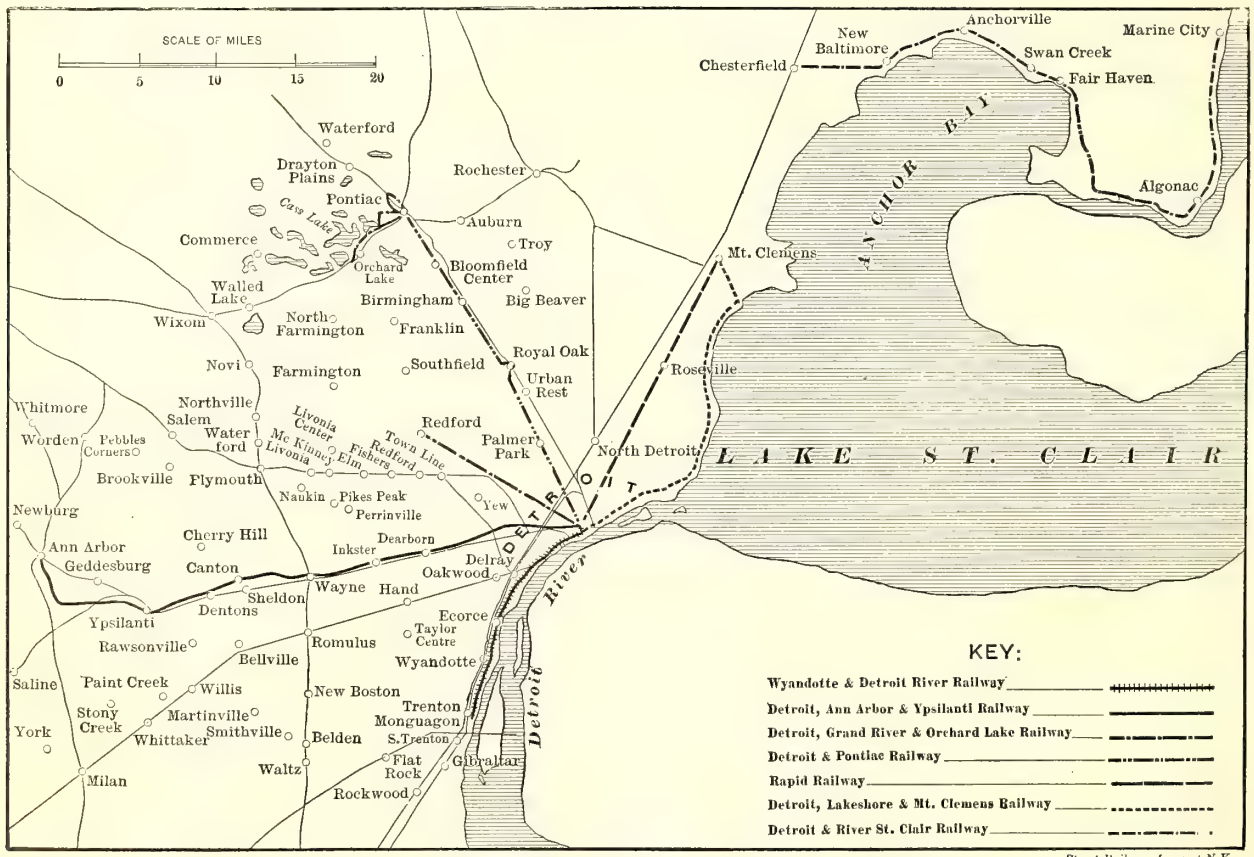
POWER STATION—DETROIT, YPSILANTI & ANN ARBOR RAILWAY

whose owners are identical with or closely allied to those of the electric railway. Within the city the cars operate by a traffic arrangement over the lines of the Detroit Citizens' Railway Company, which controls all of the lines in that city, and all start from or near the central square in Detroit, around which they make a loop; while on the lines of this company the cars are operated by employees of the Detroit Citizens' Street Railway Company, which takes the local fares and pays the interurban railways a certain mileage for the use of the cars. Upon arriving at the city limits, or at the terminus of the Detroit Citizens' Railway lines, the crews are changed and employees of the interurban lines assume the operation of the cars.

Two of the five most important lines have been built have offices in the city at which tickets can be purchased, and on one of the lines, mileage books are sold, though the coupons are detached in multiples of five. On one or two of the others duplicate fare receipts are issued by the conductor when fare is paid on the cars. All the roads are divided into 5-cent zones, and the average fare charged is about a cent a mile. Many, if not all, of the lines parallel steam railroads, and, although the running time between termini does not equal in point of speed that of the steam railroads, the frequency of the service, the ability to discharge passengers along the line and the low fares, have attracted considerable traffic from the steam rivals. The electric roads undoubtedly have also created a great deal of traffic.

Nearly all of the lines carry baggage and operate a light express system, and some operate regular freight trains, which they are entitled to do under the laws of the State of Michigan. These freight cars are of the regular box type, but neatly painted, and are run either as motor cars or as single trail cars, usually at night. Stations for the receipt of express and freight matter are located in the cities through which they pass. A considerable item of freight from the country into the city is milk, which is collected at points along the line in the early morning and delivered to depots in the city, where it is distributed in the usual way.

In spite of the long distances involved, it is interesting to note that no attempt has been yet made to transmit and distribute power by the alternating current system. The standard voltage on the trolley wire varies from 500 to 650, but the drop on the long lines is cared for by boosters, with which the stations of nearly all the companies are equipped.



MAP OF INTERURBAN ELECTRIC RAILWAYS NEAR DETROIT

One outlying line, the Detroit & River St. Clair Railway, which extends from Chesterfield to Marine City, is now operated by steam power, the trains coming in from Chesterville on the tracks of the Michigan Central Railroad. The electrical equipment of this line and its extension to Mt. Clemens at an early date, is probable, however.

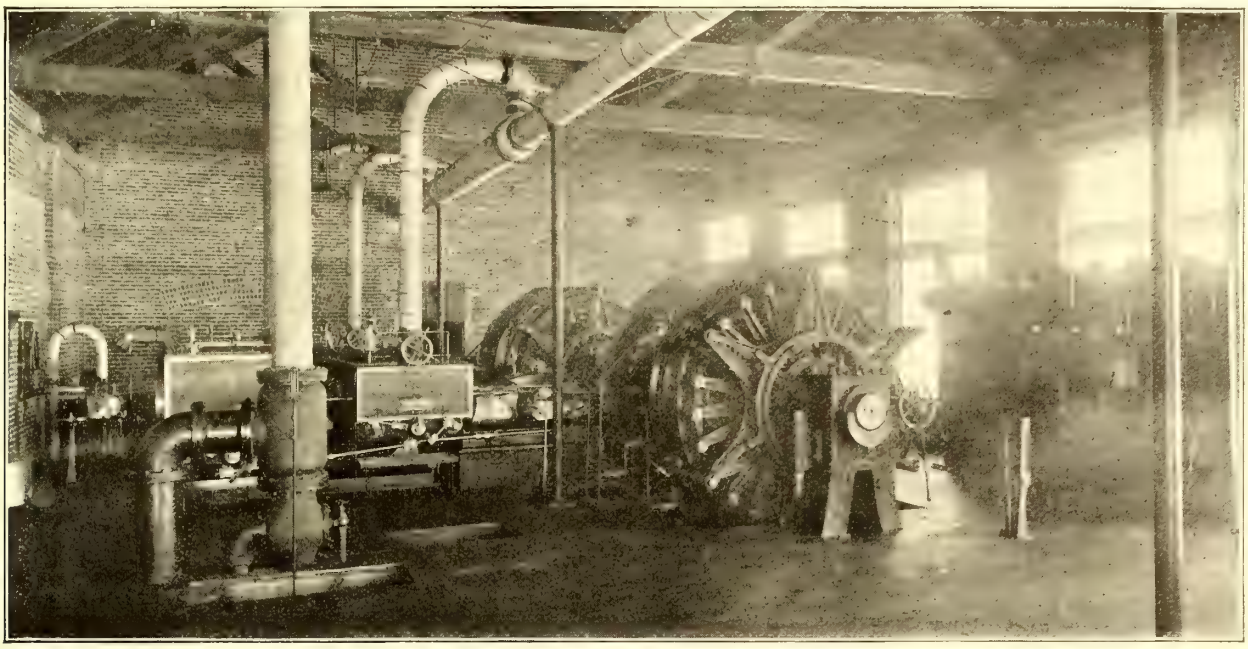
POWER STATIONS

The Detroit, Ann Arbor & Ypsilanti Railway, the longest line of the group, was put in operation last summer and takes its power from two stations, one at Dearborn, the other at Ypsilanti. The stations are identical, with the exception of the number of units in each, so that a description of the Dearborn station will suffice for that at Ypsilanti. The station is of brick, 73 ft. 6 ins. x 68 ft. 5 ins., divided into an engine room 71 ft. x 31 ft., and a boiler room 71 ft. x 35 ft. The former contains three 500-h.p. Westinghouse Kodak compound condensing units, with two boosters rated at 150 kw. each, but frequently carrying a very much higher load than this. The circuit breakers are set at 1150 amps., although the generators are rated at 392 amps. The switchboard is of the Westinghouse panel type, and a large Whiting crane runs the full length of the engine room. The gage board is of 2-in. marble, measures 4 ft. x 6 ft., and is particularly handsome. The floors are of concrete, laid with steel I-beams, with brick arches, making the station entirely fireproof. The boiler room is equipped with three batteries of 250 h.p., Babcock & Wilcox boilers, fitted with Roney mechanical stokers, which are giving excellent satisfaction. Mechanical draft is used, supplied by a duplicate set of 110-in. Detroit blowers belted to small Westinghouse Junior engines. An extra wheel is put on the stoker engine and is belted up to a shaft, by which the economizer scrapers are operated. The rest of the equipment of the boiler room includes Worthington compound duplex jet condensers, Baragwanath heaters, the Wefugo filters, and an American economizer. The feed water is first taken from the hot well, thence passes into the filter, thence to the heater, and thence to the economizers, from which point it is introduced into the boilers. The piping is extra heavy, on account of the high steam pressure used, viz., 175 lbs. to the inch. From the boilers the live steam passes by 6-in. w.i. header to a 10-in. w.i. main, from which it is fed by 8-in. pipes to the engines. The usual Westinghouse steam loop and separators are employed, and no elbows are used in the live steam piping, which is covered by Johns magnesia covering.

In the basement is a Worthington fire pump, 12 ins. x 7 ins. x 10 ins., with a capacity of 320 gals. per minute. This is also used for washing cars in the car barn, sprinkling the lawns, etc. Steam is always kept up in this pump, even when not in use, and it can be made to operate by the turning of a valve. The contractors for this station, as well as for all the electrical apparatus, were Westinghouse, Church, Kerr & Co.

The power station of the Lakeshore Railway Company

is at Lakeside, and has an entirely different equipment. It is of brick, 100 ft. x 40 ft., with metal roof, and contains two Russell compound 4-valve engines, guaranteed to develop 450 h.p. on 125 lbs. of steam, with an efficiency of 90 per cent when working at the most economical point of cut off; each engine directly connected to a 300 kw. Siemens & Halske generator. There is also a 200 h.p. Russell 4-valve engine directly connected to a 100 kw. Siemens & Halske booster. The switchboard is of the usual type. The boiler room contains two Stirling water tube boilers, each equipped with a Jones mechanical stoker. The room also contains a Laidlaw-Dunn-Gordon single-jet condenser for each engine, Wainwright closed feed water heater and the usual apliances.



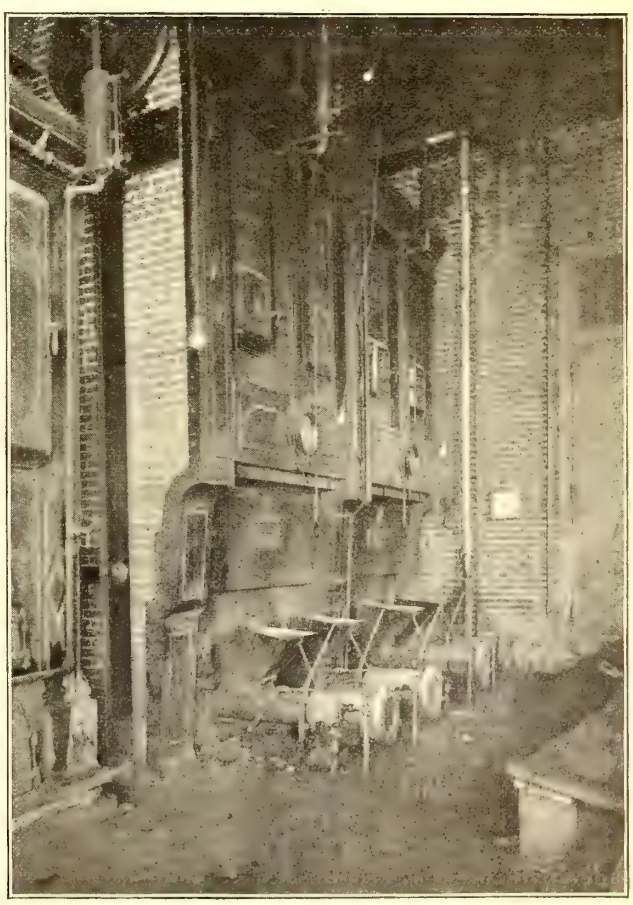
ENGINE ROOM—DETROIT, LAKESHORE & MT. CLEMENS RAILWAY

On account of the great depth and mass of the coal in the stoker, forced draft was considered desirable. The pressure of air ranges from 1½ oz. to 5 oz. per sq. in., according to the steaming capacity of the boiler, and the quality of coal used. The quantity of air delivered at these pressures ranges from 6500 cu. ft. to 12,000 cu. ft. per minute, which is sufficient for a consumption of from 1600 lbs. to 3600 lbs. of coal per hour.

The blower used was made by the American Blower Company. The wheel is 34 ins. in diameter, and the discharge outlet 20 ins. in diameter. When running 830 r.p.m. this blower will produce 1½ oz. pressure, and at 1525 r.p.m. will produce a 5-oz. pressure, with an expenditure of about 2 per cent of the total output of steam from the boilers, for power to drive the blower when running at maximum speed. The blast piping runs along the front of the boilers over the fire doors with branches extending down between them and discharges into what is ordinarily the ash pit, but with these stokers it is an air chamber beneath the stokers. This piping is made of heavy galvanized iron, soldered and riveted to make it air tight. In each branch pipe from the main pipe is fitted a blast gate to control the volume of air delivered to each boiler, according to how the fire burns under each. The air finds egress through long narrow slits or openings in a row of tuyere blocks, running the entire length of the stokers. This brings the blast beneath the ignited coal and causes the fire to burn with equal force at the front, middle and back of fire-bed.

The well from which the feed water is taken holds 39,000 gals., and is fed by an 18-in. intake pipe from the lake and an overflow pipe of the same size from the engines. The station, with the car house adjoining it, was built by the Arbuckle-Ryan Company, of Toledo, under the supervision of the engineers of the company, Van De Mark & Hill. The road was financed by the International Construction Company, of Detroit.

The power station of the Detroit & Pontiac Railway is at Birmingham. It contains two Westinghouse compound condensing engines with Worthington pump and condenser, a Westinghouse generator belted to one engine and two Detroit generators belted to the other engine.



BOILER ROOM—LAKESHORE & MT. CLEMENS RAILWAY

The boilers are of the horizontal return tubular type with vertical open heaters and New York filter. The total power capacity of the station is 600 h.p.

The power station of the Wyandotte & Detroit River Railway is at Ecorce, and contains two 150 Dick & Church compound condensing engines, built by the Phœnix Iron Works, each belted to a Westinghouse 4-pole 100 kw. generator. The boilers are of the Manning vertical tubular type, with Conover condensers and closed heaters.

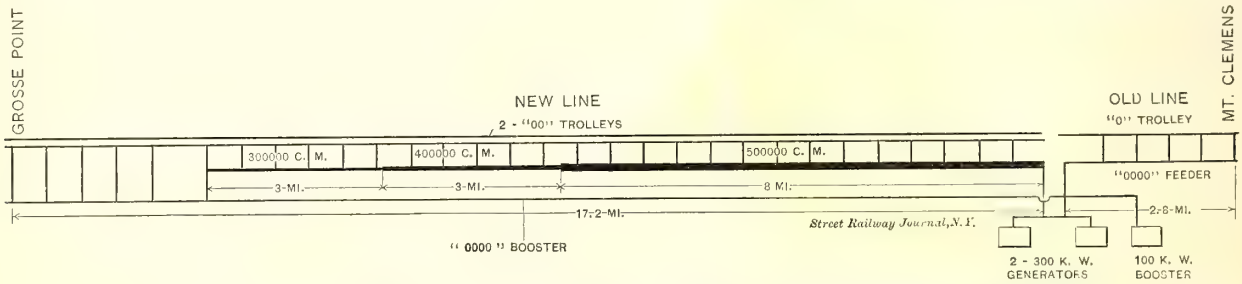


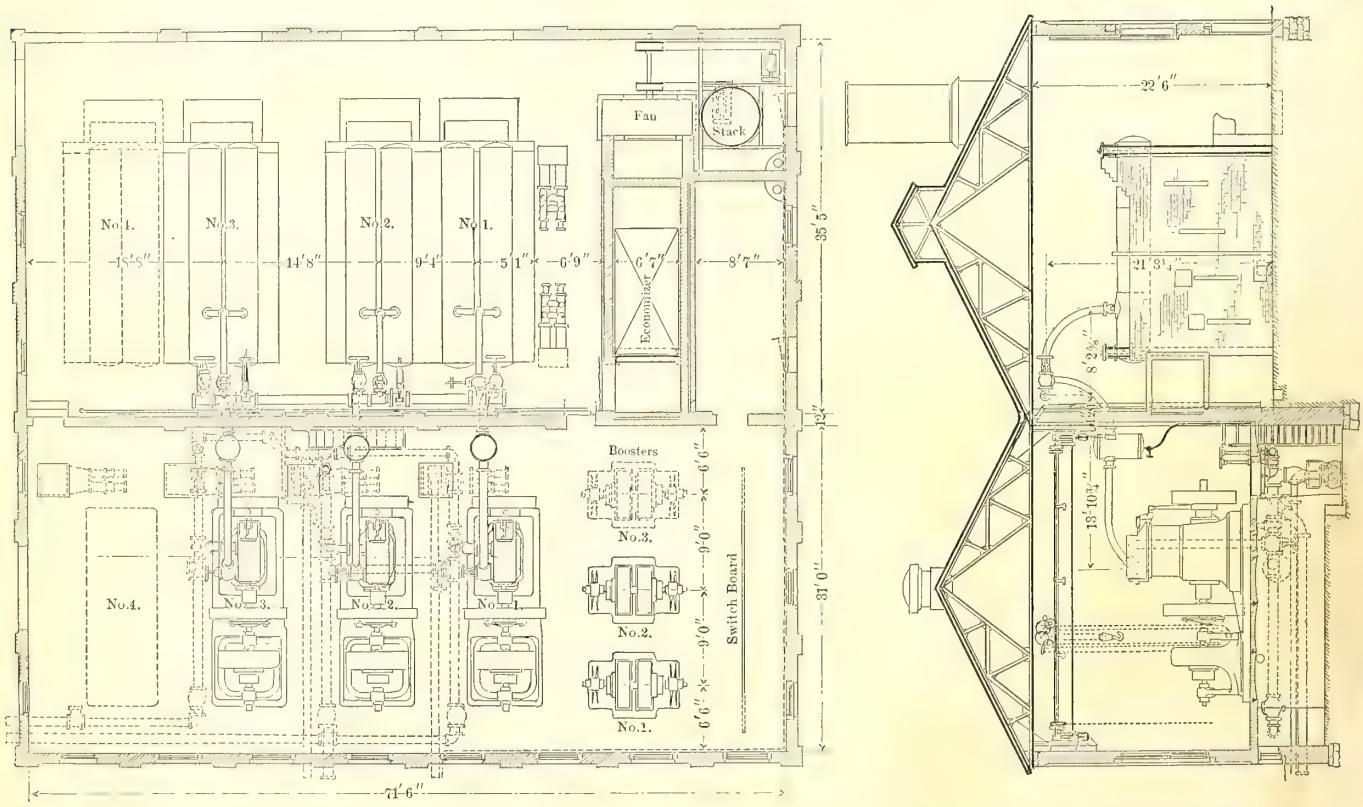
DIAGRAM OF FEEDER SYSTEM—DETROIT, LAKESHORE & MT. CLEMENS RAILWAY

The power station of the Rapid Railway contains two 250 kw. and one 400 kw. Walker generators, driven by Dick & Church engines. The boilers are of the horizontal tubular type.

The Grand River & Orchard Lake Railway power station is at Pontiac, and contains an American engine belted to a Walker generator.

OVERHEAD CONSTRUCTION

The overhead construction employed on all the roads is generally of the bracket type with flexible suspension. It is universal to use two trolley wires on all the single-track roads to avoid frogs, which have been found undesirable when running at high speeds. These trolley wires are connected together electrically at intervals of every five or ten poles, so that they reinforce each other and reduce by the amount of their cross sections the amount of feeder required. The two latest roads built employ No. 00 Fig. 8 trolley wire, equipped with Ohio Brass Company appliances. The poles are universally wooden and the specifications for those on the Lakeshore Railway, which are good samples of those employed, require that they shall be from 30 ft. to 35 ft. in length, depending upon whether they are side poles or curve poles, 7 ins. in diameter at the top, of cedar, and set one-sixth of their length in the ground. The poles have all rock setting, are spaced 115 ft. apart, and are 6 ft. 9 ins. from the center of the track. On the Pontiac and the Wyandotte lines every pole is numbered by miles; thus, those in the first mile are numbered from 0 to 42 or 43, in the next mile from 100 to 142, etc. The Wyandotte line was originally equipped with rigid brackets, but they were found undesirable for this service, as the wire would break at the hanger. On these two lines, which were for a long time under the same management and which are among the oldest of the interurban lines, pine, hemlock and cedar poles have all been used, and but little difference has been found in their life, each kind having to be replaced at the end of six years. The Lakeshore Railway is employing bare feeder wires and its feeder system is shown diagrammatically above. This distribution is based on a service of six cars, each of which takes on an average about 150 amps. when running at 30 miles per hour on a level.



PLAN AND SECTION OF POWER STATION—DETROIT, YPSILANTI & ANN ARBOR RAILWAY

Quite a little difference exists in the use of trolley wheels. The Lakeshore cars are fitted with two trolleys, one immediately in the rear of the other, but the two are used only in the case of heavy loads. The wheel has a diameter

of 6 ins., with a groove 2 ins. in width and flange 1¼ ins. in height. Wilson-Thompson trolley pole catchers are employed on this line. Practically all the lines employ the Kalamazoo trolley wheel, the hub of which is hollow and contains oil, providing excellent lubriction. This wheel



VIEW ON PONTIAC RAILWAY SHOWING TRACKS AT SIDE OF HIGHWAY

seems to answer well the requirements of high-speed service.

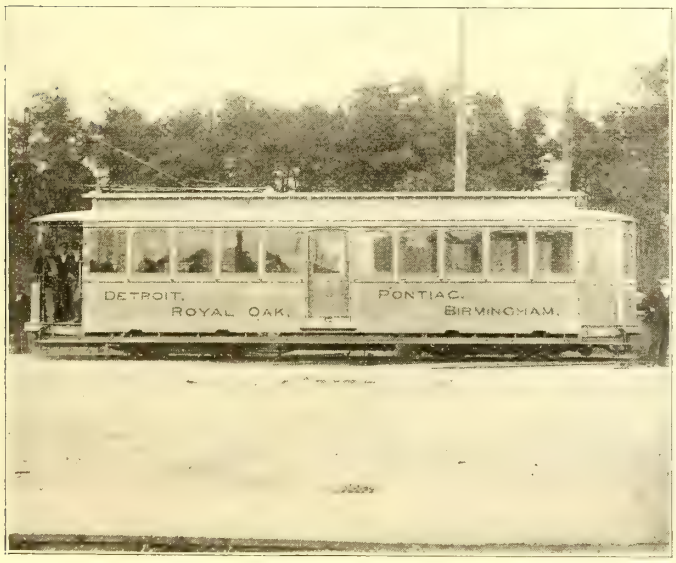
Practically all of the lines maintain a telephone service throughout the entire line. Every car carries a telephone and connection can be made with the telephone wires at turnouts by means of junction boxes. If the conductor should desire to send a message between turnouts, he makes connection with the telephone wires by means of a flexible connection, and jointed poles furnished with hooks are hooked over the telephone wires.

TRACK CONSTRUCTION

The T-rail is used throughout and the section of the American Society of Civil Engineers is popular. The rails weigh from 70 lbs. to 75 lbs. per yard on the lines lately equipped. On the earlier lines they are from 56 lbs. to 60 lbs. The ties are usually steam railroad standard, 6 ins. x 8 ins. x 8 ft., and spaced 2 ft. centers. The ties are usually set in gravel, and where the rail is carried through the towns, the side is packed with gravel. The Ypsilanti & Ann Arbor road and the Lakeshore road employ Forest City protected bonds; Washburn & Moen bonds are used on the Pontiac line. On the Lakeshore line American rail joints are used throughout; on the road, the special work was supplied by the Cleveland Frog & Crossing Company.

ROLLING STOCK

The tendency in rolling stock on the interurban roads around Detroit is unquestionably toward long, heavy cars. On the Lakeshore Railway they reach a maximum in being 50 ft. 6 ins. over all. This line has six motor cars and four trail cars, and will place an order for ten more cars for spring business. The Detroit, Ypsilanti & Ann Arbor Railway has fourteen long cars in use on its interurban line and twenty short cars belonging to the old Ann Arbor & Ypsilanti Railway and in use on the city lines in that city. The interurban cars on this railway and on the Lakeshore Railway were built by the Barney & Smith Company. The Rapid Railway has seventeen 42-ft. cars, supplied by





EXTERIOR AND INTERIOR OF DETROIT & PONTIAC CAR

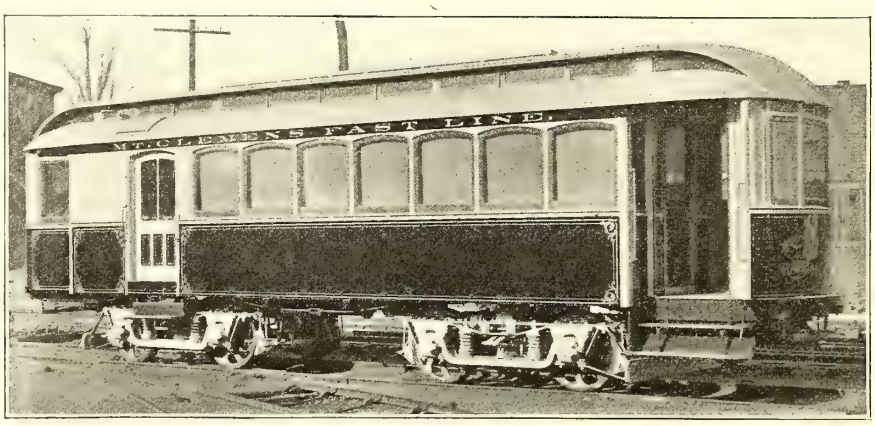
the Barney & Smith Company; one 47-ft. and eight 32-ft. cars, built by the Jackson & Sharp Company. In addition, it has sixteen freight cars, all trail cars. The Detroit & Pontiac Railway has twelve Kuhlman cars, 42 ft. over all, for passenger service. The Wyandotte & Detroit River Railway is equipped with Jackson & Sharp single-truck cars measuring 30 ft. over all. The Grand River Railroad has on its Grand River section five motor cars and four trail cars, built by the Brill Company and the Wells-French Company. The Detroit & River St. Clair Railway, being equipped at present with standard steam equipment, will not be considered in this connection.

The number of miles run per day by each car on the different electric roads averages about 300. All the recently



LAKESHORE CAR

built cars are similar in appearance to steam railroad cars, and have straight sides. Views of a number of these cars are given herewith. Those on the Lakeshore will attract attention as being the most novel in floor-plan and general arrangement. Each car contains a baggage and smoking compartment, which is fitted with foldable seats; a state-room, containing four seats, which are rented for the trip for ten cents additional fare; complete toilet, water cooler, etc., besides regular passenger compartment seating about fifty passengers. These cars are lighted with twenty-five 16-c.p. lamps each, and carry a Wagenhall's electric headlight. The weight of these cars without electrical equipment is: body, 25,320 lbs.; truck, 13,140 lbs.; total, 38,460 lbs. The state-room idea is a novel one in electric railroading, and has proved extremely popular with the patrons of the line; it is often rented to a party of four commuters, who wish to play cards on the trip, or who desire special seclusion. The weight of the convertible on the same line is: body, 18,600 lbs.; trucks, 12,600 lbs.; total, 31,200 lbs. The floor plans of these cars give full information as to dimensions.

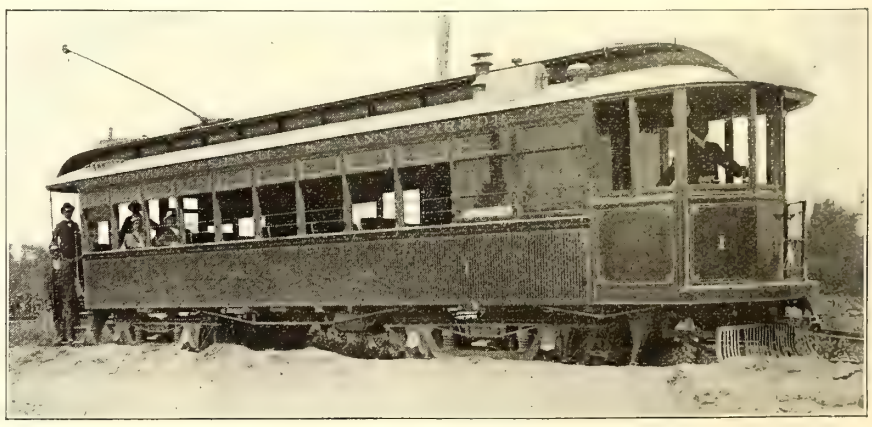


RAPID RAILWAY CAR

The Detroit, Ypsilanti & Ann Arbor cars were also built by the Barney & Smith Company, and are very complete. They are of two types, one of which is illustrated. Both are equipped with combination baggage and smoking compartments, toilet, etc. The long car weighs: body, 25,500 lbs.; trucks, 13,600 lbs.; total, 38,100 lbs. The shorter car weighs: body, 22,900 lbs.; trucks, 13,600 lbs.; total, 36,500 lbs. The trail cars on this line weigh: body, 20,500 lbs.; trucks, 13,600 lbs.; total, 34,100 lbs.; all without electrical and air-brake equipment. An interesting feature of these cars is the novel arrangement of the vestibule. Owing to the length of these cars the passengers are allowed to enter and leave the car at either end, and to prevent their passing through the motorman's compartment, the front of platform is only half vestibuled. On some of the cars which the company is proposing to install, the center of the front platform only will be vestibuled, leaving exits on each side for passengers without entering the motorman's compartment.

The Detroit & Pontiac cars, which are also illustrated, were built by the G. C. Kuhlman Company, with a side aisle on what is commonly known as the Kuhlman pattern, and a number of them are fitted with baggage and smoking compartments. They measure inside 33 ft., and over all 42 ft. One characteristic of these cars, besides their extremely handsome appearance, is that they are very low, in spite of the fact that 33-in. wheels are used. This result is accomplished by making the wheels swing inside the side sills of the car.

The Rapid Railway cars, built by the Jackson & Sharp Company, also deserve special mention. The motor cars are of two lengths, one with 24-ft. body and 32 ft. over all, finished in cherry, with cross seats upholstered and rattaned, and a passenger and baggage car with 37-ft. body and 47 ft. over platforms, finished in quartered oak. The Jackson & Sharp Company also supplied this company

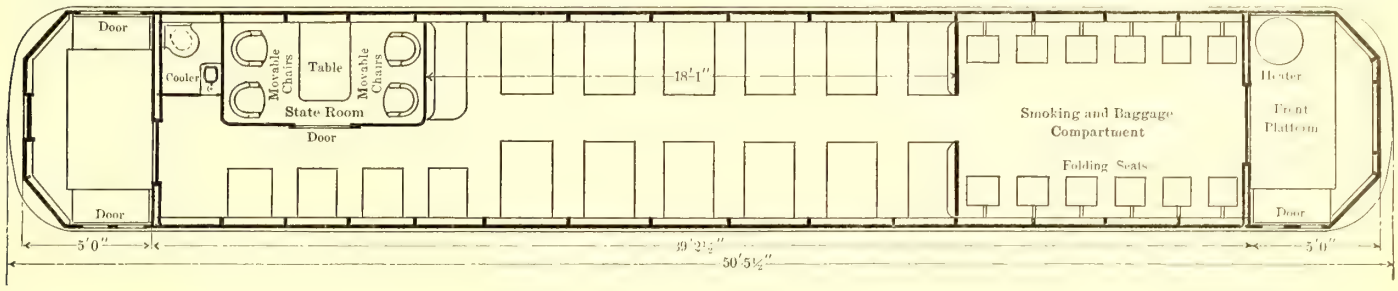


YPSILANTI & ANN ARBOR CAR

with eight ten-bench open trail cars, with six reversible and four permanent seats, finished inside with white ash, with cherry moulding and white birch veneer ceilings.

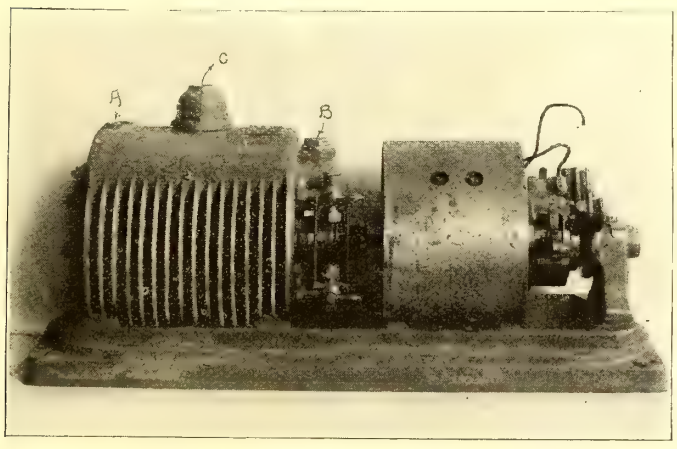
The motorman's vestibule in all these cars contains quite a variety of apparatus. A list of these as carried on the Lakeshore cars, which are a good sample of all, includes

a long-distance telephone, with flexible connections, for communicating with the central office from any point of the line; a G. E. circuit breaker, the Christensen airbrake controller with gage, fuse-box and automatic controller for the motor compressor; sand-box, bell, handbrake, and hot-water heater, besides the regular motor controller and appliances.



PLAN OF DETROIT, LAKESHORE & MT. CLEMENS CAR

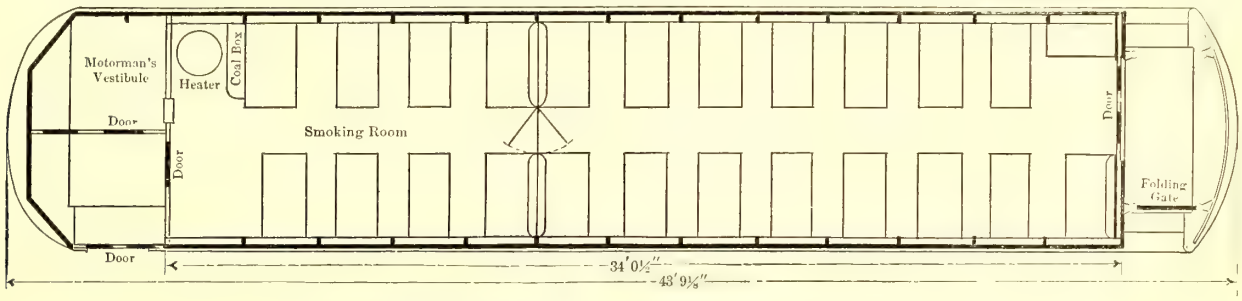
The heaters employed are generally of the hot-water type, Baker heaters being the most generally used. These heaters are of the "Mighty Midget" type, in which the heater is carried on the front platform, and the interior of the car is warmed by hot-water pipes fed from it. The heater occupies but little room on the platform, and is cared for entirely by the motorman. Full particulars of this heater are given elsewhere in this issue, and it seems to be giving excellent satisfaction. On the Lakeshore and on the Pontiac cars the heater is carried on the front platform; in the Ann Arbor cars, in a closet in the regular passenger compartment.



MOTOR COMPRESSOR

AIR BRAKES

There is a wide divergence in the practice in the use of air brakes, four different kinds being in use. The Detroit, Ypsilanti & Ann Arbor Railway employs the Westinghouse airbrake with automatically controlled electric motor and compressor, this being the first application of this system to any electric road. The general diagram of the arrangement of the system, together with a view of the motor and compressor directly connected and mounted on a single base, is given on this page. The compressor is of the rotary type, and the cast iron housing in which it is placed forms an oil reservoir, the upper portion of which is a suction chamber. The ribbed construction of the housing is for providing greater cooling surface for the compressor. The course of the air is from inlet *A* to the suction chamber, thence through a valve suitably arranged at *B* for allowing the air to pass into the pump and out at either of the reservoirs. The compression is effected in two separate cylinders, one for high pressure, and the other for low pressure.



PLAN OF DETROIT, YPSILANTI & ANN ARBOR CAR

The Pontiac Railway employs the Magann air brake, in which no compressor of any kind is in use on the car, but the air is stored to a pressure of about 225 lbs. in reservoirs carried on the car. These reservoirs are connected through a reducing valve with a working reservoir of about 40 lbs. pressure, from which the jam cylinder is operated. The compressor for storing the reservoirs on the cars is located at the power station, in Birmingham. Connection is made by a flexible coupling, the cars are stored and disconnected from the coupling in less than half a minute.

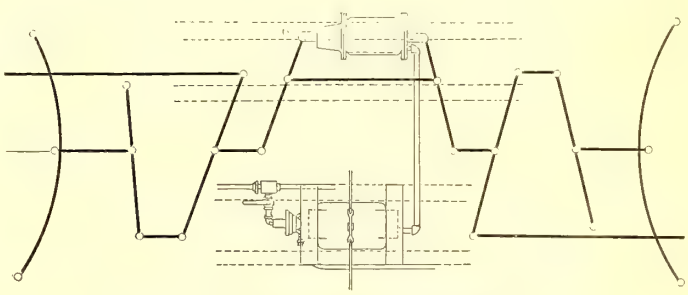


DIAGRAM OF AIR BRAKE EQUIPMENT

Full particulars of this air brake are given elsewhere in this issue.

The Lakeshore cars are equipped with the Christensen air brake, with motor compressor, which is carried under the car between the trucks. This system is working very satisfactorily.

On the Rapid Railway twelve of the cars are equipped with Hunt air brakes, with motor compressors, and two with Sellers, Beamer & Nauger air brakes, with compressors of the axle driven type with automatic cut-outs. Both are reported to be giving satisfaction.

MISCELLANEOUS CAR EQUIPMENT

The car wheels are usually of the plate type and vary from 500 lbs. to 350 lbs. each, depending upon the weight of the car. On the Pontiac Railway a spoke wheel weighing 480 lbs. is employed, the management of this line thinking that these wheels are more noiseless than the plate wheels.

Brill 27 trucks are used on the Pontiac line, Barney & Smith trucks on the Ypsilanti and Lakeshore lines, Du Pont trucks on the Wyandotte lines, and Barney & Smith and Jackson & Sharp trucks on the Rapid Railway.

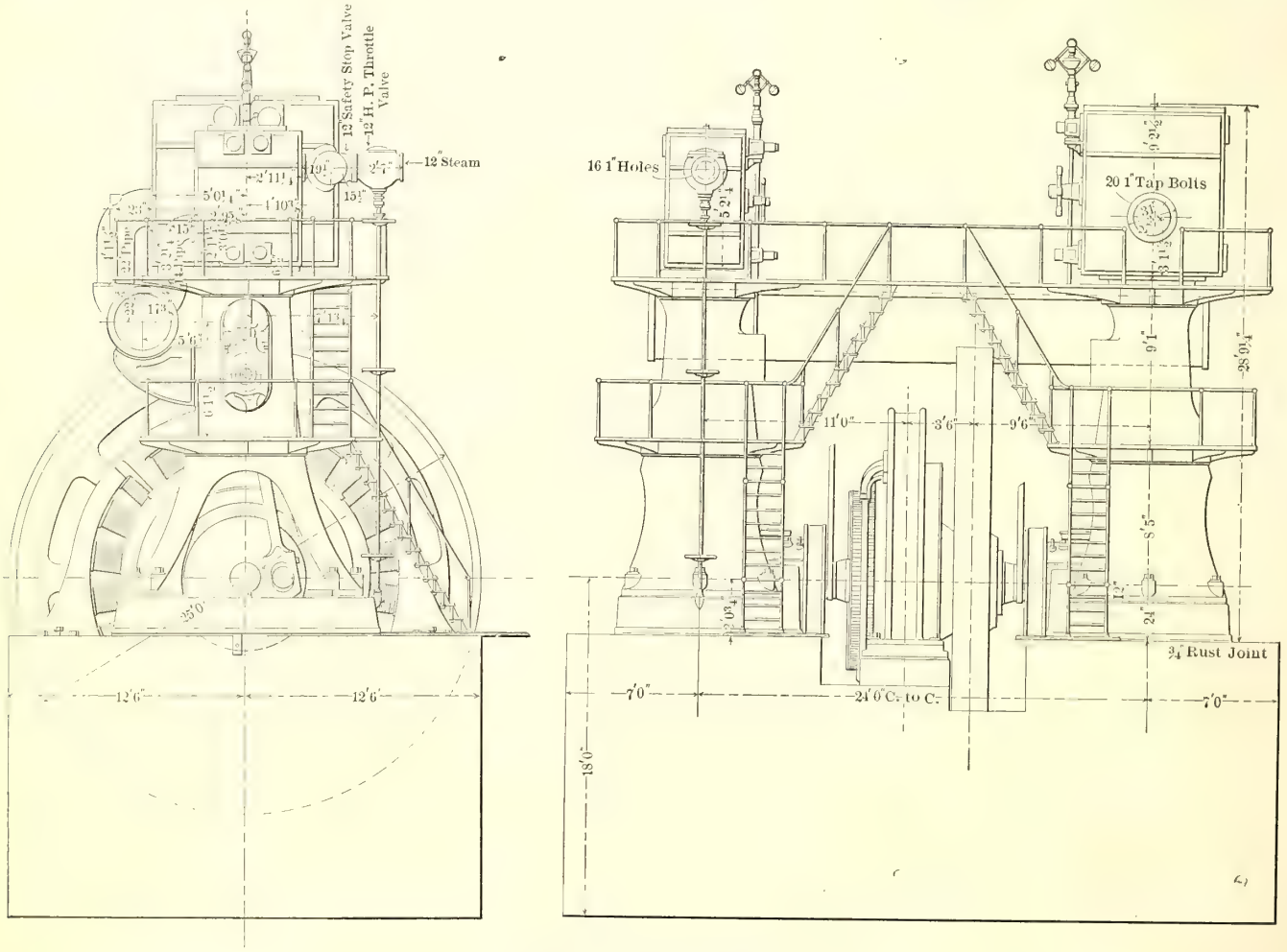
The Ann Arbor & Ypsilanti and Lakeshore lines use four motors for each car, the type employed being 50-h.p. Westinghouse, with Westinghouse 4-motor controller. The Pontiac line (double-truck cars 42 ft. over all) and the Wyandotte line (single-truck cars 32 ft. over all) use two motors on each car. On the Pontiac line the two motors are carried on the rear truck, the bolster of which is set 1 ft. nearer the center of the car than is the bolster on the front truck. The motors on the first line are mostly Steel motors, that on the latter Westinghouse No. 3, with old type resistance controllers. The Rapid Railway employs both practices on its long 42-ft. cars. The motors are mostly of the Walker type, and the general manager states that he finds two 75-h.p. motors more desirable than four 50-h.p. motors, and as easy to obtain traction with them. On this road, where two motors are employed, a motor is carried on the rear axle of each truck.

Our experience has been that if the conductors and the passengers will use the transfers as we intended they should use them, we can afford to give them.—From address at the Montreal Convention, 1895.

Large Engine for Louisville

The accompanying illustration shows side and end elevations of one of the largest engines, if not the largest, yet built for electric railway service. It is a vertical compound, with cylinders 40 ins. and 78 ins. x 48 ins. stroke, and was constructed for the Louisville Railway Company of Louisville, Ky., by the E. P. Allis Company. It is direct connected to a 1600 kw. General Electric generator, and the large size of cylinders was necessary on account of the low steam pressure used, about 100 lbs.

The main shaft of the engine is solid, and is 27 ins. in diameter. The fly wheel is 25 ft. in diameter, and weighs 160,000 lbs. The journals are 24 ins. x 48 ins. The crank pin is 12 ins. x 12 ins. The normal speed is 75 r.p.m. The valve gear is of the regular Allis-Corliss type. The engine is fitted with two governors, one for ordinary running and one for operating the safety stop valve, which becomes operative when the speed exceeds the normal by five revolutions. The total weight of the engine is 325 tons.



LARGE ENGINE FOR LOUISVILLE

The engine illustrates the current favor with which vertical engines for large units are regarded. The chief advantages claimed for this type are the reduction in wear, less chance of cylinder cutting, and less lubrication. The limiting size, according to present practice for horizontal engines, seems to be in the neighborhood of 50 ins., cylinder diameter. The saving in floor space is also an important item. For the same capacity as the engine illustrated a horizontal engine would have to be of the same width, but 40 ft. length instead of 25 ft.

The engines being built by the Allis Company for the Metropolitan Street Railway Company, of New York, are also of the vertical type.

The New Power Station of The Capital Traction Co., Washington, D. C.

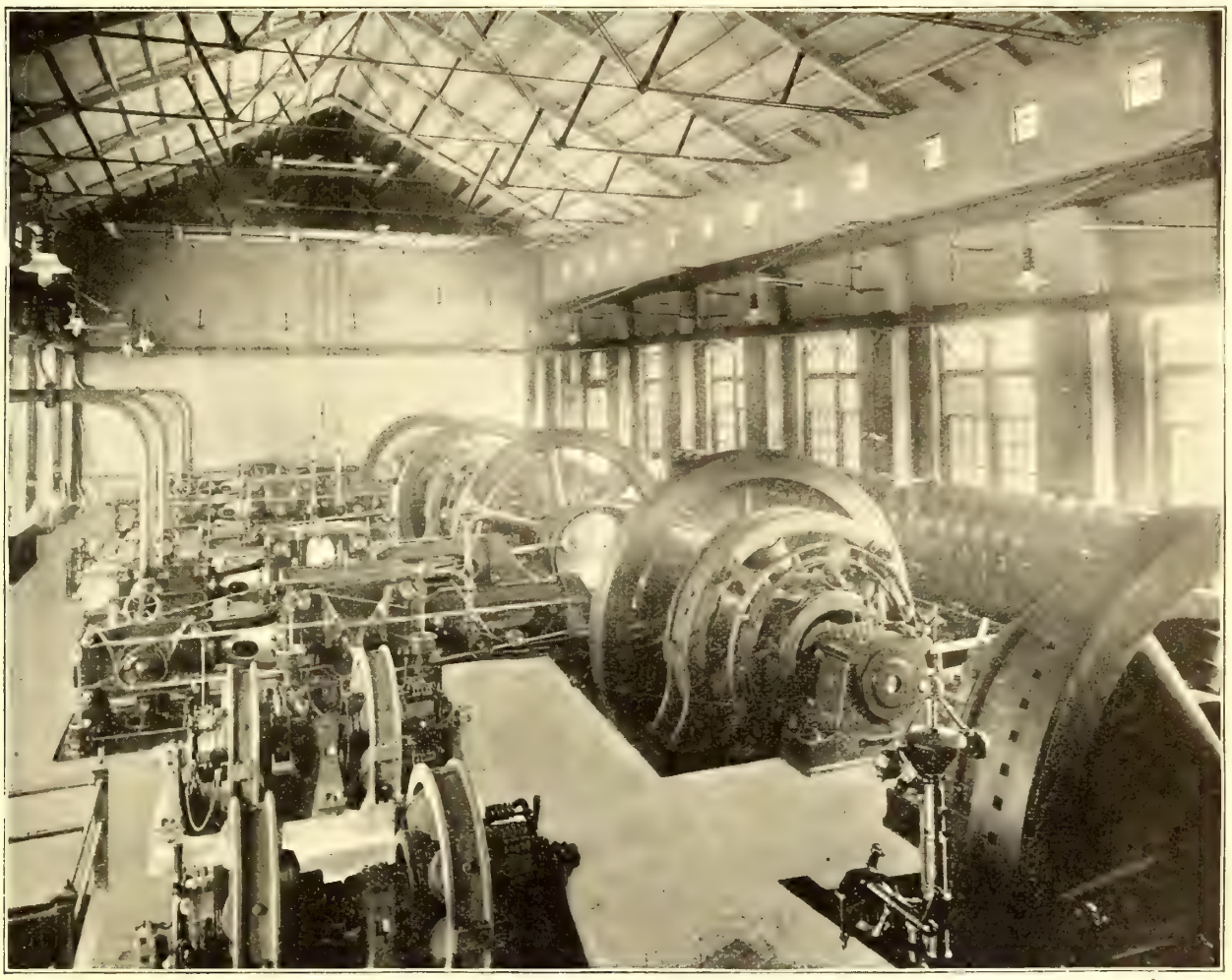
On Sept. 29, 1897, the power house of the Capital Traction Company, on Pennsylvania Avenue, Washington, D. C., was destroyed by fire, and the system which, up to that time, had been driven entirely by cable, was brought to a complete standstill. Traffic was resumed temporarily by means of horse cars, and the contrast between the modern system in use on other roads and the antiquated method which the Capital Traction Company was compelled to employ on Washington's streets at that time, emphasized distinctly the tremendous progress made in city transportation during the last decade.

In re-equipping the road the use of the trolley was prohibited by the municipal laws, so that choice lay between the electrical underground conduit system and cable. The former was adopted, and full particulars of the method of converting the existing cable conduit to one suitable for electric use was fully described in the STREET RAILWAY JOURNAL for January, 1898. Since that time the power station of the company has been completed, and is distributing power not only to the main lines of the company on Pennsylvania Avenue and Seventh Street, but also to the suburban lines using the trolley system.

The company was fortunate in possessing a location for its power house most conveniently situated for the purpose. On the banks of the Chesapeake and Ohio Canal it owned an old warehouse, one side facing on the canal, the other on Grace Street, between Thirty-second and Potomac Streets. This it practically rebuilt.

The present power house is 300 ft. long x 60 ft. wide and 65 ft. high, and is divided into two parts by a heavy brick partition wall, the eastern end being occupied by the engines and dynamos, and the western end by the boilers. West of the main building is the coal handling building. Facing the power house on the other side of the canal is a large car barn and repair and machine shop.

The boiler room, 162 ft. 9½ ins. long, contains eight Cahall, Babcock & Wilcox boilers of 350-h.p. capacity each, arranged in four batteries. The flues pass into a steel brick-lined stack of 9 ft. internal diameter and 150 ft. high, standing on a 25-ft. brick base, giving it a total height of 175 ft. The stack was built by the Campbell & Zell Company, and is provided with Locke regulators and dampers. The boilers are equipped with Roney mechanical stokers, built by Westinghouse, Church, Kerr & Company, and driven by three small Westinghouse engines, two driving the stokers for the three main batteries, and one those of the battery made up of the boilers on the west side of the stack.



INTERIOR OF POWER STATION CAPITAL TRACTION CO., WASHINGTON

The coal is taken directly from the canal barges on the Chesapeake and Ohio Canal by coal handling machinery furnished by the Steel Cable Engineering Company, of Boston, and operated by electric motors. It is housed in a small steel structure forming the western annex to the main building. A 30-h.p. motor operates a tub elevator, which raises the coal from the canal boats and dumps it into a receiving hopper, whence it passes to a weighing hopper with a capacity of 2000 lbs. on a Fairbanks scales. After weighing it drops through a chute into a crusher driven by the same motor. After crushing, the coal drops into the conveyor, which is driven by a 15-h.p. motor. The conveyor carries it up and dumps it into the coal bins over

the boilers. The returning buckets pass down the eastern side of the boiler room and through a tunnel below the boilers, where they catch the ashes from the ash hoppers and bring them out on the return journey, dumping them into an ash tank, from which they are transferred to other canal boats or to carts to be carried away. The capacity of the conveyor is 30 tons per hour. The coal used is "run of mine" Cumberland. The coal bins are duplicate bins, built of steel, and occupy the entire space above the boilers, or 162 ft. 9½ ins. x 60 ft. The bins are lined with concrete on corrugated iron arch plates. They were built by the Structural Iron Company, and have a capacity of 2000 tons. The coal is delivered into the furnaces of the boilers through measuring hoppers, each having a capacity of 1000 lbs. The coal from the rear or auxiliary bins can be chuted down through three supplementary chutes set between the boilers to the conveyer in the ash tunnel, and can then be carried up again and dumped into the forward or main bin.

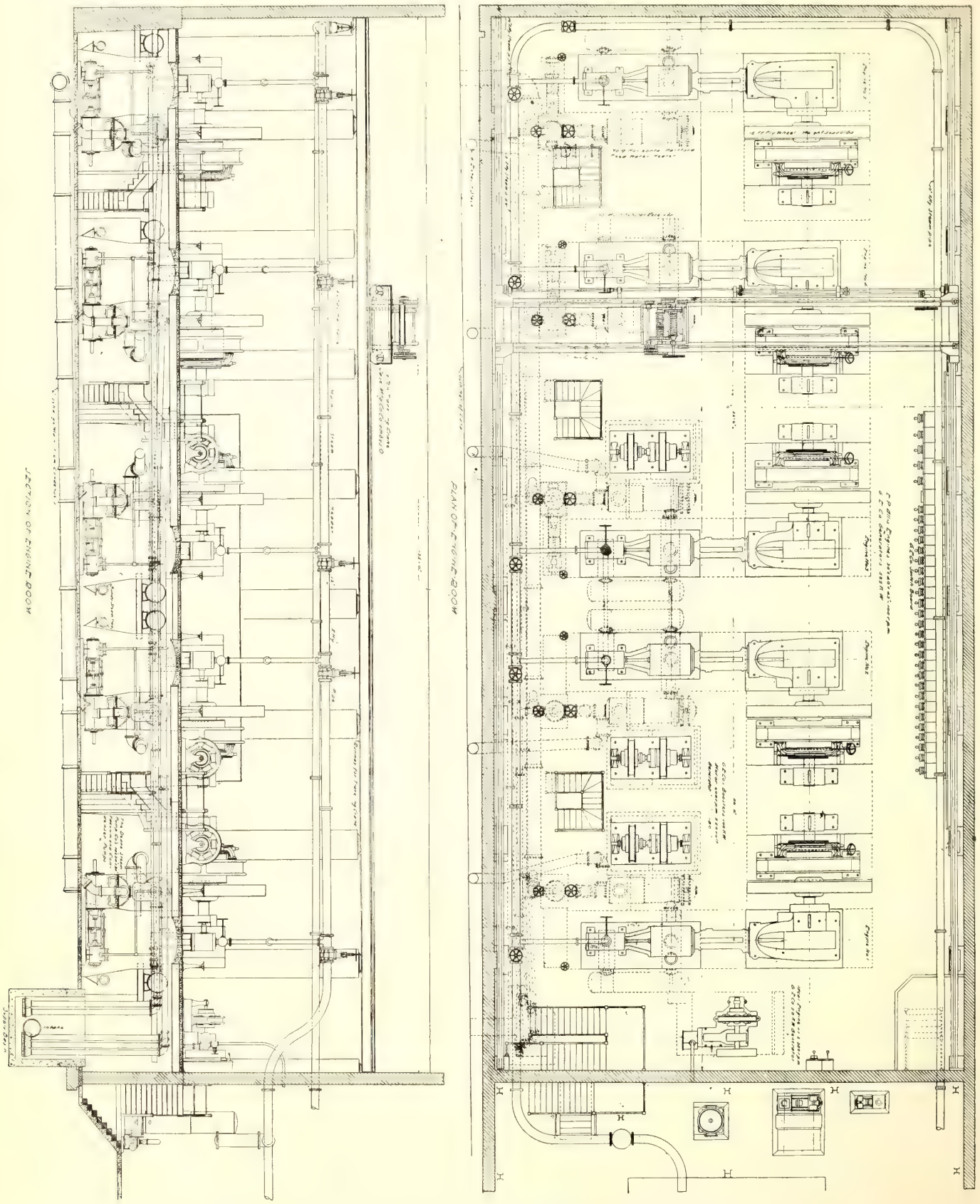


FIG. 1.—PLAN AND SECTION OF ENGINE ROOM—CAPITAL TRACTION CO.

Water for the boilers is pumped from a well in the base-

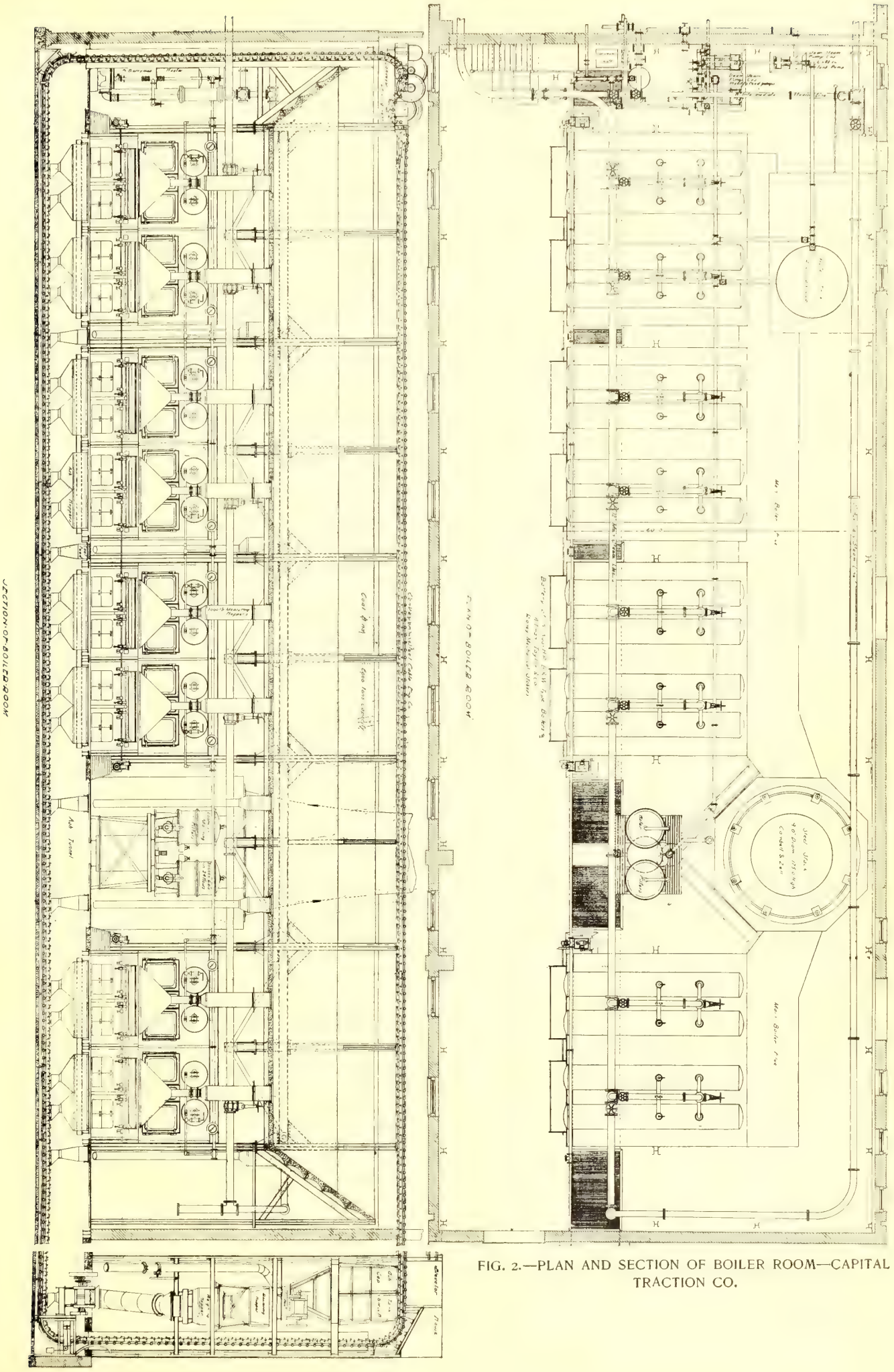


FIG. 2.—PLAN AND SECTION OF BOILER ROOM—CAPITAL TRACTION CO.

ment of the engine room, supplied from the canal, into a 4000-gal. tank, from which it passes into two Loomis-Manning filters having a capacity of 300,000 gals. in twenty-four hours, thence through Deane feed pumps to the primary heaters, then into a supplementary Berryman heater, and thence to the boilers. Water can also be taken from the city mains. After entering the main tank its course is similar to that of the canal water. Should the main feed lines or pumps break down from any cause, two Metropolitan injectors can be brought immediately into action on the auxiliary feed lines.

The arrangement of the piping above the boilers allows any battery to be cut out at any time, and, in fact, the entire arrangement of the piping and valves is such that any engine or boiler or any length of pipe can be cut out should occasion require without interfering with the running of the plant. The piping is in duplicate and extra heavy in both pipe and fittings. The valves are all of the Chapman Valve Company's make. All are constructed for a pressure of 200 lbs., although the initial steam pressure is at present only 140 lbs. The duplicate or auxiliary piping is arranged as a loop running from the main header in front of the boilers along the western, southern and eastern walls and joining the main steam line again on the north wall. At the eastern end of the boiler room connection from side to side of the loop is made by an intermediate pipe. The main steam line is of 12-in. pipe, the auxiliary of 10-in. pipe, and the intermediate steam line of 8-in. pipe. At the two points where the intermediate pipe joins the main and auxiliary piping a steam separator is provided. All piping is protected by Keasbey & Mattison magnobestos covering 2 ins. thick.

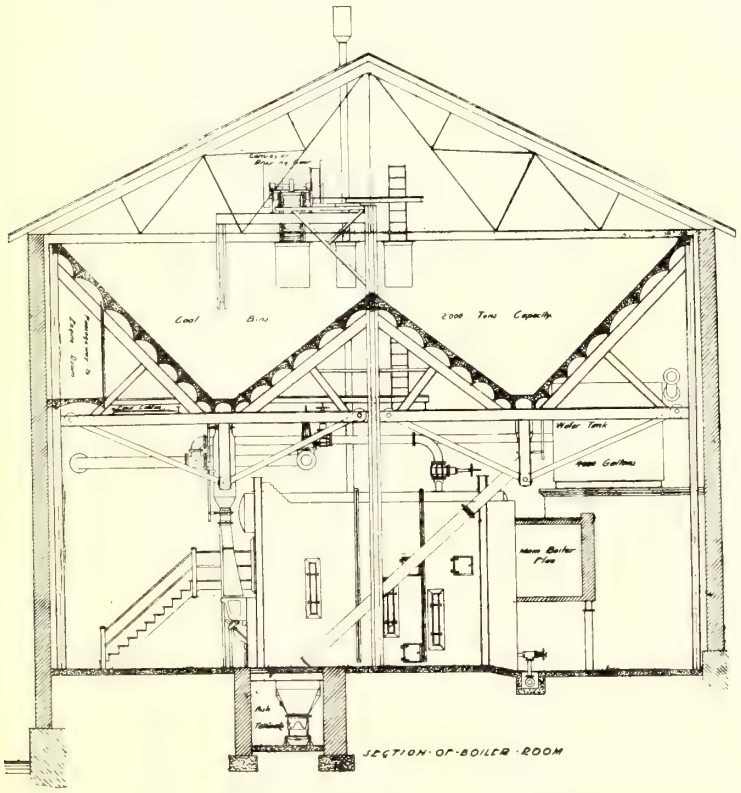


FIG. 3.—CROSS SECTION OF BOILER ROOM

Behind the boilers space has been left for the installation of economizers should their use be decided upon. Behind the boilers also have been fitted up a bath-room for the engineer and lavatories for the men.

The engines, of which there are five, are Allis horizontal tandem compounds with 1890 frame, each 20 ins. and 40 ins. x 42 ins., rated at 800 nominal h.p. at 100 r.p.m. They are provided with double-ported valves and double eccentrics, and the ball governors have a safety attachment which automatically shuts the steam off from the cylinder in case the governor belt should break. Each fly-wheel is 16 ft. in diameter and weighs 50,000 lbs. The engines can be run condensing or free exhaust. Each engine is an entirely separate unit with primary feed water heater, receiver, condenser and separate free exhaust. The receivers are each 30 ins. inside diameter and 12 ft. 6 ins. long. The condensers are the jet type, built by the Deane Steam Pump Company, and the condenser valves are controlled by valve standards on the engine-room floor. In the event of accident to the condensing apparatus an automatic action opens the valve from the engine into the free exhaust pipe, through which the steam passes to the open air. Bundy steam traps are provided—one to each receiver, and one to the main steam lines. All the gages and instruments are of Crosby make.

Lubrication of the engine cylinders is effected from two pressure oil tanks in the basement, the oil being forced up by steam pressure through brass pipes to the cylinders. A third tank supplies the oil for the boiler-room pumps and engines. Ashton sight feed lubricators enable the engineer to gage the supply of oil as desired. Lubrication of the bearings is effected by a gravity system, the oil descending from a 50-barrel tank on the east wall, whither it is pumped up again after use, after first passing through filters.

The generators are directly connected to the engine shafts, and four are set in pairs, each pair facing each other; that is, with the two commutators on the inside. The commutator of the fifth faces engine No. 4. The generators are set in a line down the south side of the engine room, and are faced by the switchboard on the south wall. They are of the standard General Electric eight-pole, 525-kw. type, running at 100 r.p.m. and delivering current at 550 volts no load, and 600 volts full load.

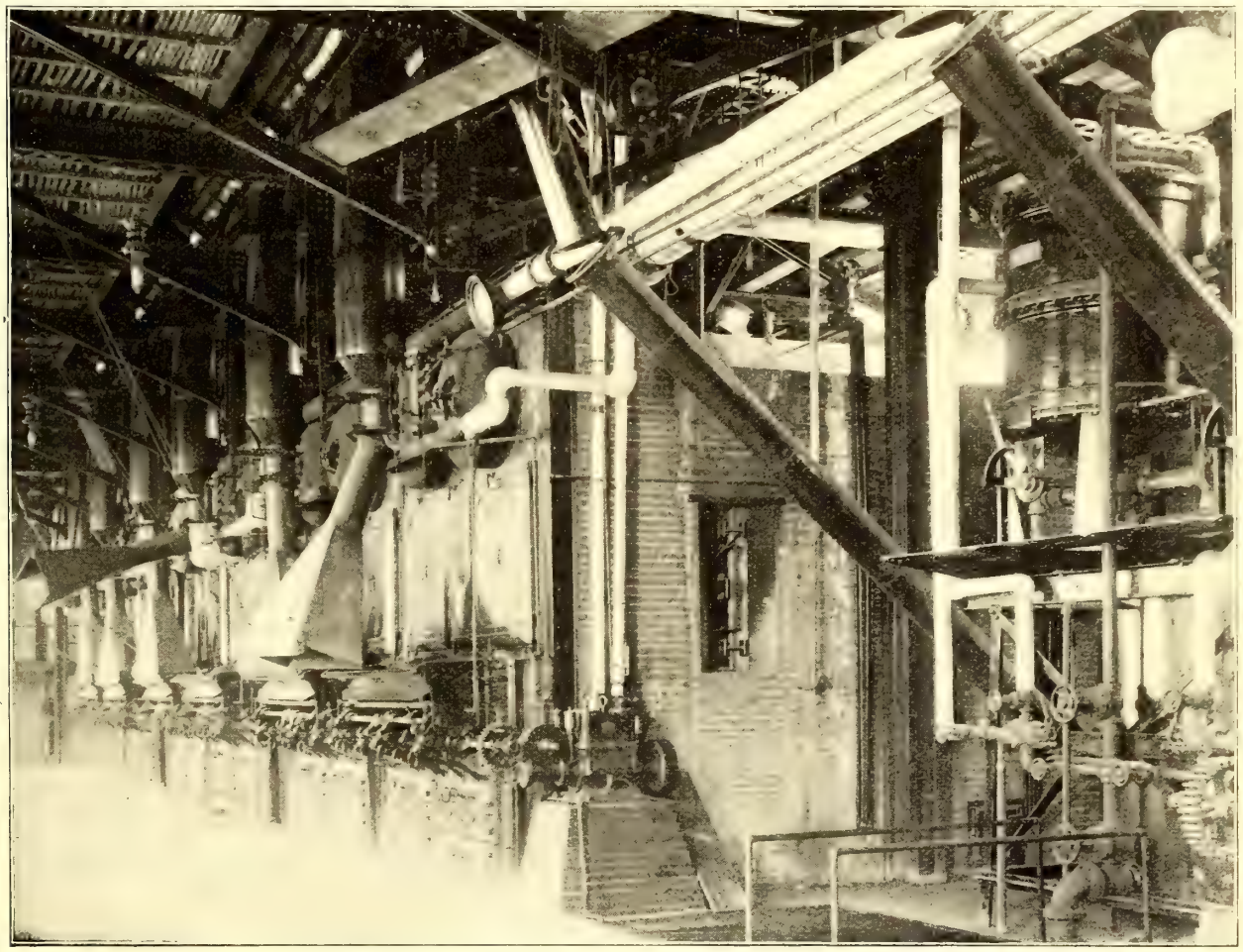
In order to compensate for drop on the Mt. Pleasant and Navy Yard lines—4 miles long in the first case and 5 in the latter—three boosters have been provided, two between engines one and two and one between engines three and four. These boosters are generators series wound for a maximum load of 550 amps. at 180 volts, and so proportioned as to give practically a straight line from zero potential to 100 volts. They are six-pole machines, each of 100-kw. capacity, running at 600 revolutions, and were supplied by the General Electric Company. Each booster is driven by a six-pole, 110-h.p., 600-revolution motor wound for 550 volts and driven from the main railway circuit.

The switchboard, about 50 ft. long, stands 5 ft. away from the south wall. It faces engines two and three, and is built up of standard General Electric panels. It comprises five generator panels, one station panel, three booster motor panels, eight pairs of feeder panels, two booster generator panels, two pairs of panels for the four booster feeders, one rheostat panel and a special panel for controlling the power house and shop motor circuits and the 500-volt lighting circuits. Each generator panel is equipped with a standard M. K. automatic circuit breaker, 5000-amp. current indicator, rheostat, two main switches, voltmeter switch and lighting switch. The station panel carries a G. Q. 5000-amp. Thomson recording station output wattmeter and an illuminated dial Weston ammeter reading to 8000 amps. Each feeder panel carries an M. K. circuit breaker, round dial ammeter reading to 1000 amps., and one double-throw, quick-break switch. The rheostat panel is equipped with an M. K. circuit breaker, 1500-amp. ammeter and three 1200-amp, single-throw, single-pole switches. The booster motor panel carries a circuit

breaker, two main switches, an ammeter and one field rheostat, as well as one starting rheostat, which serves to start any one of the booster motors. The booster generator panels carry an arrangement of switches which allows the engineer to throw the booster current on to either of the two pairs of feeders as desired. They are also equipped with circuit breakers, and in addition with an ingenious relay, devised by the engineers at Schenectady, which comes into action in case the motor circuit breaker trips, opening the booster generator circuit breaker and thereby preventing the generator from running as a motor. At the west end of the board is swung an illuminated dial Weston station voltmeter. The equalizing switches are erected on pedestals in front of each machine.

The lighting of the power house, shops and car barns and the Union Station building is effected from a 50-kw. 125-volt General Electric machine directly connected to a 75-h.p. Harrisburg Ideal engine, the set occupying a position at the west end of the room next to the partition wall. The lighting switchboard is made up of two panels equipped with a 500-amp. Weston ammeter, 150-volt voltmeter, P. C. rheostat, one three-blade main switch and six double-blade, quick-break switches for the separate circuits. The lighting is effected by General Electric inclosed arc single-globe and reflector lamps and incandescent lamps. The inclosed arc lamps in the engine room are swung on brackets made up of a 12-ft. length of gas pipe so hinged that they may be swung against the wall to allow of the passage of the 15-ton Case travelling crane, which travels the length of the room. Ten arc lamps illuminate this room, two over each engine, and each lamp is provided with its own knife switch. Six arc lamps are used in the boiler room. The incandescent lamps are set in three-light clusters scattered throughout the room. These clusters are made up of two railway lamps, one on each side of a 120-volt incandescent lamp. A similar system is followed in the lighting of the basement and the boiler room. All the arc, incandescent and railway branch lighting circuits in the engine room run in tubing. In the basement all the branch circuits to the brackets run in tubing, while the other wiring is run on insulators. In the boiler room the incandescent and arc branches, as well as the railway series circuits, are run in tubing, the other wiring on insulators.

The railway feeder cables drop from the switchboard to the basement, to the ceiling of which they are attached by insulators, rise up the partition wall and run along it to the canal side of the power house. They are then carried on a rack along and over the north side of the boiler room to a bridge crossing the canal. Passing across this bridge they drop down into a manhole, and proceed underground to their several destinations. The feeders are lead-covered 1,000,000-c.m. cables from the Roebling works, Trenton, and are laid in National Conduit Cable Company's conduits, and in Camp and Potomac terra cotta ducts set between the tracks. The first named are iron cement-lined pipes 8 ft. long and $3\frac{1}{2}$ ins. inside diameter. The latter are terra cotta 18 ins. long and of the same diameter. At intervals of about 400 ft. on the straight track and at shorter distances on the curve sections suitable manholes have been constructed between the tracks. Each manhole has concrete walls 12 ins. thick, and on the two sides next to the tracks wooden blocks are let into the cement to support the brackets for the feeder and tap wires. Each manhole is 4 ft. x 4 ft. and 6 ft. deep, but where the conduits drain into them the depth is increased to 7 ft. 6 ins. Slot



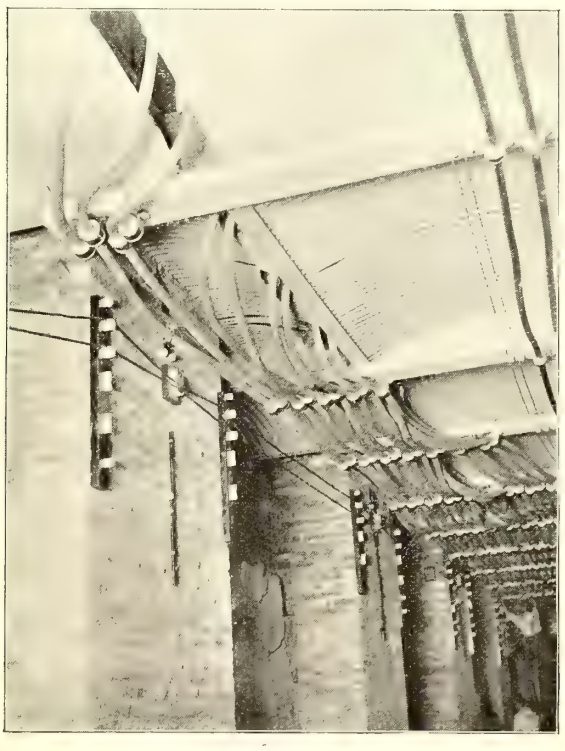
VIEW OF BOILER ROOM SHOWING MECHANICAL STOKERS

hatches are provided at intervals of 800 ft. along the slot, to allow the conductors to be drawn into the conduits and run to their proper positions.

The conductor rails are set 13 ins. to the center below the wheel rails, the distance between the face of each being 6 ins. The conductor rail weighs 23½ lbs. to the yard, with an area of 2.3 sq. ins., and is made up of 31-ft. 6-in. sections. The face is 4 ins. deep and ⅜ in. thick, and the rail is provided with a 1½ x ⅜-in. rib. The conductors are held in position by insulators suspended from a cast iron two-armed cup 5½ ins. deep, with a corrugated inner surface holding a heavy porcelain cup insulator, with exterior corrugations to correspond to the interior of the cup. Between the porcelain and the iron cup cement is poured, which holds the porcelain firmly in place. The bracket support for the conductor is bolted to a stud screwed and cemented into the porcelain cup. The distance between the center of the stud and the face of the conductor is 5⅝ ins. The arms of the cup holding the porcelain insulator are bolted into the slot rail. Over 16,000 insulators in all are used.

Each bracket is also provided with an arm, which is fastened to the conductor rail by two keys. Each length of conductor is bounded to the next by means of two flexible Washburn & Moen copper bonds, having a total cross section of 423,200 c.m.—one bond 11½ ins. long, the other 14 ins. long. These insulator brackets are placed at intervals of 15 ft. 9 ins. on the tangents, and at 9-ft. intervals, or every other yoke, on the curves, and access to each is had by a hand-hole.

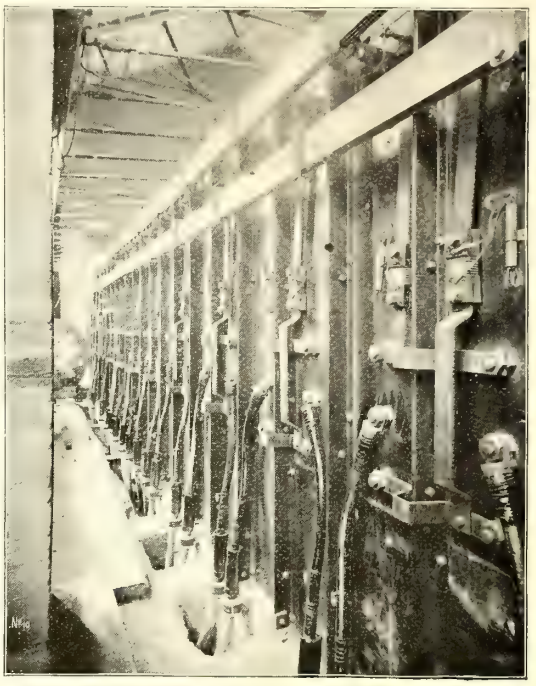
The entire length of the main line operated on this



FEEDER CABLES IN BASEMENT OF STATION

underground conduit system is about 22 miles of single track. An angle was riveted to the old slot rail, as explained in the January, 1898, issue, and illustrated in the section of the conduit herewith, and a part of the old track on Pennsylvania Avenue, from Seventeenth Street to the Capitol, a distance of about 1 1-3 miles, was replaced by 6-in. grooved girder Johnson rails weighing 86 lbs to the yard. All rail joints are cast welded. Seventh Street, Georgetown, Fourteenth Street and the Navy Yard sections are laid in 82-lb. 6-in. grooved girder rails.

The rolling stock consists of 188 motor cars and 174 trailers. All the new motor cars are from the shops of the American Car Company, and measure 26 ft. over all. They are mounted upon Lord Baltimore trucks constructed by the Baltimore Car Wheel Company. Each motor car is equipped with two G. E. 1000 A-3 motors, the characteristic curve of which is shown in Fig. 8. The motors are provided with sixty-nine-tooth gear and fifteen-tooth pinion, giving a reduction of 4.6. The series parallel controllers are of the K-9 magnetic-blowout type. Each car



REAR OF SWITCH BOARD

is lighted by three three-light clusters, the extra light burning on either platform as the case may be. All cars are provided with the "Parmenter" front fender and wheel guard, made by George Parmenter, Cambridgeport, Mass., and with registers made by the International Register Company, Chicago.

In addition to the rolling stock mentioned above, four Brill snow sweepers are used.

The contact plows used are the forms eight and nine, General Electric plows. Type nine is shown opposite. The plow handle is provided with a slot at each end, and the plow is supported by these slots on two iron bars each 9 ins. long, which run transversely on the truck. The plow can move along them transversely to the truck 4½ ins. on each side of the center, but if it runs more than 4½ ins. it runs off these supports or guides and drops into the slot sufficiently far to allow the bottom of the motors to pass over it without touching it. The conductor connections from the plow run to other connectors attached to hinged couplings on the car. When the plow falls these are pulled apart by the strain, and connection between the plow and the motors is instantly broken. Thus, should the plow follow along the wrong switch, it moves transversely to the truck until it falls from the guides, drops down into the slot and breaks the circuit at the connectors. As it cannot move either vertically or longitudinally the advantages of this construction can be readily understood. This method is intended to prevent delays, which would necessarily occur should the plow jam in the slots at any of the switches, turnouts or crossovers.

The conversion of the Seventh Street line of the same company has also been effected. The remarkable feature of this conversion is that it was made while the cable was

running, without interruption whatsoever to the service. It is the first case of this kind on record, and the skill with which it has been carried out is a tribute to the ability of the company's engineers, D. S. Carll and W. B. Upton, and to the contractor, E. Saxton. The length of the Seventh Street system is about 3 miles of double track. The cable was hauled out on May 25 last, the last cable car hauled into the car barn on the tail of the cable and without interrupting the service the underground contact cars entered upon their duties.

Along U Street, from the junction of the Seventh Street line as far as Eighteenth Street, 1 mile of double track is laid down with the Love system. This terminates at Eighteenth Street, the cars then running under the overhead trolley as far as Chevy Chase, a distance of 6 miles. The Love system will be made uniform with the rest of the system, and may be extended as far as Rock Creek.

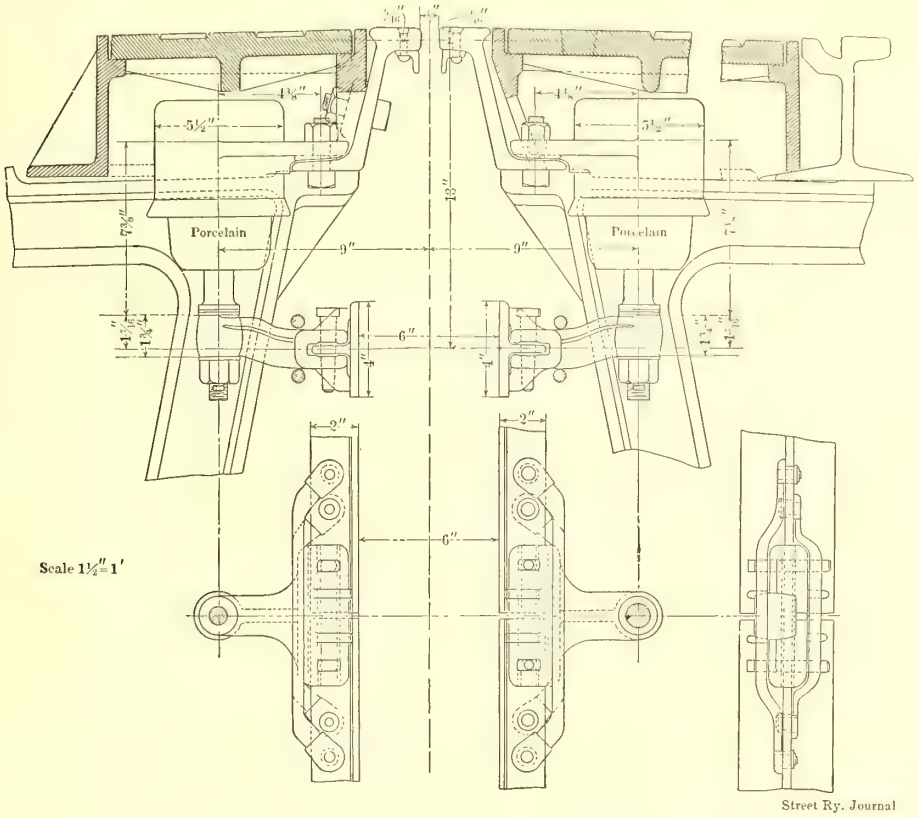
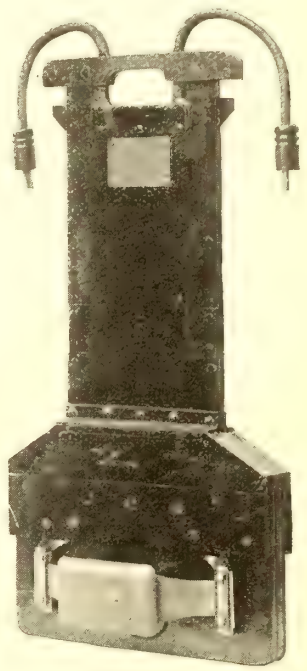


FIG. 4.—PLAN AND SIDE ELEVATIONS OF INSULATORS IN CONDUIT



PLOW

On the opposite side of the canal from the power house, the Capital Traction Company owned another large building, used in the horse-car days as car barn and stable. This has been entirely remodelled, and is now divided into car barn, paint shop, repair shop and machine shop. The car shed has nine tracks, divided transversely by tracks, on which run two transfer tables. Each track is provided with a pit, and floors and pit are of cement. To move the cars a trolley device is employed. This is a small four-wheeled trolley resting on two conductors, strung longitudinally between and over each pair of tracks. From this depend two conductors, which are connected by their own terminals to the plow terminals on the cars. Switches on a slate switchboard on the wall control the car-shed circuits. On track No. 9 is set a Murphy car-wheel grinder, driven by a G. E. 800 motor. Reduction in the speed of the car wheels during grinding is effected by means of water rheostats.

The paint shop is a spacious, well-lighted room, provided with every facility for rapidly handling the cars. The machinery in the repair shop, on the south side of the building, is driven by a 20-h.p. motor, and consists of a planer, joiner, mortising machine, band saw, circular saw, borer and grindstone. On the east side of the car shed are the machine and blacksmith shop, in which the machinery is driven by steam.

In addition to this building, the Capital Traction Company has five car barns in the following localities: Union Station, Georgetown; Navy Yard, Seventh Street, Mount Pleasant and Chevy Chase.

The Capital Traction Company has a capital of $12,000,000. Its officers are G. T. Dunlop, president; C. C. Glover, vice-president; C. M. Koones, secretary and treasurer, and D. S. Carll, chief engineer and superintendent. W. B. Upton is principal assistant engineer; J. H. Hanna, assistant superintendent; H. P. Clark, master mechanic, and Carroll Hashall engineer of power house.

The entire work of installing the electrical system was carried out under the direction of a building committee consisting of the president, Henry Hurt, director, and S. L. Philips, a stockholder. Dr. Louis Duncan was consulting electrical engineer.

An Ingenious Method of Removing Snow from Tracks

The street railways of Detroit are employing snow boards or scrapers attached to the trucks for cleaning snow from the tracks, instead of regular snow plows. The board employed is 2 ft. wide x 10 ft. long and is set on a diagonal under the rear platform. It is shod with iron, and is attached to the side bars of the trucks, which are of the Du Pont type. All the cars run on loops, so that the board always remains under the rear platform. In the case of a light snow storm every fourth or fifth car sent out from the car house carries one of these scrapers. If the severity of the storm should demand it, every car is so equipped. The method has the advantage, of course, that no extra men are needed and that snow is kept off of all parts of the system at the same time. The company also has a leveler, which is run out to throw the snow from the side of the track, where it is piled by the scraper into the gutter, but it is not necessary to run this leveler during a snow storm over any track more than once or twice during the day.

The Three-Phase Electric Railway from Stansstadt to Engelberg

BY CHARLES ROCHAT

The year 1898 will mark an interesting date in the history of electric traction by the application, on a large scale, of the alternating current, utilized directly for the propulsion of electric cars and trains. The first attempt made in this direction was in 1896, when a small city tramway with a length of 4.5 km. was installed at Lugano, but the roads put in operation during the past year leave this modest installation far in the rear.

Several weeks ago the mountain railway up the Gornergrat, near Zermatt, and the first section of the Jungfrau railway from Scheidegg to Eigergletscher were put in operation, and then, most recently, the electric railway from Stansstadt to Engelberg. It is this latter road that I now wish to describe to the readers of the STREET RAILWAY JOURNAL.



VIEW FROM FOOT OF 25-PER-CENT GRADE—THREE PHASE RAILWAY

By a half hour's trip by boat from Lucerne, the starting point for tourists in Switzerland, and in the center of a region of that incomparable beauty which characterizes central Switzerland, is found the small town of Stansstadt, which is located in the canton of Unterwald. It is here that our railway commences. It then traverses the little coquettish town of Stans at the foot of the Stanserhorn, and the capital of the demi-canton of Nidwald. It then rises through the entire length of the beautiful valley of Engelberg to come out at the locality of that name, after traversing a distance of 22.5 km. The profile of the railway is represented on the map herewith (Fig. 1), which gives the names of the stations.

From Stansstadt as far as Obermatt, where the power station is located, or about 18 km. (11.2 miles), the track is of the ordinary type, depending upon adhesion for traction. From Obermatt to a place called Gherst the roadbed is furnished with a rackrail of the Riggenbach type, the same as that used on the Rigi; then from Gherst to Engelberg the track is again of the ordinary adhesion type. The rackrail has a length of 1.54 km. (0.95 mile), and the grade surmounted by its help has an average of 25 per cent. The maximum grade on the sections depending for traction on adhesion are 5 per cent, and the minimum radius of curves is 50 meters (164 ft.). The track is built of Vignole rails weighing 20 kg. to the meter (41 lbs. per yard), placed on metal ties of 22 kg. (48 lbs.) The rails have a length of of 10.5 m. (34.6 ft.), and the ties are spaced eleven to each rail length.

The problem of equipment has been complicated, as can be easily seen, by the presence of a section of rack road, laid in between the two sections of ordinary track. After a study of the conditions the engineers decided to employ large cars with a seating capacity of forty-eight, operated as motor cars on the ordinary sections, and drawn on the rackrail section by an electric locomotive.

The entire line passes through a very interesting country, and beautiful vistas are presented on the trip. It is built upon its own right of way and not upon highways. The stations are tasteful in design, and the depots are furnished with facilities for handling baggage. This makes the system resemble a railway more than an ordinary tramway.

ELECTRICAL EQUIPMENT

The character of the current adopted is the three-phase alternating, supplied directly to the motors of the cars and the locomotives by means of two trolley lines carried overhead at a height of 4.5 meters (14.9 ft.) above the track and supported 0.9 meter (2.96 ft.) apart. The rails form the third conductor for the system. The diameter of the trol-

ley wire is 7.5 mm. (.295 in.). They are supported by steel span wires of 5.5 mm. (.216 in.) diameter, held between two wooden poles placed on each side of the track and about 35 meters (115.5 ft.) apart. The poles are of spruce, creosoted, and have a diameter at the base of 230 mm. (9 ins.) and at the top 170 mm. (6.7 ins.) All the mechanical details of the construction of this line have been calculated with a factor of safety of four against breakage. The trolley line has a double insulation against the soil. The insulators employed were supplied by the Billings & Spencer Company, of Hartford.

The three-phase current is produced at the power station at a potential of 750 volts, and for the section immediately adjoining the station is conducted directly to the trolley wire. The power station is located close to the track at Obermatt. In addition, feeders are run from the power station to Grafenort for one section and to Grünenwald for another section, in order to reduce the loss of voltage on those parts of the line having the steepest grades. To feed the section situated near Stans, a part of the current of the generators is led into a transformer of 90 kw., and is raised from 750 volts to 5000 volts. This high tension current is carried by an overhead conducting system of three wires of 3.5 mm. (.141 in.) in diameter each as far as Dallenwyl, situated at 11.1 km. (6.9 miles) from the power station. Here it is led to another transformer, which lowers the tension from 5000 volts to 750 volts. This second transformer is also of 90 kw. capacity.

The generators have a capacity of 200 h.p. each, operate at a speed of 650 r.p.m. and are each driven by a separate impulse wheel, working under a very high head; the number of periods in the current is 3900 per minute. Two generators are at present installed. They are excited by two small continuous current generators of from 10 to 12 h.p. each, operating at a voltage of 110 and running at 1800 r.p.m. Each of these is driven by a small turbine.

The power station, shown on page 20, is built with a capacity of three generating units, and can be enlarged if the needs of the traffic require it. The switchboard carries the usual apparatus, such as voltmeters, amperemeters, circuit breakers, etc. In the rear of the board are the fuses and the different connections of the transformer, to which reference has already been made. The overhead wires are protected at the point where they leave the station by lightning arresters of the Siemens horn type, placed on the first pole of the line. At the side of the station is a siding for the electric locomotives.

An interesting feature is the method of braking; when a train descends the grade of 25 per cent the motors of the locomotive are connected in parallel with the generators at the central station, and so produce a certain amount of power. This power is utilized directly in part by the other cars on the section, but as the amount of power produced in descending this steep grade is generally greater than the consumption of the other trains, the surplus has to be absorbed in some other way. Consequently at the central station there has been installed a water rheostat, consisting of three rails laid in the discharge canal from the turbines. The distance between these rails and their length has been so adjusted as to permit their absorption of from 140 to 240 h.p. When a train starts to descend the steep grade the central station is advised of the fact by telephone, and the engineer at the central station throws in the water rheostat by means of two special switches. The system, although somewhat primitive, has given excellent results so far.

Another interesting feature is the device intended to prevent accidents from the breakage of the wires of the 5000-volt circuit. The State railway department has imposed on the Stansstadt-Engelberg Railway Company the following condition: to install a device which will immediately interrupt the current in case of a break of the high tension wires. Complying with this, the company has installed the device illustrated in Fig. 5. The primary coils, *A*, *B* and *C*, of the three small transformers, are connected

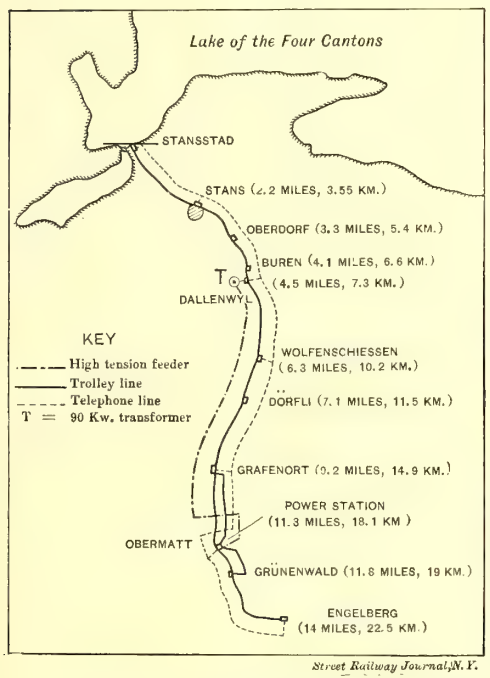
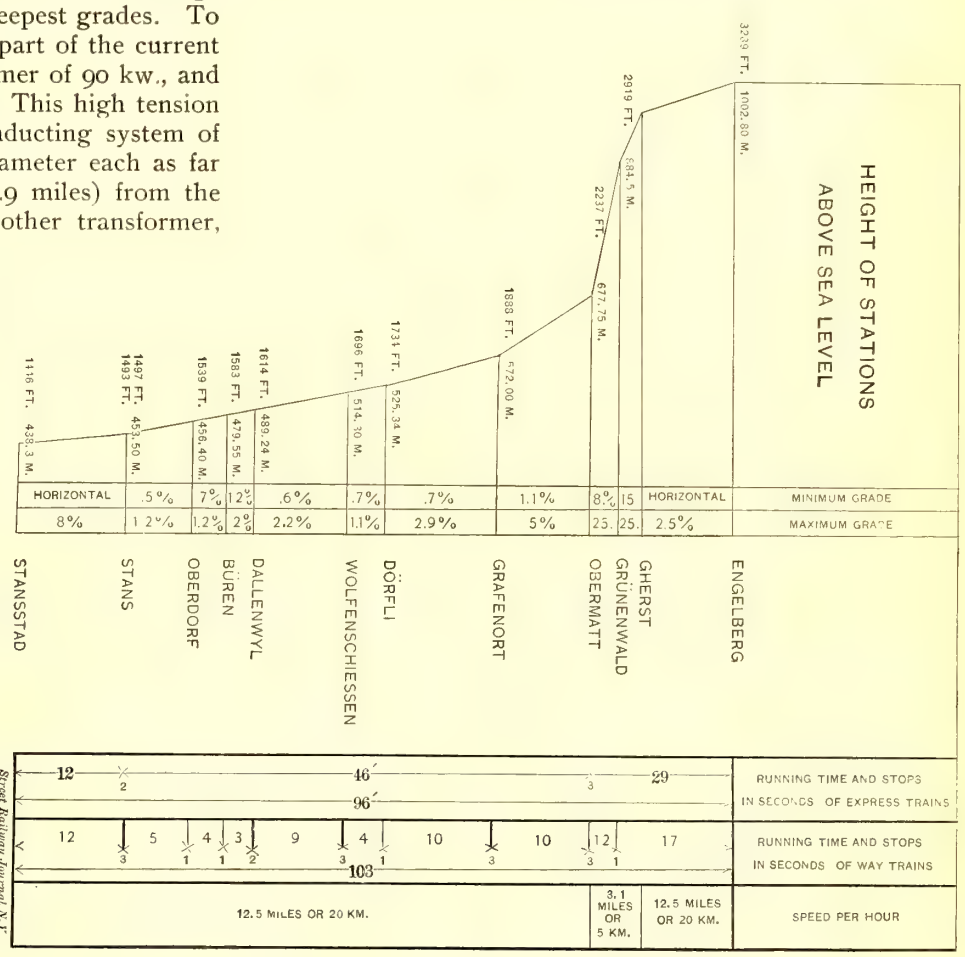


FIG. 1.—MAP OF LINE SHOWING FEEDERS



FIGS. 2 & 3.—PROFILE AND RUNNING TIMES

to three wires of the high-tension circuit at the points where they leave the station, and possess a common point *o*, which is led to earth. The secondary currents of these three transformers are connected in series to single circuit, in which is connected the apparatus which will produce the interruption of the primary circuit at the moment designed. The secondary e.m.f. of these transformers is 50 volts. The automatic circuit breaker in the circuit at *I* is an arc lamp. The following result is then secured: When there is nothing abnormal in the circuit, that is to say, when there is no broken wire, there is an equilibrium of the entire system, and the secondary coils of the three small transformers are not transversed by any current. When, on the other hand, any one of the three wires is broken, the equilibrium is interrupted. The unequal

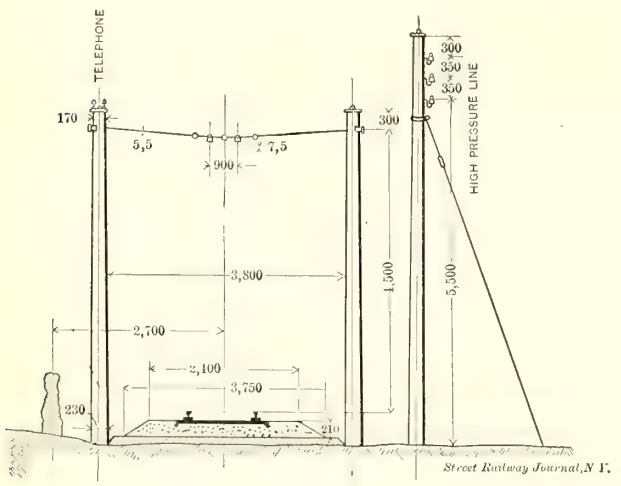
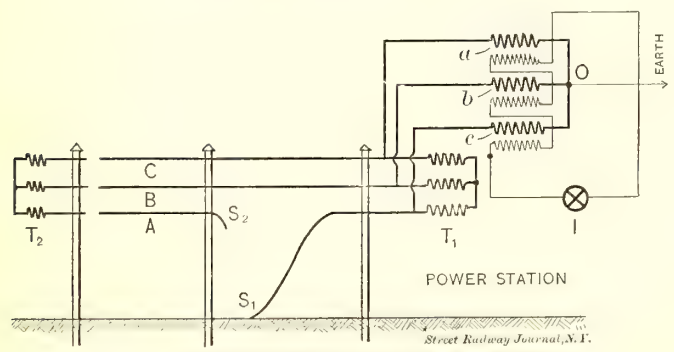


FIG. 4.—SECTION OF LINE



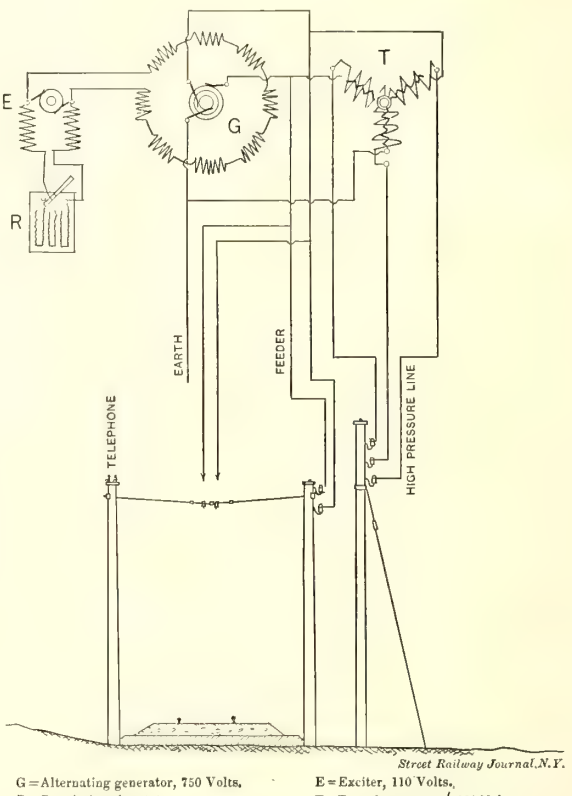
T_1 = Transformer 750/5000 Volts, 90 Kw., at the Central Station
T_2 = " 5000/750 " 90 " at Dallenwyl.
I = Automatic circuit breaker (arc lamp)

FIG. 5.—DIAGRAM OF CONNECTION OF AUTOMATIC CUT-OFF

phases excite the secondary coils and the current circulates in the lamp circuit arranged, so that the moment the carbons light they interrupt the exciting circuit of the generators. The tests made with this apparatus have consisted in letting a wire of the transmission circuit fall to the ground, and have shown that the interruption of the exciting circuit of the generators is produced in a length of time varying from four to seven seconds. The effect is then not absolutely instantaneous, but it would not be difficult to increase sensibly the rapidity of its operation, for example, by substituting for the arc lamp a circuit breaker which would open the circuit almost instantaneously. To avoid the disastrous effect of a sudden interruption of the current it would be possible to substitute for the circuit breaker an automatic switch, which would shunt the exciting current through a rheostat in series with the main switch on the exciting dynamos. The exciting circuit being 110 volts, there is not much danger, however, in breaking the circuit quickly. There is another inconvenience, however, in that the apparatus might be too sensitive, and that it might be operated by lightning. This arrangement, although somewhat crude, is still interesting to mention, for it is possible of having wide application, the high-tension lines being extremely numerous and the dangers resulting from them increasing with the number of installations.

ROLLING STOCK

The rolling stock is composed of two electric locomotives, five motor cars and four freight cars. The locomotives, which have a weight of 16.5 tonnes (36,300 lbs.), are intended, as stated, to draw the cars on the rackrail section, as well as to handle the freight trains. These locomotives are mounted on two axles, and are equipped with two electric motors of 75 h.p. each, and drive the rack gear wheel by a double reduction gearing. The motors operate at a speed of 650 r.p.m., and the speed on the rackrail is 5 km. per hour. In addition, the locomotives are so built that the rack gear can be disconnected, and they can operate on the ordinary sections at a speed of 11.5 km. per hour.



G = Alternating generator, 750 Volts. E = Exciter, 110 Volts.
R = Regulating rheostat. T = Transformer, 750/5000 Volts.

FIG. 6.—DIAGRAM OF STATION CONNECTIONS

The equipment of the locomotives includes a switch, a diverter, a volt and ampere meter, lightning arresters and fuse plugs. The duties of the engineer are very simple. He closes first the main switch and slowly cuts out the resistance which is in the circuit of the motors. The motors operate then in synchronism with the generators of the power station and at a constant speed, independent of the load drawn. When ascending a grade of 25 per cent and pushing a motor car completely loaded the locomotives absorb an average of from 95 to 100 amps. at 750 volts. In descending and with the same conditions of load, the motors furnish a current from 60 to 65 amps. going up to a maximum of 75 amps. The current is taken from the overhead wires by means of two sliding bow contacts, which are composed of two long cylinders of aluminum separated from each other by a piece of wood soaked in paraffine. The bow system of contact has been adopted in order to avoid the difficulties of construction with overhead

frogs, which were not considered desirable with two trolleys. The bows have given up to the present excellent satisfaction.

The locomotives are fitted with the following braking apparatus: first, ordinary brake shoes that operate on the four wheels; second, the motors working as generators when the current is reversed, the speed of the motors being constant whether they work as motors or generators; third, the emergency brake, operating simultaneously on the two grooved pulleys or drums, of which one is mounted on the shaft of the motor and the other on the countershaft placed between the motors and the axles. These two brakes are connected mechanically together in such a way that the pressure divides itself uniformly on the two axles. When the eight brakeshoes are applied a pressure is brought to bear against the grooved pulleys at the same time. The rack brake is operated in two different ways, by hand and automatically. To secure this a speed governor is used, which puts the brake in operation when the speed exceeds the normal. Moreover, when the main switch is opened the brakes are automatically set.

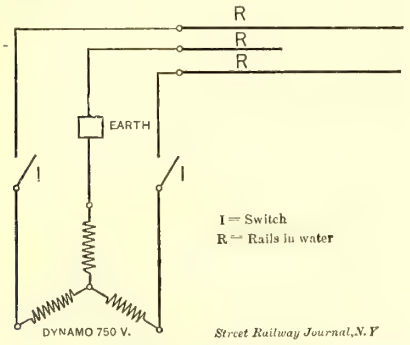
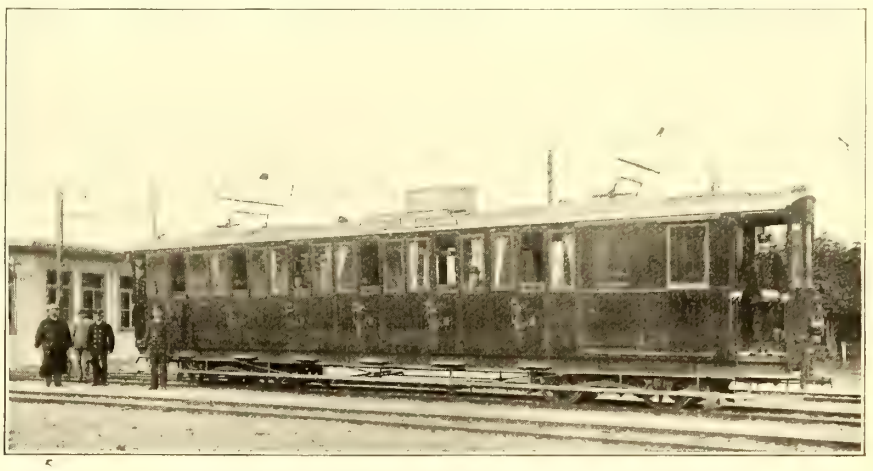


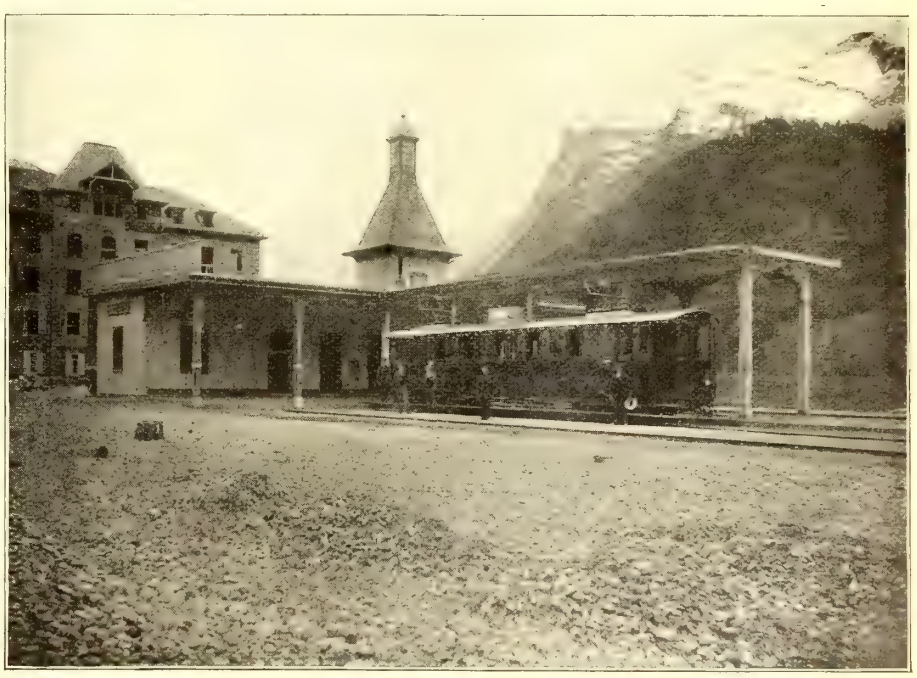
FIG. 7.—CONNECTIONS OF STATION WATER RHEOSTAT



STANDARD MOTOR CAR

The locomotives for driving gear are fitted with two shafts, of which one is supplied with a gear toothed for fitting into the rack. The motors drive an intermediate shaft placed between the two main car axles, and on which is mounted a toothed pinion, which is loose on the shaft. This pinion is operated by the electric motors through the intermediary of two trains of gears, reducing the speed in the proportion of about 15 to 1, for operating on the rack. Each motor transmits its work by a pinion of 156 mm. (6.1 ins.) diameter, mounted on the extension of its shaft. This pinion engages with a gear of 1092 mm. (43 ins.) diameter mounted on an intermediate shaft. On this shaft are found two other gears of 256 mm. (10 ins.) diameter, which engage in their turn with two gears of 608 mm. (24 ins.) diameter placed on each side of the toothed wheel engaging in the rack. The intermediate axle on which are mounted the two gears of 256 mm. (10 ins.) carry at their ends a friction coupling in order to throw the regular wheels into gear. The driving gear in the rack is then always connected mechanically with the motors, while the driving wheels are uncoupled during the ascent on the rack. For operating on the ordinary line, the friction coupling is thrown in and power is transmitted through the car axles through the intermediary of two gears of 432 mm. (17 ins.) diameter connected by means of cranks with two others of the same diameter mounted on the car axles. Below the motors is a diverter, operated by a handle, which connects the carbon contacts with the different sections of the resistance. All of the controlling mechanism of the locomotive is located in the cab, which is furnished on all sides with windows and has two doors.

The motor cars at present are five in number, and have a length of 14 meters (46.2 ft.). They are mounted on two trucks having a wheel base of 1.80 meters (5.94 ft.) and spaced 8.30 meters (27.9 ft.) apart. The car is built according, in compartments, to the French system. The number of these compartments is six, not counting the compartment for baggage placed at the end of the car. The number of seats varies from 44 to 48. The two platforms are inclosed by a vestibule, the windows of which can be lowered at pleasure. The forward platform is reserved for the motorman, who has at hand the following apparatus for controlling the speed: a switch, a lever for throwing in the resistance of the diverter, and hand brake.



STATION AT ENGELBERG

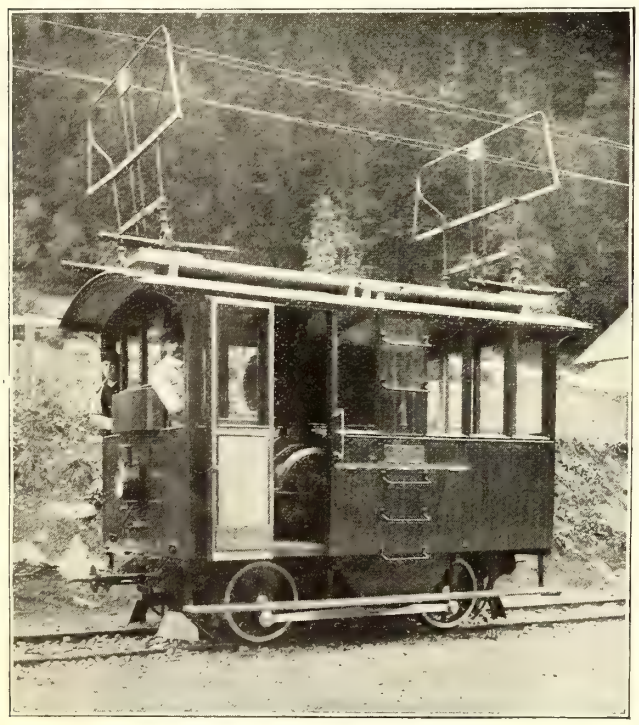
The approach of the car is signaled by means of a horn,

and the car carries a small, primary battery, so that the conductor, who is on the rear platform, can signal to the motorman on the front platform. The two motors are carried on the two axles of the same truck; they are of 35 h.p. each with six poles, revolve at 480 r.p.m. and drive the axle by gearing. The free swivel truck is furnished on one axle with a toothed gear engaging in the rack and arranged to be braked by means of an emergency brake carried on the rear platform of the car. The efficiency of the motors at full load is 80 per cent, including the gears.

The regulating resistance, which is thrown in the induced circuit of the motors, is carried on the roof of the car and enclosed in a water tight case. The electric equipment of the cars is completed by fusible plugs and lightning arresters, as well as lamps for the general lighting of the interior of the car, and two signal lamps carried regularly on the hood.

OPERATION

As stated, the distance from Stansstadt to Obermatt, where the power station is located, is about 18 km. (11 miles) of ordinary track, on which the grades do not exceed 5 per cent. This section is operated by single motor cars, which are designed to be capable of drawing one trail car. They weigh 5 tonnes (11,000 lbs.) empty, and 26 tonnes (57,200 lbs.) loaded. At Obermatt the motor car first runs on the rack for about 20 meters (66 ft.). Then the electric locomotive is run up behind it, and, without coupling, the train proceeds up the grade under the power of the locomotive only. The rack has a length of 1540 meters (5050 ft.) and terminates at Gherst. On arriving at that point the motorman on the car turns current into the motors and the car proceeds under its own power without



ELECTRIC LOCOMOTIVE

being obliged to uncouple from the locomotive, as explained above. The locomotive remains at Gherst to wait for the return car. A siding at this place permits two trains to follow each other, if desired, the locomotives being shunted onto the siding. To descend, the motor car runs on the rack section just far enough so that the gear wheel of the emergency brake is able to engage in the rack. Then the locomotive is coupled onto the car and the descent commences. When they arrive at Obermatt the locomotive is uncoupled and is then shunted onto the siding, and the motor car proceeds independently after about two minutes required for uncoupling. The speed of the cars is absolutely constant, a result which naturally follows the use of the alternating current, and on the ordinary track is about 20 km. per hour, although on the rack section it is only 5 km. per hour, owing to the change in gearing. The speed is the same in descending and ascending.

From the standpoint of the operation of locomotives and motor cars this constant speed is without doubt of ad-

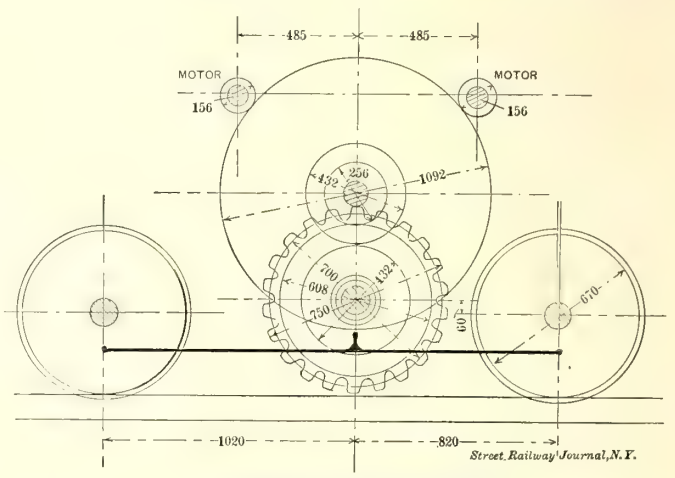


FIG. 8.—GEARING FOR LOCOMOTIVE

vantage, for the motorman is not able to waste current by lack of judgment; in a word, to take liberties with the timetable. He has absolutely only to close the switch and to cut out the starting resistance. This comprises all his work. On the other hand, from a practical standpoint, it is often desirable to be able to vary the speed within certain limits, either to gain lost time or else to vary the speed according to grades of the track, curves, where the car is passing through towns, etc. From this standpoint a three-phase current as applied in this instance has a disadvantage as compared with the continuous current, for the latter is undoubtedly much more flexible in its employment.

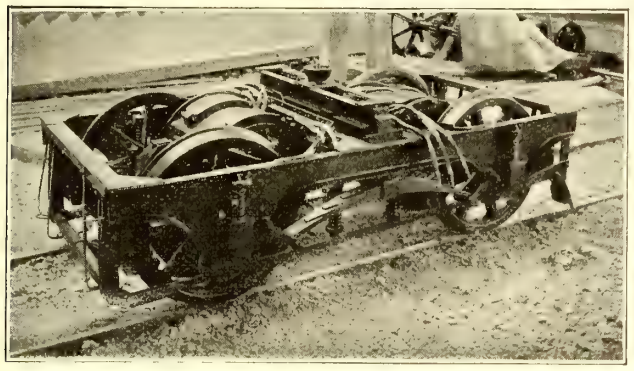
The different stations are connected between each other by telephones, using a complete metallic circuit to overcome the effect of induction and leakage from the alternating currents used. The two telephone wires are crossed every five poles, corresponding to a distance of about 175 meters (574 ft.). The wires of the public telephone system, which parallel the railway for a considerable distance, have been crossed every pole to eliminate induction. Since this was done the telephone circuit works very satisfactorily.

CONCLUSIONS

One great advantage of the direct application of the three-phase alternating current for traction lie in the facility of transporting the electric energy over considerable distances at high tension and of reducing it to a working voltage without recourse to rotary transformers, which are more or less complicated and expensive. The transformers for the alternating current are simple, take little space and require practically no attention. There are other advantages, however. The motors are of simple and strong construction as compared with continuous current motors, and have no commutator. On the other hand there are some undoubted drawbacks. Reference is not made to these to cast any discredit on the builders, who deserve great credit for their pioneer work, but to call to their attention those points which are yet capable of improvement.

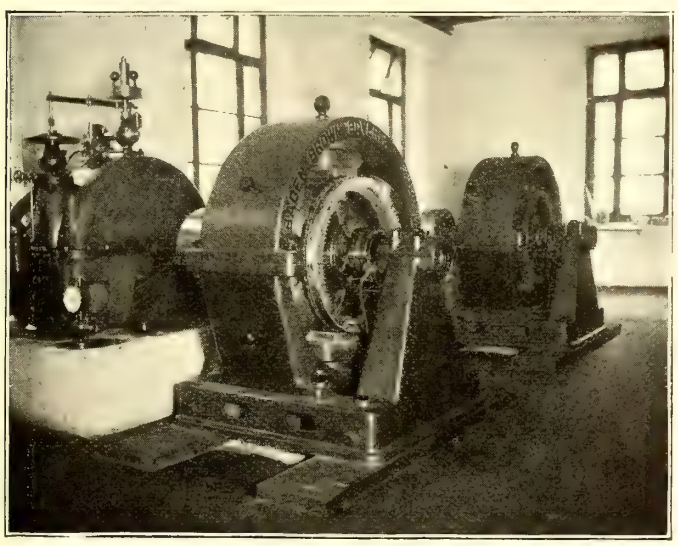
From a construction standpoint the overhead line is undoubtedly more difficult to build, more costly and more

heavy than that required for a continuous current. The installations at switches are particularly complicated and heavy. The difficulties attending the taking of current from the trolley wires are considerable, especially with the system of bow contact, where there is no guide to the



MOTOR TRUCK

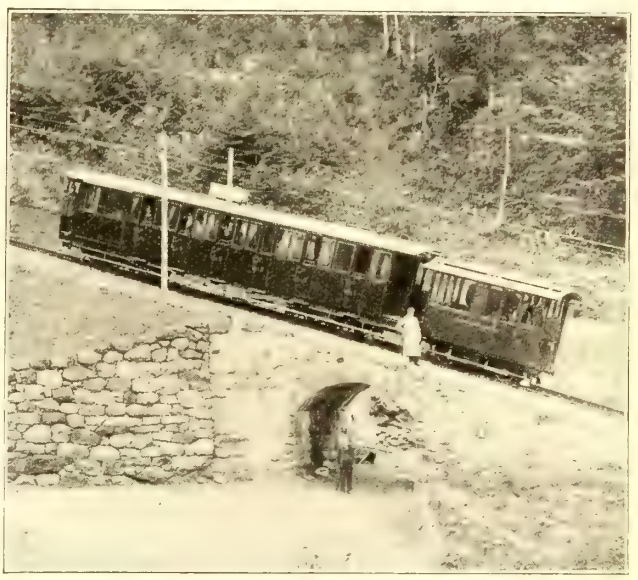
current collector. From an operating standpoint the great disadvantage is the necessity of maintaining a constant speed whether on grades or on level; that is to say, without regard to the work required of the motors. It is absolutely illogical, for example, that a car should have a speed of from 18 km. to 20 km. per hour on levels and on grades. On the former the speed ought to be much greater than 20 km., and descending a grade it ought to be somewhat less. There is another disadvantage of the system in that there is absolute dependence on the trolley line for operating the electric brakes. An example will demonstrate this. Let us consider our car descending a



GENERATOR AND TURBINES

grade of 5 per cent at a speed of from 18 to 20 km. per hour, and that we have good contact with the overhead wires. The motors are in phase with the generators and the speed cannot exceed or be less than that determined by the periodicity of the latter. Let us suppose that the current suddenly stops or that the generators are cut out for some cause or another. Our car immediately acquires a high speed, which may become dangerous if the car be not immediately checked by the ordinary mechanical brakes. With a continuous current where in descending grades the motors can be made work as generators it is possible to maintain the speed within desired limits, and this can be done with complete independence of the overhead line.

The foregoing are briefly certain critical considerations which suggest themselves to me in comparing the continuous alternating current as applied to electric traction. The criticisms, as stated, are not directed against the builders, whose work at this installation ought to be considered as a valuable contribution to the science of electric railroading. The objections may no doubt be overcome, and the alternating current, in the future, may be a considerable if not a formidable rival of the continuous current, at all events, under certain conditions. In conclusion I wish to express my thanks to the builders of the line, who have kindly supplied me with information for this article, viz.: Messrs. Brown, Boveri & Company, of Baden,



CAR AND LOCOMOTIVE DESCENDING 25-PER-CENT GRADE

Switzerland, who carried out all the electric work; La Société Industriele Suisse, at Neuhausen, who supplied the cars, and La Société Suisse pour la Construction de Locomotives, at Winterthun, who build the two electric locomotives.

Electrical and Repair Shop Practices in Philadelphia

It is the practice of the superintendent of the overhead lines and cables of the Union Traction Company, of Philadelphia, to furnish the emergency repair men blue prints showing the trolley sections fed by each cable. These blue prints are numbered, and sections belonging to power station No. 1 run from 1 to 199; those from station No. 2, from 200 to 299, and so on to the other stations, of which there are seven, and one battery station, the latter being of the chloride accumulator type. These blue prints show all the trolley sections in detail, giving the location of points where connection is made from the underground cable to the trolley wire and the location of section insulators. The number of the adjacent sections are also given, as shown by the accompanying sample print, Fig. 1.

Since the consolidation of the different companies there has been a rearrangement of feeder lines, so that the different stations are coupled in the most economical manner, resulting in a large saving of current and copper by the transfer of cables to new districts. It should be remembered that in this system nearly all feeders are carried underground in the company's own conduits. There are over 1000 miles of underground cable, composed of 620 miles of lead-covered feeder cable, 170 miles of telephone cable, and 210 miles of return cable. Since the burning of

the Thirteenth and Mt. Vernon Street station, and the consequent disarrangement of the cables in the power-house vaults, a systematic arrangement of the cables in these vaults has been effected, and the contrast is shown in the accompanying illustrations.

Fig. 2 shows the condition of a portion of one of the vaults before the change, and Fig. 3, the same manhole,

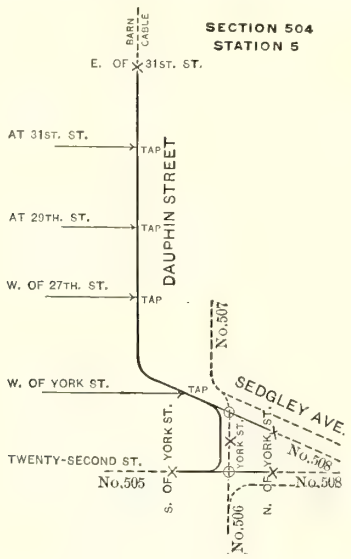


FIG. 1.—SAMPLE LINE MAN'S SHEET

with the cable systematically arranged. Figs. 4 and 5 also show how order was brought out of confusion in another vault. Fig. 6 illustrates the method of supporting lines of lead cable round a corner and also from the ceiling. In this connection, however, it may be noted that a peculiarly formed metal bracket has recently been devised by this

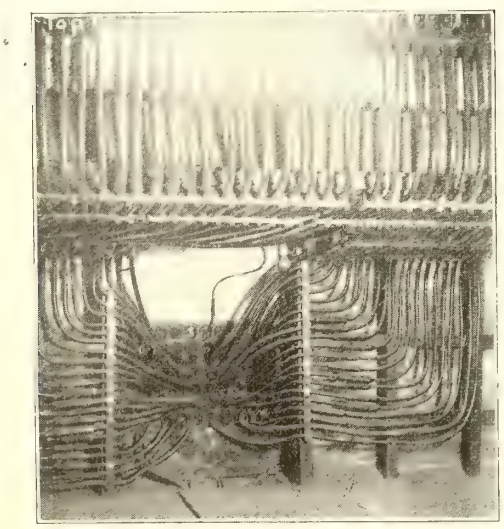


FIG. 3.—SYSTEMATIC ARRANGEMENT OF CABLES SHOWN IN FIG. 2

department. It is intended to replace the wooden strips used in the manholes, as the supports made from wood are found to rot out after about three years of service.

Five plumbers with the necessary number of helpers are employed in keeping the lead-covered cables in proper repair.

TELEPHONE SERVICE

The company maintains an independent telephone system of about 100 instruments, which connects the department offices, and also the emergency stations, power houses and car houses. The system is known as that of the Standard Telephone Company, and an independent switchboard is provided. The current for operating the call circuit of the telephone system is generated by a pair

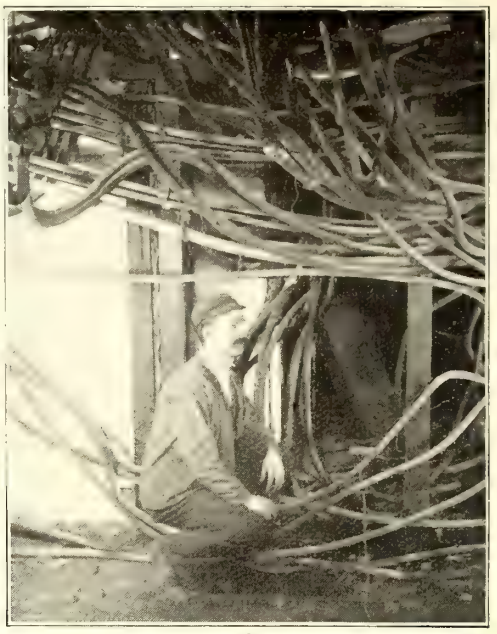


FIG. 2.—CABLES IN VAULT BEFORE CHANGE

of motor dynamos, which are located in the same room as the switchboard. There are two of these machines, but only one is operated at a time. These machines are of the Crocker-Wheeler type, and transform a 500-volt direct current down to 75 volts alternating. The switch connected with these machines is provided with an automatic cut-out and rheostat, so that if the current breaker in a power station opens, the current is automatically cut off from the motor transformer.

An operator is always on duty, who also acts as emergency dispatcher and keeps a record of all calls answered by the emergency wagons. Trouble of all kinds is re-

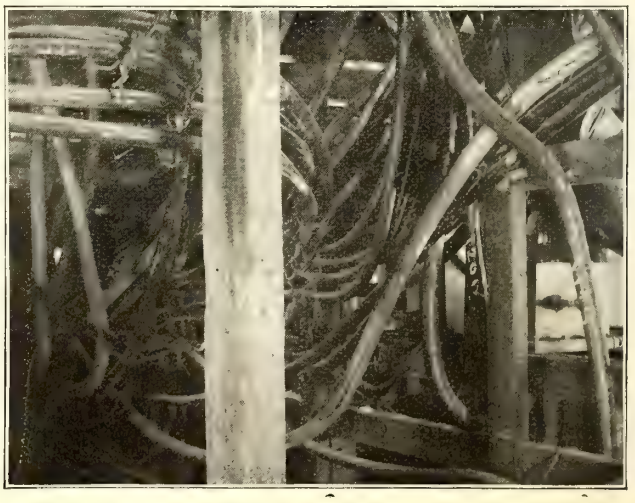


FIG. 4.—ANOTHER VIEW OF CABLES BEFORE ARRANGEMENT

ported to the central office, and this department is also connected with the city fire alarm signals, the emergency wagon running on each fire alarm, the same as the fire engines. At fires, the tower wagons are frequently used as hose bridges, so that the cars are allowed to pass through. Each wagon crew is composed of a lineman, helper and driver, and the lineman reports by telephone

the nature of all the calls to which he may respond and the time consumed.

The company employs eight emergency tower wagons, six of which are on duty throughout the twenty-four hours, and two that are on duty for twelve hours. These tower wagons are of the McCardall & West type, manufactured at Trenton, N. J.

Some idea of the work required of this department can

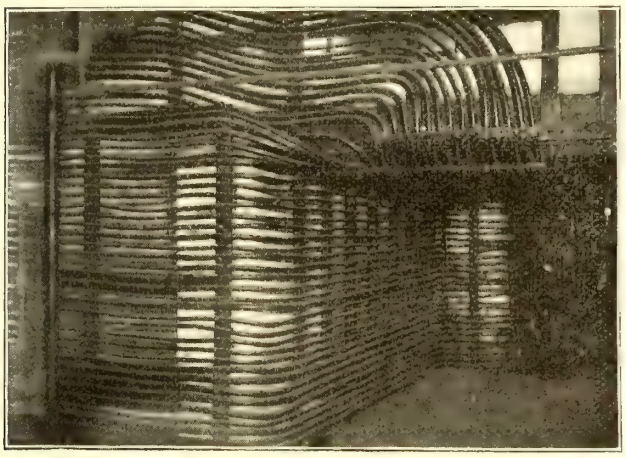


FIG. 5.—SYSTEMATIC ARRANGEMENT OF CABLES SHOWN IN FIG. 4

be formed from the statement that the system embodies about 500 miles of trolley wire and 300 miles of overhead feeder cable. No. 00 trolley wire is used in re-equipment throughout the entire system. The overhead construction is supported by tubular iron poles 30 ft. in height and in three sections; the telescoped sections are 7 ins., 6 ins. and 5 ins. A special device is employed at the overhead crossings, which prevents the wearing out or crystallizing of the trolley wire at these points. This consists of a sheet of steel about 3 ft. in length and 4 ins. in width placed above the wire with the ends turned up, and so arranged that when the trolley wheel approaches the crossing the flanges of the wheel come in contact with the curved plate, freeing the groove from the wire and relieving the latter from the blow that is otherwise dealt at the rigid point.

REPAIR SHOPS

In the main repair shop, which is at the corner of Eighth and Dauphin Streets, there is a home-made electric transfer table, Fig. 7, which eliminates almost all the hand labor required for shifting cars. This table is of sufficient length to accommodate the longest and heaviest cars, and plies between the repair shop on one side of the track, and the wood working department on the other, and crosses the tracks of the repair pits and the station storage tracks.

The table operates on four tracks, which are slightly depressed, so that the tracks on the platform are on a level with the shop tracks. The current for operating the motor

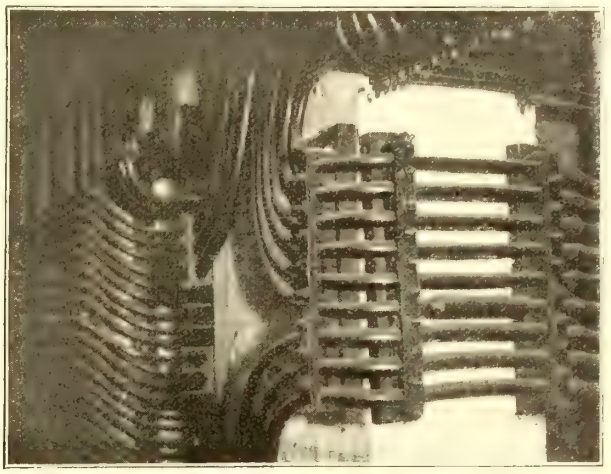


FIG. 6.—METHOD OF CARRYING CABLES AROUND CORNER

is collected by an under-running trolley, which is in contact with a T rail, used as a conductor. This rail is embedded in asphalt between the track rails, and its surface is about 2 ins. below the asphalt paving. An ordinary car motor of the G. E.-800 type, with type K-2 controller, is employed, and this is geared to the main axle, as in car practice. The resistance coils are in three sections, and boxed in directly under the main axle. The fuse box and switch are placed near the operator. Each axle has four wheels, those on the motor side of the table being 30 ins. in diameter, of special pattern undished, while the wheels on the opposite side of the table are 15 ins. in diameter. The outside wheels of each set are plain, without flanges and their axles are coupled to the driving axle by a peculiar clutch coupling, which allows them to turn independent of the driving axle. Roller bearings are provided for each journal, and these are what are known as the Standard roller bearing.

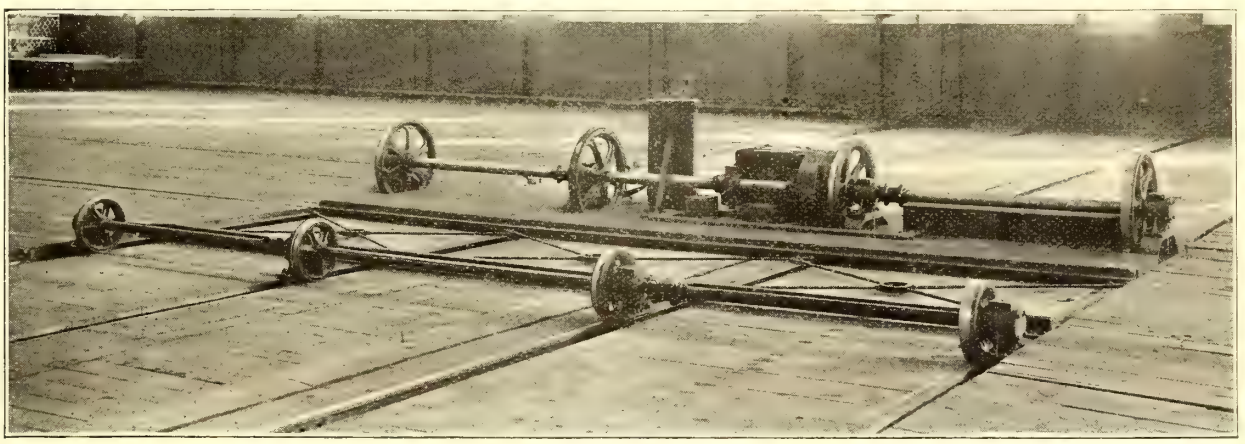


FIG. 7.—ELECTRIC TRANSFER TABLE—EIGHTH AND DAUPHIN STREETS

The middle driving wheel next the controller is provided with a band brake, which is operated by a foot lever within easy reach of the operator. The table runs very rapidly, and is readily controlled by the brake. The company has two of its shops equipped with this type of transfer table, and both are giving excellent satisfaction.

LETTERS AND HINTS FROM PRACTICAL MEN

Reversible Street Railway Rails

Philadelphia, Pa., Dec. 2, 1898.

Editors Street Railway Journal:

The reversible girder rail is by no means a new idea. Such a rail was patented in England and Germany many years ago, and, as is well known, is used to-day largely in Great Britain and on the Continent of Europe; however, the rail forms which I illustrate in this letter are, in matter of design, proposed method of manufacture and application, original with the writer.

It is well known that in cities, under heavy traffic, the average life of the straight-line rail is from seven to ten years only; on curves this life is reduced to from two to six years. In Europe, the experiment of reversing double-headed rails on steam roads has proved a failure, due to the fact that the double or "bull"-headed rail is set on chairs, and the wear is thus concentrated on that part of the rail in contact with the chair. The consequence is that the rail is worn on the under side, and presents a series of indentations, sometimes amounting to as much as an eighth of an inch in depth.

This indentation of the rail does not occur when the rail is in contact with wood or has a uniform bearing of large surface on metal or concrete. As a maintenance of way engineer and one engaged in the manufacture of rail work, it has been a study with the writer for years how to increase the life of rails, and, while an earnest advocate of



PROPOSED SECTIONS OF REVERSIBLE RAILS

high carbon and special steels, yet even the recourse to such has not solved the problem of economical maintenance, in the writer's opinion. In the illustration are shown several designs of reversible rails; some of these are no doubt of little utility; others are superior.

Figuring at the present price of steel rails, their average life and renewal costs, allowing current prices for scrap, with interest on increased investment in the case of the reversible rail, also taking into account additional present cost of rolling the reversible rail, it appears that this form of rail presents an economy of at least one-third over the present form of rail. The pros and cons may be stated as follows:

AGAINST

1st. Increased cost of rolling.

2d. Increase of capital in investment, due to increased weight of rail.

3d. Difficulties of fastening.

4th. Fatigue of metal.

FOR

1st. Increase of life, double that of single head.

2d. Ease of change, when renewal comes.

Answering objections, I would state that with the method of rolling which I propose, the cost will not be increased, and a better rail will be obtained than in the case of a thin base, making a rail subject to internal stresses. It is true that the capital investment is slightly increased, but this is more than offset by gain in efficiency.

With the New York type of rail, shown at the extreme right, there is no increase of difficulty in fastening the rail to the tie over the ordinary base rail, and with the other forms it is generally proposed to use a concrete roadbed, which overcomes any difficulty of this kind. The concrete roadbed for street work is used so successfully abroad and at home that its introduction in such an event may be considered on the line of improved practice.

The fatigue of metal in a rail long in use would be an argument against in steam road practice, but conditions are radically different on the street railways, where the breakage of rails in use is rare. With the tremendous traffic developed by electric service in cities has come the demand for something more permanent than what is known abroad as "permanent way," but which unfortunately hardly deserves this title. Figuring the length of street railways in the United States at 12,000 miles, and assuming the average weight of rail 70 lbs. to the yard, which is low, the annual saving per mile of track per annum would be $136.19, or a total for the United States of $1,634,280, representing at 4 per cent a capitalization of $40,857,000. On such a system as the Union Traction Company, of Philadelphia, the annual saving would be nearly $70,000.

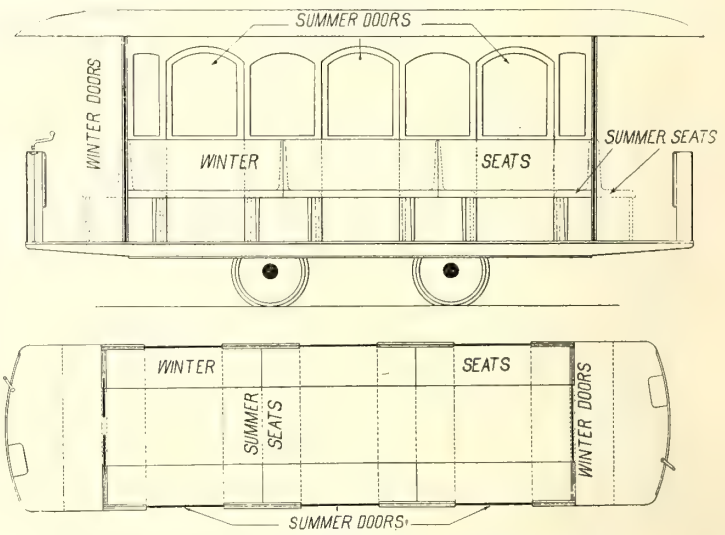
G. W. Chance.

Proposed Convertible Car

Johnstown, Pa., Dec. 5, 1898.

Editors Street Railway Journal:

Upon reading your editorial upon convertible cars in the current issue of the Street Railway Journal, the construction shown in the sketch herewith suggested itself. Upon examination and research it will probably be found "as old as the hills," yet I cannot remember seeing it before. The length of the car must be a multiple of the width, which permits the same seats to be arranged lengthwise or cross wise for winter or summer, as desired. The sketch



SIDE ELEVATION AND PLAN OF CONVERTIBLE CAR

illustrates a car 18 ft. body, having three doors in the side and one at each end. The side doors can slide, as noted in the sketch, so that in winter they can be securely tightened in place, like cab doors. Two extra seats may be provided on the platforms for summer travel, which is almost always greater per car than in winter. I have paid no attention to detail, as I am not building such a car, merely offering it as a suggestion. For summer use the end doors are securely closed and the running boards are used for steps. The side doors are then fastened back or taken off. The only work involved in the alteration is the shifting of the seats. The two extra seats for the summer car would be the only parts requiring winter storage, and they can be so made that they will retain their shape in or out of use.

S. E. Clarkson.

Street Railway Park at Columbus, Ohio

THE COLUMBUS CENTRAL RAILWAY COMPANY,
COLUMBUS, OHIO, Dec. 11, 1898.

EDITORS STREET RAILWAY JOURNAL:

The view herewith is a flash-light photo taken of the audience at our theater, Minerva Park Casino, on the evening of Oct. 2, 1898. We consider this picture a strong argument in favor of street railway parks and summer vaudeville, which many of your contributors seem inclined to regard as at least partial failures. Without being posted on the local conditions obtaining, the price paid for artists by these gentlemen would, it seems to us, account for the failures, as performances costing $200 to $250 will not draw, while performances costing twice that amount will command in business many times the difference paid for performers.

At Minerva Park Casino we maintain an excellent orchestra of fifteen pieces, which doubles to brass for a short concert before the performance. We pay from $500 to $600 for artists, and book all acts separately, thus avoiding anything objectionable or undesirable.

We have in the capacity of amusement manager a competent theatrical man of extended experience, and book without charge attractions for a circuit of street railway parks extending from Pennsylvania to Illinois. The object of this circuit is to enable us to contract with performers for ten or twelve weeks' steady work with short railway jumps and consequent small traveling expense, at a reduction in salary of 25 to 50 per cent to the advantage of those in the circuit.

Regarding fares, we issue an excursion ticket during the summer season for 15 cents, including a coupon for admission to Minerva Park. Five cents is credited to the park for every coupon taken at their turnstiles. No admission is charged to the Casino, but we reserve 1200 seats at 10 cents and 100 box-seats at 25 cents. The balance of the house is free. The total seating capacity is about 3000. Reserved seats are on sale at the principal hotels ten days in advance.



AUDIENCE IN CASINO, COLUMBUS

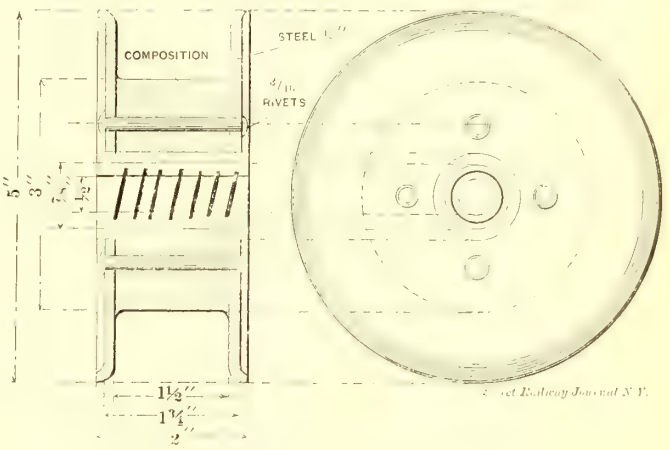
Minerva Park covers 156 acres, and contains all the usual amusements. The stimulus given to business by the addition of the vaudeville greatly increases the value of the numerous concessions on the grounds.

As a further argument that summer vaudeville can be successfully run in street railway parks, we can point to Minerva Park as a railway park that is self-sustaining, and which brings in considerable traffic to this road.

F. N. BENDELARI, Agent for Receiver.

Trolley Wheel for High Speed Roads

In the early experiments in high-speed heavy electric railroading with overhead construction carried on by the New York, New Haven & Hartford Railroad Company on its Nantasket Beach and New Canaan branches, considerable difficulty was experienced in getting a satisfactory form of trolley wheel. As explained by Col. Heft in the issue of STREET RAILWAY JOURNAL for November, 1897, it was found that as soon as the speed of the cars was increased beyond a certain point the ordinary trolley wheels would jump the wire very frequently, particularly at curves. Many trolley poles were broken in this way in addition to the damage done to the overhead construction. It was also found that the wheels were very often destroyed by the almost continual arcing when taking from the wire the heavy currents required in starting and during acceleration as well as the smaller currents taken at the maximum speeds.



TROLLEY WHEEL FOR HIGH SPEED ROADS

In order to overcome these difficulties the form of trolley wheel shown in the accompanying illustration has been devised and is now the standard type on all the overhead electrical divisions of the New York, New Haven & Hartford Railroad. The wheel is made up of a cylinder of composition metal 3 ins. in diameter, and with curved edges, which fit against 5-in. steel flanges which are ⅛ in. thick and riveted through the body of the wheel. The tread for the wire is 1½ ins. wide, this large gage being employed in order to give to the wheel more play upon the trolley wire and thus prevent it from jumping at high speeds. The tread can be easily replaced when worn out without renewing any of the other parts of the wheel.

The New York Auto-Truck Company is the title of a corporation recently organized in New York to build automobile drays, operated by compressed air motors. Joseph H. Hoadley and Henry E. Knight are largely interested.

STREET RAILWAY JOURNAL

JANUARY, 1899.

PUBLISHED MONTHLY BY
THE STREET RAILWAY PUBLISHING COMPANY,
HAVEMEYER BUILDING,
26 CORTLANDT STREET, NEW YORK.

WESTERN OFFICE:
MONADNOCK BLOCK, CHICAGO, ILL.
EUROPEAN OFFICE:
39 VICTORIA STREET, WESTMINSTER, LONDON, ENGLAND.

Long Distance Telephone, "New York, 2664 Cortlandt,"
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / £1 5s 0 / 31 fr
Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

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Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL, *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

Address all communications to
The Street Railway Publishing Co.,
Havemeyer Building, 26 Cortlandt St., New York.

Street railway earnings are improving—not by leaps and bounds, but steadily and satisfactorily. The improvement appears to be general over the entire country. The great rise in the prices of "traction stocks" in the New York, Boston and Philadelphia stock markets since election day has excited widespread comment and has made bankers and brokers eager to put new enterprises upon the market—enterprises which in some cases have been shelved for several years waiting for favorable money conditions. Wall Street is full of money, full of confidence and full of daring to-day. In the vernacular of the Street, "stocks are booming" and "anything goes." It is superfluous to say that there is danger to the permanent investor at such times as this, and much discrimination should be used in sorting out the sheep from the goats. Nevertheless, the fact remains that the street railway industry of the country is in good condition, so far as earnings are concerned, and needs only a few years of continued prosperity to become favored of capitalists as a field for investment.

Americans cannot longer ignore broad world problems and responsibilities. Whether we will or not, "imperialist," or "expansionist," ideas must prevail in the long run, and no "strict construction" group of legislators or individuals can prevent it. We say this calmly and dispassionately, more as recording a prediction than as supporting a debatable policy. If the history of our own and other countries proves anything, it proves that nations are constantly broadening out in their interests and ambitions—not turning all their efforts back into the narrower grooves of self-improvement. The reflex action of a widening national policy upon the individual citizen is not the least valuable of the results which will follow. So long as Americans deal with purely national or local matters they are individually provincial. So soon as they reach around the world and grapple with international ones they become cosmopolitan. The London bus driver gravely discusses with his nearest top passenger the morning's report of Russian encroachments in Manchuria. The flower of British young manhood is winning fortune and fame in India, South Africa or Alaska. French and German capitalists examine all countries for opportunities for investment. Shall Americans, then, in proud but short-sighted self-sufficiency, say, "Our country is large enough for us?"

It would be hard for American manufacturers, and particularly for the makers of street railway apparatus, to be other than "expansionists." When the crash in prices came five years ago and home business had to be taken by our manufacturers without profit, or at a loss, the foreign markets began to be explored, at first diffidently, if not despondently. Greatly to their surprise, they found better chances for success than had been deemed possible. The high prices paid for American labor were counterbalanced by a much less rate of production per workman in foreign countries, where trades unions hold full sway, while the magnitude of our markets was, and is, such that division of labor and use of labor-saving machinery can be carried to the highest perfection, and so large a quantity of manufactured product can be turned out that much of it can overrun into other countries and be sold at a price less than the foreign cost of production with their smaller and greatly subdivided markets. As a consequence, we see enormous annual increases in the foreign shipments of American manufactured goods, which have excited the wonder of our own and of foreign statisticians, and have raised us at least to the second position among the creditor nations of the world. Moreover, it is not true, at least in the street railway manufacturing industry, that American makers have been forced to content themselves with lower prices for goods sent abroad than for those sold at home. Instead of this, materially higher prices have ruled for foreign consignment and reports of heavy price cutting and losses, circulated at home as well as abroad, are false. America has as fine a corps of selling and distributing agents in Europe as is possessed by the manufacturers of any country. We have not, however, properly and fully sought the trade of the Orient and of South America. The Philippines should be invaluable to us as a vantage point for the immense and just opening development of the Chinese Empire, for which Russia, Great Britain, Germany and France are striving. With the Nicaragua Canal constructed, with the Hawaiian Islands as stepping stones to Eastern Asia,

and with a Pacific cable binding our new possessions more closely to us, the American Empire will be firmly established in the front rank of the great world powers, and will be able, with dignity, fairness and moderation, to preserve or improve its standing, and to obtain for its citizens a rapid increase of individual and collective wealth and prosperity.

The Paris Exposition of 1900 promises to draw to that city a very large number of Americans, among whom will undoubtedly be numbered many of our readers, who will take the opportunity which the visit to Paris affords to inspect the tramway systems of France, and perhaps those of some of the other countries of Europe. The next convention of the International Tramways Union is scheduled for Paris in 1900, and Americans, who are interested in street railway enterprises here, and who expect to attend the Paris Exposition, would do well to time their visit, if possible, so as to be present at the meeting of that association. The date of that meeting has not yet been announced by the executive committee of the Union, but will be duly published in the JOURNAL when it is made public. In this connection, Mons. Lavalard, one of the managers of the General Omnibus Company, of Paris, the largest tramway company in that city, has sent us a letter in which he suggests that a congress of all the tramway companies in the world be held in Paris at the time of the Exposition, and states that he believes that a great deal of mutual benefit would be derived from such a meeting. The plan of a World's congress seems an excellent one. In spite of the differences in steam railroad practices between this country and Europe, the International Railroad Congress, held abroad, is always well attended by American railroad officials. The differences existing in electric tramway practice here and abroad are much less than in steam railroading, and, in the essential features of the mechanical and electrical sides of the subject, are practically *nil*. It is not too much, therefore, to expect good results to follow such a meeting, and what city and time are more appropriate for the first meeting than Paris and 1900?

A very large amount of the wear to which special work is subjected is caused, not by the normal, but by the abnormal, wear of the wheels. A properly proportioned wheel will not be anywhere near as destructive to special work as an improperly proportioned wheel, or one which through wear has lost its original shape. For this reason, wheel wear must not be considered as being limited to the wheels themselves, but as covering a very much wider field, and, as wheels are very much cheaper than special work, it is almost a truism to say that there is no economy in trying to get wear out of wheels after they lose their shape to any considerable extent. In other words, after they have reached a certain point, they are so destructive to track and special work, particularly when the latter is not of the hardened center type, that there is no economy in trying to save the metal in the wheel. This is one argument against the use of steel-tired wheels, which are more popular abroad than in this country. As we have repeatedly pointed out in these columns, the use of steel-tired wheels on tramways or street railways, where there is apt to be grit and dirt on the track, is an entirely different proposition than on steam railroads where the track is laid with exposed ties. With the head of the rail on a level with the pavement steel-tired wheels soon lose their shape, and while they can be run within much closer limits, so far as flange breaking and chipping is concerned, than chilled iron wheels, it is needless to say that when worn out of shape they are exceedingly destructive to the track construction. On the perfect condition of the latter hinges directly the life of the cars and motors, together with the comfort of the passengers, so that a badly worn wheel, if persistently used, is apt to produce effects of a far-reaching nature to all branches of a road's permanent way and rolling stock.

We commend to the special attention of street railway secretaries, treasurers, auditors and accountants the paper in another column on "An Ideal System of Street Railway Accounts." This is an entirely dispassionate discussion, from the standpoint of a professional accountant, of the relationship which the different classes of accounts in the profit and loss statement and the balance sheet bear to each other, and to the general accounting scheme. The key-note of the discussion lies in the statement that "the one aim of the skilled bookkeeper is to be able to produce when necessary a clear and correct final balance sheet. * * * * The ideal in bookkeeping, therefore, is a perpetual balance sheet, a balance sheet that is an integral part of the accounting system, and not something that is made up outside of the books at intervals." (In this last use of the term "balance sheet" there is included the profit and loss statement.) In other words, there is brought out in this discussion for the first time, so far as we are aware, a description of the "Balance Sheet System" of bookkeeping as applied to street railway accounting, and we heartily indorse the suggestion on its broad lines as a good one. The "Chart of Analysis and Classification" presented by Mr. Kittredge will be of great value to accountants, as it expresses the locations and relationships of the different accounts in the clearest possible manner.

The remarkable presentation in our November issue of the "Comparative Costs and Profits of Electric Cable and Horse Railway Operation in New York City" has naturally been widely noticed, and in many cases reproduced, by the engineering and daily press at home and abroad, while it has been reprinted in pamphlet form for the use of members of the London County Council and of the Glasgow Council. Many analyses and attempted applications of these figures have been made in editorial and correspondence columns, and by the advocates of different motive powers in municipal councils. The New York figures have surprised and puzzled many people, for one reason and another, and the mistake has frequently been made of trying to fit them to other conditions. Whenever startling differences in receipts and operating expenses of any two roads give rise to speculation as to causes, it is a quite safe plan to turn first to the car mileage records and ascertain the differences of practice between the roads in the matters of schedule speeds per hour, miles per car-day, use of trailers, etc. Among others, we notice in a recent number of the "Railroad Gazette," an interesting comparative schedule of the costs per car-mile of the conduit electric

system of New York, and the trolley system of Chicago, and of the cable systems in the two cities. The differences are remarkable, and, unfortunately, little attempt at explaining them is made by the author. The putting together of figures of this kind without an accurate statement of the differences in practice is a mistake from the standpoint of the true statistician, since wholly incorrect deductions may be drawn by the ill-informed, and action may sometimes be taken involving the gravest financial consequences from mere impressions given by such figures. How can New York and Chicago results be compared? In New York no trailers are used on either grip or electric cars, while in Chicago a grip car carries from one to four trailers, according to the time of day, thereby saving greatly in power consumption and in transportation expenses per car-mile; the schedule speeds per hour in the two cities are quite different, which affects both transportation expenses and power; the time interval between cars on the Broadway system is so short that the load and wear upon its cables are terriffic, thereby causing an expense for renewals of cable alone amounting to 20 per cent more than the entire maintenance of way expenses of the Chicago City Railway Company; transportation wages per hour are different in the two cities; electric cars are mostly long in New York and short in Chicago, and, finally, many of the expenses are functions not of car mileage, but of miles of road or gross receipts. The car-mile unit for comparison is extremely fallacious and misleading—the ton-mile unit, when possible to obtain it, far better.

The increasing unwillingness of municipalities in Europe and America to grant any but short-time franchises or renewals of franchises to their street railway companies is deplorable, from almost every point of view. Granting that the public should derive the greatest possible benefit, in one form or another, from the use of its streets for transportation purposes, it is yet always possible to arrange compensation over a long term of years on some sliding scale, such that this desirable end can be obtained without, on the other hand, forcing the street railway companies to borrow money at high rates or to have their securities regarded as unstable. It is always to the advantage of the municipalities, as well as of the companies, to have the former's securities regarded as low rate—4 per cent, for example—investment, but a short tenure of franchise or any other element which makes the immediate future uncertain tends to raise the rate of interest demanded by capital, and therefore reduces the concessions which can be made to the public in the way of improved service, extensions, etc. The English plan of twenty-one-year franchises has worked so wretchedly by emasculating enterprise and retarding the growth and expansion of cities, that the object lesson ought to be taken to heart by well-informed Americans. On the other hand, the magnificent enterprise shown by private companies in those places, in America, particularly, where franchises have been granted for long periods, is an object lesson of the other kind. Does any one suppose the New York City street railway companies would have spent $30,000,000 to $40,000,000 in the adoption of the cable and electricity, or would have instituted their almost universal transfer system and improved their cars and car service so tremendously had their franchises been granted but for twenty-five, or even fifty, years, instead of in perpetuity? Or would the City of New York itself, had it owned its own railways, have grappled with the city's transportation needs and problems in so bold and far-seeing a manner? No. The "debt limit" scare, or the fear of showing a temporary deficit would impel politicians at the moment in charge of the city's development to look to the present, rather than the future, and the "conservative" element would prevail. We have little need to cast our eyes over the water to British cities, which own their tramway systems, to see how true this is, and how impossible it must be for large bodies of elective trustees of the public interests, such as the London County Council, to act promptly or in a broad-gage manner on the most urgent problem with which they have to deal, that of providing a centrifugal force, in the form of transportation facilities, for throwing their populations farther and farther away from their congested districts.

* * * * * * *

In Chicago, we are just now seeing the beginnings of a retrogressive action, which may be one of the most disastrous calamities which that city can suffer. A young man, with an ambition for high political preferment, is Mayor of the city. It is openly alleged, and so far without contradiction, that he has entered into an agreement with all but one of the prominent daily newspapers of Chicago, by which he is to assist them in their efforts to "hold up" the great traction companies of Chicago for large sums of "hush money," in consideration of their support of himself as candidate for another term as Mayor, and eventually for higher office. In pursuance of this alleged agreement, the Mayor and these newspapers of Chicago are working together in every conceivable way to excite the people against the companies, and to prevent the passage of an extension ordinance in the council. These newspapers are refusing the companies a hearing in their columns. They have actually, in times past, refused to publish the text of the legislative bills which they have been fighting, even when the street railway companies offered to pay them for such publication at regular advertising rates. The companies have been forced to reach the public through the one newspaper independent of the "combination," and by circulars in their own cars. Mass meetings have been called, and threats of violence against the Aldermen, in case they vote for the measure, have been freely made, and the Mayor—an officer, sworn to uphold the law and to preserve public order—has intimated in public that he would not be disposed to call out the city's protective forces to prevent such violence. To the credit of the public of Chicago, it should be said that their love of fair play appears to have caused them to resist to some extent these inciting influences. Mass meetings appear to be not "overflows," by any means, and one instance is recorded of a mass meeting attended by four people only, who passed "without a dissenting voice" (as the combination papers said the following day), a vote declaring for municipal ownership!

Some Facts and Probabilities About Interurban Electric Railroading

The interurban electric railway system around Detroit, an extended description of which is published in this issue,

is a good example of a branch of electric railroad work in which comparatively little has as yet been done. Outside of the interurban electric railways around Cleveland and Boston, there is no system in this country which can compare in extent to that around Detroit, and, of course, there is none in any other country. It is difficult to say to what length these interurban electric railway projects can be carried to advantage. Those in the neighborhood of Detroit already reach out, in some instances, a distance of about 40 miles from the city, and nearly all of them are from 20 to 25 miles in length, while a railway from Detroit to Toledo is already under way, and appearances are that it will be completed. The roads around Boston, to which reference has been made, differ materially from those around Cleveland and Detroit, in that while as long trips in a direct line can be made on electric cars, the system is made up for a large part by the lines of separate companies, which bear a closer resemblance to the ordinary city or village railway than in the case of Cleveland and Detroit. In these last cities each radiating line is operated as a unit, the cars are long, resembling in appearance steam railroad cars, and more of an effort is made for through business than in the case cited in New England. It would seem as if these roads are prototypes of extended electric systems which will spring up around large cities, or between smaller towns, where there is a sufficient number of inhabitants along the route to develop traffic, and the effect of these lines on steam railroad traffic, while comparatively small in individual cases, must in the aggregate amount to considerable. It has been shown that with the saving which these lines can effect by building along the line of the highway and in the cheap subdivision of power possible with electricity, passengers can be profitably carried at an average rate of about a cent a mile, a figure which seems impossible under present conditions with steam railroads. The latter already recognize a dangerous competitor in electric railroads for this short distance traffic and are doing their utmost to suppress it; but it is a condition, not a theory, which confronts them, and if electric roads can be built and operated at these low fares, village and town authorities will find some way of granting them the necessary franchises.

In some, in fact, in a great many respects, the interurban railway proposition is an attractive one, especially to those railway owners and managers who have had experience with city properties. In the first place, the question of franchises is usually much simpler than with city railways, in spite of the fact that concessions have to be secured from a greater number of municipal or other governing bodies. The reason of this lies in the fact that (a) the abutting property owner is benefited to a greater extent, or "injured" to a less extent, by having the railway in front of his property than in the case of city roads, as esthetic objections to the overhead wires do not trouble him, there is less noise from the railway traffic, and it gives him direct means of transportation at his door; and (b) the community, as a whole, welcomes a transportation agency which is always more convenient and cheaper than that which existed before. In the second place, the franchises are usually for definite and longer periods and are less apt to be reviewed by common councils with a change of administration. In the third place, the ability to run at high speeds offers a continuous opportunity to reduce transportation charges, while the traffic on such a road has nearly always as great possibilities of development as the city railway without as much danger of competition. In the fourth place, many of the mechanical problems which make the life of the city manager a burden and keep him awake at night disappear in the interurban railway. One of the most important of these is that of track, which can be built according to steam railroad standards with exposed rails and ties, on which joints can be watched and bolts kept constantly tight, without continuous pavement excavation. Many problems connected with interurban electric railroading yet remain to be solved, but, taken as a whole, they do not seem to be any greater than those connected with city railway service, even in its present development, and there seems little chance that any radical changes will be effected.

In one respect, interurban electric railroading as practiced in this country seems to have taken a direction which has somewhat surprised owners of similar projects abroad, and that is the universal employment of the continuous current for transmitting power and for use on the line. In another article in this issue we print an extended description of an interurban railway in Switzerland, which is considerably smaller in extent than very many in this country, but on which the alternating current motors are employed. The author of the article, M. Charles Rochat, who has charge of the engineering branch of the Railway Department of the Swiss Government, in reviewing the application of 3-phase currents on this road, takes occasion to point out certain defects in alternating current motor work. One of these, that of constant speed under all conditions, does not seem to be unsurmountable. The use of two trolley wires is certainly a drawback, for while most of the single-track interurban railways in this country employ two trolley wires, they do so for the sake of avoiding switches at turnouts, and with the 3-phase system, if overhead switches are to be eliminated, four overhead wires would have to be used. Evidently the possibilities for trouble in the use of polyphase currents for traction work and the comparative newness of this branch of the work has so far discouraged railway managers in this country from taking it up. The continuous current motor has reached a high state of development. Its defects, though numerous, are all known and tend to decrease with the size of the motor and with time. The only immediate saving in the introduction of the alternating system would be in reducing the size of the feeders, and, as we all would

> " Rather bear those ills we have,
> Than fly to others that we know not of";

the continuous current is likely still to remain a favorite, especially as, with the use of boosters and from 600 to 650 volts on the trolley wire, the feeder cost can be kept down considerably below that required by current city practice.

Electrical improvement has cost individuals and communities large sums of money, but it has in every case produced more than the cost; and it has been cheaper to have these improvements than to do without them. This fact cannot be questioned, and the isolated cases of failure in practical experiments or poorly calculated investments are but the sacrifices by which the general good has been gained. I think I may venture the statement that the electrical industry has produced more changes in the mechanical service and convenience of civilized life than has ever been caused by the application of any other force subject to the service of man.—From paper read at the Montreal Convention, 1895.

An Ideal System of Street Railway Accounts *

BY A. O. KITTREDGE, F. I. A., C. P. A.

One of the most eminent authors of modern treatises on accounting says: "The object of all good bookkeeping is the exhibition of the growth or decline and present value of capital, and of each of the parts of which capital is made up. A perfect balance sheet shows all this in the clearest and most concise manner. A perfect balance sheet should not only give the present value of each of the component parts of capital, but should also indicate its growth and decline since the last statement. The one aim of the skilled bookkeeper is therefore to be able to produce, when necessary, a clear and correct final balance sheet."

From this we derive inferentially that the more frequently a balance sheet is made up, the more thorough is the showing with reference to the condition of the capital, its growth or decline and its distribution in different places. The ideal in bookkeeping, therefore, is a perpetual balance sheet, a balance sheet that is an integral part of the accounting system, and not something that is made up outside of the books at intervals. In this last use of the term "balance sheet" there is included a profit and loss statement. A balance sheet, so arranged as to be an equivalent, for example, of the cash account, and which, through the medium of its divisions, shows the growth and development of the business in all its branches, just as the cash account shows fluctuations in the cash on hand, is a desideratum worth striving for. On the other hand, a perpetual profit and loss statement, which shall show the relation of expenses to earnings in all proper detail, is also something well worth the effort required to secure it.

The analysis of accounts, which it is the purpose of this article to describe, and which is herewith presented in chart form, is that which is required where the balance sheet is made an integral part of the bookkeeping system and where the profit and loss statement is made perpetual and also a going part of the bookkeeping system. What is shown is no new or untried scheme. It is something that is now in successful use in some hundreds of enterprises throughout the country and something that has been found entirely satisfactory in various lines of business, from that of transportation companies to banking, from manufacturing enterprises to mercantile houses, and from the largest jobbing concerns down to small retail establishments. The universal success which the application of this plan of analysis has met, wherever tested, warrants its presentation to the street railway accountants of the country. That its application requires some books of peculiar construction and certain mechanical facilities which it is not the purpose of this article to describe, should not in the least detract from its interest. Suffice it to say in this connection that whatever is special in this regard is far less in amount and expense than the necessary equipment of various other improved methods used every day in offices of street railway companies, as well as in other directions.

At the outset it is only right that attention should be called to certain divisions or elements recognized in the chart, which to some accountants, who have not had a broad experience, will appear strange and unusual, and yet the function of each of these, it is believed, will be made clear as the explanation proceeds. Again, it should be remarked that in describing an ideal system it is necessary to include more in items and detail than perhaps ever would be employed in any individual case. The system, to be adequate, must be exhaustive in its presentation, leaving to the individual user the privilege of selection and adaptation.

All the accounts of a street railway company, as well as of any other business, are comprised in two general classes —namely, the accounts of the balance sheet and the accounts of the profit and loss statement. It is impossible to conceive of any account that will not properly fall under one or the other of these heads.

Referring now to the chart, it will be seen that the accounts of the typical overhead electric railway company are presented in these two grand divisions—first the balance sheet, and second the profit and loss statement. The balance sheet divides under the two heads commonly recognized in a document of its kind—namely, into assets and liabilities. The assets of the company, by their nature, may be divided into three classes—namely, active, fixed and passive. These terms, by the way, are optional, and others, perhaps still better in definition, might be substituted. The point is not the special names that are employed to designate classes, but the classes of the accounts in themselves.

The active assets comprise cash, the term being inclusive and embracing the amounts in the office safe and in each of the several banks in which deposits are made; notes receivable, accounts receivable, sub-divided as required, and materials and supplies, represented by such accounts in name and character as are appropriate for the purpose.

The fixed assets, as presented by the chart, are largely those designated by street railway accountants as construction and equipment accounts. This term, however, seems to be insufficient for the purpose, and therefore I have preferred the term "fixed assets," dividing under that head into two classes, the first called necessary investments and the second other investments.

The necessary investments, going back to the organization of the company, include the cost and expense of its charter and its franchise and the expenses of preliminary engineering, etc. Following this are the items properly falling under the head of way and structures, and also under the head of equipment. Way and structures subdivides into right of way, track and roadway, electric line, real estate used in the operation of the road, buildings and fixtures, being the items *B* to *G* inclusive, of the construction and equipment accounts, as reported by the committee on standardization at Boston.

Right here I desire to remark that throughout this classification of accounts I have held, so far as possible, to the terminology suggested by the committee on standardization, and have used their list almost complete. I have found it necessary, however, to make radical changes in location, so far as one or two accounts are concerned, the particulars of which will appear hereafter. In this connection the reader's attention also should be directed to the fact that in the chart the accounts suggested by the committee on standardization have been printed in different type from the balance of the chart (cap italics) and are further indicated by the letters and prefix numbers as reported by the committee.

Equipment divides into power plant equipment, shop tools and machinery, cars, electric equipment of cars, and miscellaneous equipment, being items *I* to *M* inclusive, of the construction and equipment accounts, already referred to.

Two single accounts of this class have been omitted—namely, *N* and *O*. These are "interest and discount" and "miscellaneous." The explanation of the former, as offered by the committee, is that "all interest paid or received in connection with funds for construction, and all discounts or premiums resulting from a negotiation of securities for

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construction, should be charged or credited to this account." With respect to the second, miscellaneous, the following explanation appears: "Charge to this account all expenditures for printing and stationery, office supplies, damage claims, wages of clerks, and all other expenses incident to construction not otherwise provided for." Evidently what is in mind with respect to these two accounts is that they shall include the expenses in connection with the construction and equipment of the road that are specified in the explanatory notes. The items named are parts of the cost of the assets represented in the chart by the accounts *A* to *M* inclusive, although I cannot see that they are assets in themselves. The accounts *A* to *M* represent tangible assets, whereas *N* and *O*, as above described, do not represent assets, but are parts of the cost of assets otherwise designated. Therefore, it would seem to me that the items included in *N* and *O*, instead of existing in the balance sheet as separate accounts, should at the outset be pro-rated among the accounts *A* to *M* inclusive. An expense item in the capacity of an asset is an absurdity in bookkeeping, although there are several illustrious precedents of such classification.

Other investments include, in addition to item *H*, investment real estate, of the list just alluded to, stocks of other companies, and bonds of other companies. Whether or not a given company at present owns securities of other companies, it is necessary in a scheme of analysis such as we are considering, to show where such accounts would fall, in case they were required to be opened.

By the passive assets of a company I attempt to indicate those which are not permanent in character and which are to be written off sooner or later. Under this head fall some of those items which before now have been the distress of many an accountant—for example, the accounts which must be opened to offset excessive capitalization. Good will, a convenient and elastic name of an account to which is usually charged whatever cannot be properly laid upon the tangible assets of the concern, is an excellent illustration. By items in suspense are meant accounts carrying amounts of an expense character paid in advance of their consumption in the operations of the company. In a recent article in these columns I have discussed suspense items so thoroughly that further description is not necessary at this time.

The second grand divisions in the balance sheet—namely, liabilities—divides into four classes. First come the funded debts of the company, such as first mortgage bonds, second mortgage bonds, debentures, etc. Next comes the floating indebtedness of the company, including such items as notes payable, accounts payable, subdivided as required, and dividends which have been declared, but which for the time remain unpaid. Accounts of this kind are occasionally required to be opened, but for the most part they are closed almost as soon as opened. This item in the chart is only to show the location of such accounts.

Next in order come the reserve accounts, a class of liabilities occupying middle ground between what the company owes the public under the heads of funded and floating indebtedness and what it holds in trust for its stockholders, so to speak, for certain specified purposes. The reserves enumerated in the chart are quite as many as are likely to be required in any company, and yet possibly omissions will occur to the reader, and not a few will suggest substitutions. Many are likely, perhaps, to declare some of the accounts named entirely unnecessary.

First, there is the reserve for taxes; following which is the reserve for interest on funded debt, and on the floating debt as well. Next there are the reserves for the several sinking funds necessary to retire the funded debt; following which are the reserve accounts for maintenance and depreciation, each divided into two classes—way and structures, and equipment—and, finally, the reserve to establish an emergency fund out of which to pay damages, accidents and losses from the destruction of the property.

In a recent article in this journal I have described the theory of reserve accounts, introducing illustrated examples, so that extended remarks on this subject are unnecessary at this place. Suffice it to say that the theory upon which this chart proceeds is that monthly costs shall include an allowance for each of these items. The books that this chart exemplifies are the books of the stockholders exclusively, not of the bondholders, nor yet of the public. Interest, taxes, maintenance, depreciation and emergency costs must all be met before the stockholders are entitled to a dividend. Costs on each of these items, properly pro-rated, are charged up month by month, as the profit and loss statements show, and the proper reserve accounts credited. When the time for payment of any of these costs arrive—for example, when taxes are due, or when interest is due—the reserve account is charged with the amount instead of the expense account, for the expense account has already borne the charge upon the monthly pro-rata basis.

Some of my readers may take exception to the provision that is indicated of reserves for sinking funds, and they may more particularly object to the charges forming the reserve being regarded as a part of the expenses of the road. It is to be remembered, as just mentioned above, that the point of view from which we are discussing an accounting system is that of the stockholder. The showing to be made by the balance sheet and profit and loss statement is that in which the stockholder alone is interested. The resultant profit that is shown is that which is available for dividends, all charges of whatsoever name and kind having been previously provided for.

There are several points of view from which a sinking fund may be considered. Where an enterprise is "property rich" and "cash poor," a sinking fund to provide for the retirement of bonds may be created out of assets through the process of reserving from time to time a certain percentage of the cash that is received as its property is sold. That, however, is not the position in which street railway companies are ordinarily placed.

An individual, a business firm, or a corporation borrows money to use in business, primarily because the business requires more capital than the owner can supply. Theoretically, at least, the loan is negotiated with the expectation of paying it off at maturity. It can be paid when it falls due in only one of two ways, leaving out of the account for the moment the special conditions occasionally prevailing in certain classes of enterprises just referred to above. One of these ways is to take up the original loan by negotiating another loan—that is, retiring one set of bonds by the proceeds of another issue of bonds. The second plan is to reserve enough out of the profits of the enterprise to meet the bonds when due.

I venture to suppose that there are some who read this who will say that to pay off a loan, that is to retire mortgage bonds, for example, out of profits, is an absurd idea of financing at the present day, particularly when money can be borrowed at the low rates of interest which prevail whenever good security is offered. Even so, yet the accountant, not acting in the capacity of a financier, must show, in any scheme of accounting that is intended to meet all possible requirements, how to proceed whenever the stockholders determine that the bonds shall be retired out of earnings, in order that their shares may correspondingly appreciate in value.

Some who give consideration to this subject may be disposed to argue that the increasing value of the company's property by reason of the growth of population and general development of the community through which the road runs, is in itself a sinking fund adequate for all purposes. To this the accountant, in turn, is disposed to give a strictly professional answer, namely: Do not let one thing offset another, in the belief that thereby a balance is effected, but put a proper valuation on each item, both debit and credit. Let every tub stand on its own bottom, at all times.

Whether or not a sinking fund shall be created and maintained is to be decided by the management—not by the accountant. The chart shows how to proceed where a sinking fund is decided upon, and is to be built up out of earnings at a fixed rate.

Finally, we come to the capital division of the liability portion of the balance sheet. It is divided into three heads —profit and loss, impairment and surplus, and capital stock. Profit and loss, as here shown, may be defined as capital in process of accumulation. It is subdivided into weekly, fortnightly, monthly, quarterly, semi-annual and annual accounts. Profit and loss account, as here placed, is the resultant and not the active account. Referring for the moment to the profit and loss statement, it will be seen that expenses and revenues are there contrasted. The difference between expenses and revenues weekly, if the accounting is arranged on a weekly schedule, would make the weekly profit and loss account in the balance sheet statement. If the profit and loss statement be run upon a monthly basis, then its showing would make the monthly amount in the balance sheet, and so on.

Assuming that weekly closings are being made in the balance sheet ledger (one of the special devices referred to at the early part of this article), then the weekly profit and loss account, as the weeks roll on, would be closed into the monthly profit and loss account, and the monthly, in turn, according to the preference of the management, would be summarized into the quarterly, or the semi-annual, or the annual. Each basket would be emptied as soon as filled, to be ready for the next use.

If dividends are being earned and declared, profit and loss, quarterly, semi-annually, or annually, as the case may be, would be charged with the amount of dividend declared. Any amount remaining in the semi-annual or annual profit and loss account would then be carried one step further to the credit of impairment and surplus account.

If the business is running at a loss, then the closing of the semi-annual or annual profit and loss account, as the rule may be, would be to the debit of the next account in order—namely, impairment and surplus—in a way to show an impairment of capital. Capital stock account remains a fixed quantity, either in a single amount or subdivided into common shares and preference shares, as the organization may be.

In what has preceded I have anticipated much that might be said with respect to the second grand division of the accounts—namely, the profit and loss statement. The profit or loss of any business is determined by contrasting the revenues with the expenses. Since expenses must always be borne before revenues are secured, this division is given first place in the exhibit. The expenses of a street railway company are fairly classified under three heads—namely, transportation, general and maintenance. Transportation divides into operation of power plant and car service. The subdivisions opposite each of these heads are those which have been established by the committee on standardization. General expenses have been classified under four heads—administrative, emergencies, taxes and fixed charges. The accounts opposite administrative are the same as those established by the committee on standardization. The accounts opposite emergencies are likewise the same as established by the committee, with the exception of one added at the bottom—namely, accidents and destruction of property. Fixed charges are divided into interest and sinking funds. If interest is paid, it would properly fall in this class. We have already discussed the question of sinking funds, which would belong here under certain conditions. Maintenance divides into two heads—repairs and depreciation. Each of these subdivide into way and structures, and equipment.

The theory upon which this accounting system is based is that expenses shall be charged to proper accounts as they occur, so far as possible; hence the presence in the expense schedule of accounts Nos. 10 to 39, inclusive, as formulated by the committee on standardization. Where an expense is incurred which it is impossible to pay at the time, it is still charged in and the amount credited to the proper reserve account; hence the presence under the head of reserves in the balance sheet statement, of accounts 1 to 9, inclusive, of the committee's schedule. An allowance for both repairs and depreciation of way and structure and equipment should be charged into expenses week by week, or month by month, as time goes on. Since this expense cannot be paid always when it is charged in, the reserve accounts are brought into play for holding the amount until such time as the repairs can be made, or the depreciation offset by renewals. All this, however, as before mentioned, has been discussed in a previous article, and therefore does not require extended remarks at this time.

The revenues of a street railway company proceed primarily from operation, and secondarily from various other sources. These are enumerated under appropriate heads in the lower part of the profit and loss statement. How revenues and expenses are contrasted by closing all the accounts shown in the profit and loss statement back into weekly or monthly profit and loss in the balance sheet, according to the time schedule upon which the accounting system proceeds, has already been mentioned. In the arrangement of the accounts in the balance sheet ledger provision is made for this periodical closing, thus establishing the record of the results of the business at frequent intervals.

The accounting scheme here outlined dispenses with inventories, save only as inventories are taken to verify accounts. Material and supplies are charged out as used, taken at cost prices. The balance in the account of each kind of material and supplies, therefore, should show the amount remaining on hand. An inventory, therefore, would prove the accuracy of the account.

There is no line of business which I have investigated, wherein the conditions are so entirely favorable to a perpetual balance sheet and a going profit and loss statement, as a street railway operation.

Street Railway Blanks and Forms

Late in November a circular letter was issued by W. B. Brockway, secretary of the Street Railway Accountants' Association of America, referring to the new work—namely, collecting blanks and forms—which is to be undertaken by the organization named. This is described as a new departure, and one which is believed will add to the usefulness of the organization, and make it a source of practical value to every member. It will be recalled that resolutions were passed at the Boston convention requesting every member to furnish the secretary with two copies of each and every blank and form in use upon his road, and

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ATER FOR POWER
/BRICANTS AND WASTE FOR POWER PLANT
'SCELLANEOUS SUPPLIES AND EXPENSES OF POWER PLANT
'RED POWER
'PERINTENDENCE OF TRANSPORTATION
AGES OF CONDUCTORS
AGES OF MOTORMEN
AGES OF OTHER CAR SERVICE EMPLOYEES
AGES OF CAR HOUSE EMPLOYEES
R SERVICE SUPPLIES
SCELLANEOUS CAR SERVICE EXPENSES
EANING AND SANDING TRACK
MOVAL OF SNOW AND ICE
LARIES OF GENERAL OFFICERS
LARIES OF CLERKS
INTING AND STATIONERY
SCELLANEOUS OFFICE EXPENSES
ORE ROOM EXPENSES
ABLE EXPENSES
VERTISING AND ATTRACTIONS
SCELLANEOUS GENERAL EXPENSES
NERAL LEGAL EXPENSES
NT OF LAND AND BUILDINGS
NT OF TRACKS AND TERMINALS
SURANCE
MAGES
GAL EXPENSES IN CONNECTION WITH DAMAGES
NTS AND DESTRUCTION OF PROPERTY

Mortgage Bonds
Mortgage Bonds
TURES
NG INDEBTEDNESS
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AND ROADWAY
IC LINE
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AN IDEAL SYSTEM OF STREET RAILWAY ACCOUNTS

CHART OF ANALYSIS AND CLASSIFICATION

ELECTRIC RAILWAY COMPANY

BALANCE SHEET

- **ASSETS**
  - **Active**
    - CASH — In Office; In Ninety-Ninth National Bank; In Exchange Bank, etc.
    - NOTES RECEIVABLE
    - ACCOUNTS RECEIVABLE — Subdivided as required
    - MATERIAL AND SUPPLIES — Subdivided as required
  - **Fixed**
    - Necessary Investments
      - CHARTER, FRANCHISE and
      - Way and Structures
        - *A. ORGANIZATION EXPENSES*
        - *B. PRELIMINARY ENGINEERING AND SUPERINTENDENCE*
        - *C. RIGHT OF WAY*
        - *D. TRACK AND ROADWAY*
        - *E. ELECTRIC LINE*
        - *F. REAL ESTATE USED IN OPERATION OF THE ROAD*
        - *G. BUILDINGS AND FIXTURES*
      - Equipment
        - *I. POWER PLANT EQUIPMENT*
        - *J. SHOP TOOLS AND MACHINERY*
        - *K. CARS*
        - *L. ELECTRIC EQUIPMENT OF CARS*
        - *M. MISCELLANEOUS EQUIPMENT*
    - Other Investments
      - *H.—INVESTMENT REAL ESTATE* — An Account with each piece
      - STOCKS OF OTHER COMPANIES — An Account with each lot
      - BONDS OF OTHER COMPANIES — An Account with each lot
  - **Passive**
    - ITEMS IN SUSPENSE — Subdivided as required
    - GOOD WILL
- **LIABILITIES**
  - **Funded**
    - FIRST MORTGAGE BONDS
    - SECOND MORTGAGE BONDS
    - DEBENTURES
  - **Floating**
    - NOTES PAYABLE
    - ACCOUNTS PAYABLE — Subdivided as required
    - DIVIDENDS —(Declared and Unpaid)
    - TAXES
    - Interest
      - FIRST MORTGAGE BONDS
      - SECOND MORTGAGE BONDS
      - DEBENTURES
      - FLOATING INDEBTEDNESS
    - Sinking Funds
      - FIRST MORTGAGE BONDS
      - SECOND MORTGAGE BONDS
      - DEBENTURES
  - **Reserves**
    - Maintenance
      - Repairs
        - Way and Structures
          - *1. TRACK AND ROADWAY*
          - *2. ELECTRIC LINE*
          - *3. BUILDINGS AND FIXTURES*
        - Equipment
          - *4. STEAM PLANT*
          - *5. ELECTRIC PLANT*
          - *6. CARS*
          - *7. ELECTRIC EQUIPMENT OF CARS*
          - *8. MISCELLANEOUS EQUIPMENT*
          - *9. SHOP EXPENSES* (Machinery and Tools)
      - Depreciation
        - Way and Structures
          - TRACK AND ROADWAY
          - ELECTRIC LINE
          - BUILDINGS AND FIXTURES
        - Equipment
          - STEAM PLANT
          - ELECTRIC PLANT
          - CARS
          - ELECTRIC EQUIPMENT OF CARS
          - MISCELLANEOUS EQUIPMENT
          - MACHINERY AND TOOLS
    - Emergencies
      - DAMAGES
      - ACCIDENTS
      - DESTROYED PROPERTY
  - **Capital**
    - Profit and Loss
      - WEEKLY
      - MONTHLY
      - QUARTERLY
      - SEMI-ANNUAL
      - ANNUAL
    - IMPAIRMENT AND SURPLUS
    - Capital Stock
      - COMMON
      - FIRST PREFERRED
      - SECOND PREFERRED

PROFIT AND LOSS STATEMENT

- **EXPENSES**
  - **Transportation.**
    - Operation of Power Plant
      - *10. POWER PLANT WAGES*
      - *11. FUEL FOR POWER*
      - *12. WATER FOR POWER*
      - *13. LUBRICANTS AND WASTE FOR POWER PLANT*
      - *14. MISCELLANEOUS SUPPLIES AND EXPENSES OF POWER PLANT*
      - *15. HIRED POWER*
    - Car Service
      - *16. SUPERINTENDENCE OF TRANSPORTATION*
      - *17. WAGES OF CONDUCTORS*
      - *18. WAGES OF MOTORMEN*
      - *19. WAGES OF OTHER CAR SERVICE EMPLOYEES*
      - *20. WAGES OF CAR HOUSE EMPLOYEES*
      - *21. CAR SERVICE SUPPLIES*
      - *22. MISCELLANEOUS CAR SERVICE EXPENSES*
      - *23. CLEANING AND SANDING TRACK*
      - *24. REMOVAL OF SNOW AND ICE*
  - **General**
    - Administrative
      - *25. SALARIES OF GENERAL OFFICERS*
      - *26. SALARIES OF CLERKS*
      - *27. PRINTING AND STATIONERY*
      - *28. MISCELLANEOUS OFFICE EXPENSES*
      - *29. STORE ROOM EXPENSES*
      - *30. STABLE EXPENSES*
      - *31. ADVERTISING AND ATTRACTIONS*
      - *32. MISCELLANEOUS GENERAL EXPENSES*
      - *35. GENERAL LEGAL EXPENSES*
      - *36. RENT OF LAND AND BUILDINGS*
      - *37. RENT OF TRACKS AND TERMINALS*
      - *38. INSURANCE*
    - Emergencies
      - *33. DAMAGES*
      - *34. LEGAL EXPENSES IN CONNECTION WITH DAMAGES*
      - ACCIDENTS AND DESTRUCTION OF PROPERTY
    - *39. TAXES.*
    - Fixed Charges
      - Interest
        - FIRST MORTGAGE BONDS
        - SECOND MORTGAGE BONDS
        - DEBENTURES
        - FLOATING INDEBTEDNESS
      - Sinking Fund
        - FIRST MORTGAGE BONDS
        - SECOND MORTGAGE BONDS
        - DEBENTURES
  - **Maintenance.**
    - Repairs
      - Way and Structures
        - TRACK AND ROADWAY
        - ELECTRIC LINE
        - BUILDINGS AND FIXTURES
      - Equipment
        - STEAM PLANT
        - ELECTRIC PLANT
        - CARS
        - ELECTRIC EQUIPMENT OF CARS
        - MISCELLANEOUS EQUIPMENT
        - MACHINERY AND TOOLS
    - Depreciation
      - Way and Structures
        - TRACK AND ROADWAY
        - ELECTRIC LINE
        - BUILDINGS AND FIXTURES
      - Equipment
        - STEAM PLANT
        - ELECTRIC PLANT
        - CARS
        - ELECTRIC EQUIPMENT OF CARS
        - MISCELLANEOUS EQUIPMENT
        - MACHINERY AND TOOLS
- **REVENUE**
  - **From Operation.**
    - PASSENGER RECEIPTS
    - CHARTERED CARS
    - FREIGHT
    - MAIL
  - **From Other Sources.**
    - EXPRESS
    - ADVERTISING
    - TRACK RENTALS
    - RENT OF LAND AND BUILDINGS
    - INTEREST AND DIVIDENDS ON SECURITIES
    - INTEREST ON DEPOSITS
    - SALE OF POWER
    - MISCELLANEOUS

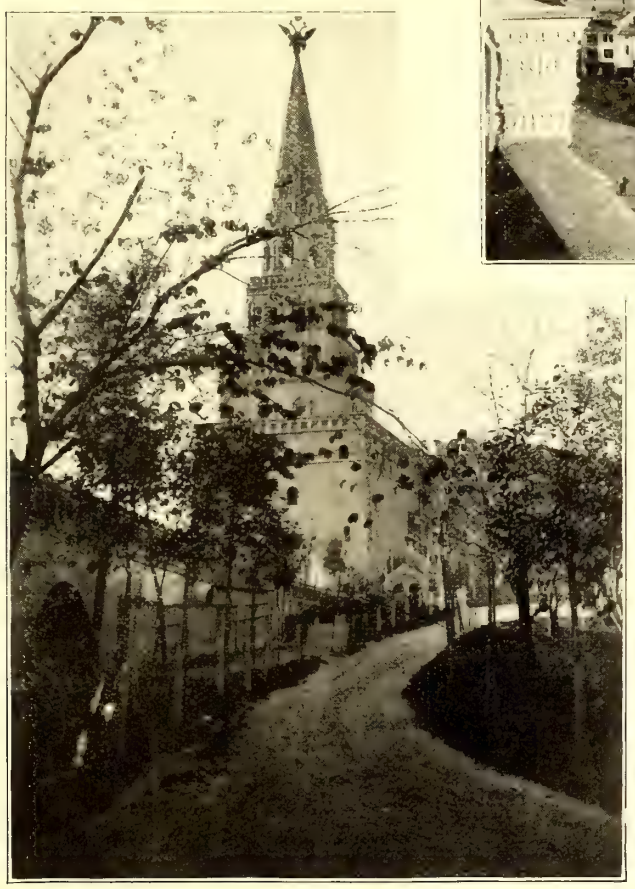
Designed by A. O. KITTREDGE, F.I.A., C.P.A.

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as rapidly as any new forms are issued, two copies of the same. Notice is given that the secretary is now ready to take charge of these forms, classify them and put them in shape for exhibition purposes and general use by the members of the organization.

It is intended that these blanks and the annual exhibition of them shall be held strictly to the members of the organization. Each one contributing, therefore, is assured that whatever blanks are supplied will be used solely for the benefit of the members of the association. It is pointed out in the circular that any member desiring to get up a form for any particular purpose, will be greatly assisted by having at his disposal hundreds of blanks pertaining to the subject which he has under consideration.

The following directions are embodied in the circular: Do not fold the blanks more than absolutely necessary; rolling is preferred. Write in ink the name of the company upon all blanks, where the name does not appear. In case the blanks do not indicate clearly their use, they are to be accompanied by a synopsis of what they are intended to accomplish. The term "blanks and forms," it is explained, is intended to cover everything used by a company, including specially ruled books and tickets. The packages are to be addressed to W. B. Brockway, secretary, 106 Summit Street, Toledo, Ohio.



A CORNER OF THE KREMLIN



CHURCH OF VASSALI BLAJENNY, NEAR THE KREMLIN

Proposed Electric Tramway System in Moscow, Russia

The City Council of Moscow is proposing to grant franchises for an extended system of electric tramways in that city. The City Council has appointed a committee, of which Chief Engineer A. A. Semenoff is chairman, to consider the reconstruction of the existing horse car lines and their equipment with electric power and upon plans prepared by Technical Engineer A. A. Lineff. It is thought that the matter will be settled Jan. 1, 1899, and that soon after that preliminary work can be undertaken.

The general conditions which the council will make for the construction of the electric tramways are briefly as follows: On all existing lines electricity is to be introduced as motive power, and the system, which now has a length of 100 km., will be increased to 135 km. A very substantial construction will be insisted upon, and the gage will be 1 m., instead of the present 1.52 m. Double tracks will be made obligatory, and the speed of the cars will be limited in the center of the city to from 10 to 12 versts (10.7 km. to 12.8 km.) an hour, beyond Sadovaia Street to 15 versts (16 km.) per hour, and beyond that 18 versts (19.3 km.) per hour. The cars in the center of the city will run on the headway of three minutes. In most parts of Moscow the trolley system will be adopted, but where this is not permitted the cars will run either by storage batteries or on the surface contact system. The cars must be lighted and heated by electricity.

The fares are limited to the present 5 copeks, for which passengers are entitled to transfers to the crosstown lines, and commutation tickets will be sold. The running of freight cars will be permitted at night, and in winter cars for the removal of snow and in summer for that of dirt and refuse will be operated.

The time limit placed upon the reconstruction of the lines is four years. During the first year 28 versts must be reconstructed, and during the remaining three years 35 versts each. The lines in the central part of the city will be the first to be equipped. The change must be made without interfering with the present system of transportation. The entire cost is placed at from 15,000,000 to 18,000,000 roubles.

Current will be taken from a central power station, which will also distribute electricity for lighting. The city selected for this station is on the bank of the Moscow River, on the so-called Salt and Vinnoy yards. The builders must deposit satisfactory bonds to guarantee the completion of the work.

The STREET RAILWAY JOURNAL is indebted for the foregoing particulars to the kindness of Mr. Lineff.

A New Feeder Map

BY FRANK H. DEXTER, M. E.

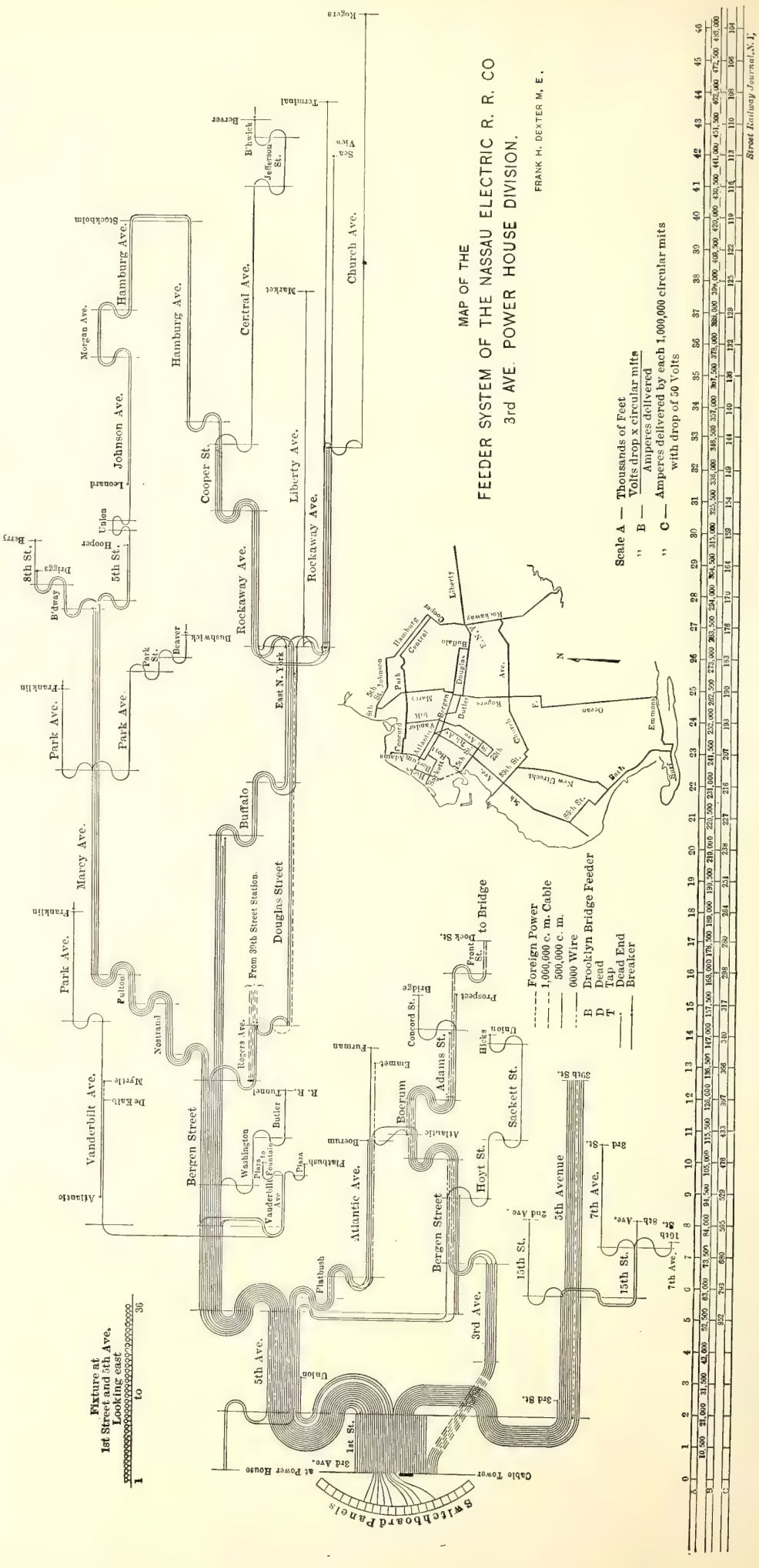
In some recent work in mapping the feeder system of the Nassau Electric Railroad in Brooklyn, the common method of laying down the wires on a map of the city was found so entirely unsatisfactory, owing to size and complexity of the system, that it was found necessary to adopt some new plan. To meet this requirement the writer devised a method which trial has proven to possess a number of advantageous features.

A map of the Third Avenue Power House Division of the Nassau system, made by this method, is shown on this page. The portion represented contains 1,000,000 lbs. of copper, which deliver, at full load, 7000 amps. to one hundred odd miles of trolley wire.

Each feeder in the system is represented on the map by a straight line parallel to a common base, and each portion of a pole line, contained by a single street, by a group of such lines. On the base line is laid off the scale of lengths adopted for the feeders. Turns are indicated by offsetting consecutive groups by a convenient distance, and to the right or left, according to the direction of the turn represented. Corresponding points of each wire are connected by suitable curves in such a way that each feeder becomes continuous from the station to its end. Since the offsets are made in a direction perpendicular to the scale, the length of the curved connection is immaterial.

In our system each wire has a distinguishing number taken from the pin it occupies on the First Street pole line where it leaves the station. With few exceptions it was found convenient to lay down the wires in the order in which they appear on the pole line; where this was not the case the pin numbers are shown on the map. Jumpers, breakers, feeding points, etc., may be shown with facility. Various sizes of cables are given distinguishing colors in the original map and by lines of different character, as dotted, dashed and solid in the engraving.

Considering the complexity of the Nassau system, it seems unlikely that the special features of any other would present any seri-



ous difficulty in carrying out the general plan described above.

By thus mapping as parallel all streets traversed by the feeders, and omitting all others, much is gained in the way of compactness, for it will be seen that, whereas the area of a common map is proportional to the square of the linear scale, that of the new form varies as the first power. Then too the convenience of being able to read at a glance the distance between points on the system is not to be regarded lightly. Information of this nature is constantly in demand for various purposes. The time saved, to say nothing of the accuracy gained, by reference to the linear scale compared with that required for reference to the tabulated data (which never contains the points concerned) or of stepping off with dividers (or a string) on the city map, is considerable.

Not less useful are the scales *B* and *C*. At every point on the line there exists a definite relation between the current flowing, the drop from the station to that point, and the size of the conductors. If *P* = the resistance of a mil foot of copper we have, as the total resistance of the conductor,

$$R = \frac{P \times \text{dist. in ft.}}{\text{cm. in conductor}} = \frac{\text{volts drop}}{\text{amps. flowing}}$$

$$P \times \text{distance} = \frac{\text{drop} \times \text{c.m.}}{\text{amps.}} = \text{drop} \times \text{cir. mils per amp.}$$

Values thus obtained are platted in scale *B*. If at any point two of the terms involved are known the third may be determined by substitution.

If it be desired to find the current delivered with a specified drop a special scale is more convenient than the general one, *B*. Scale *C* gives the number of amperes delivered with a drop of 50 volts by each 1,000,000 c.m. As before,

$$R = \frac{P \times \text{distance}}{\text{c.m.}}.$$

or

$$\text{Amps.} = \frac{\text{drop}}{R} = \frac{50 \times 1{,}000{,}000}{P \times \text{distance.}}$$

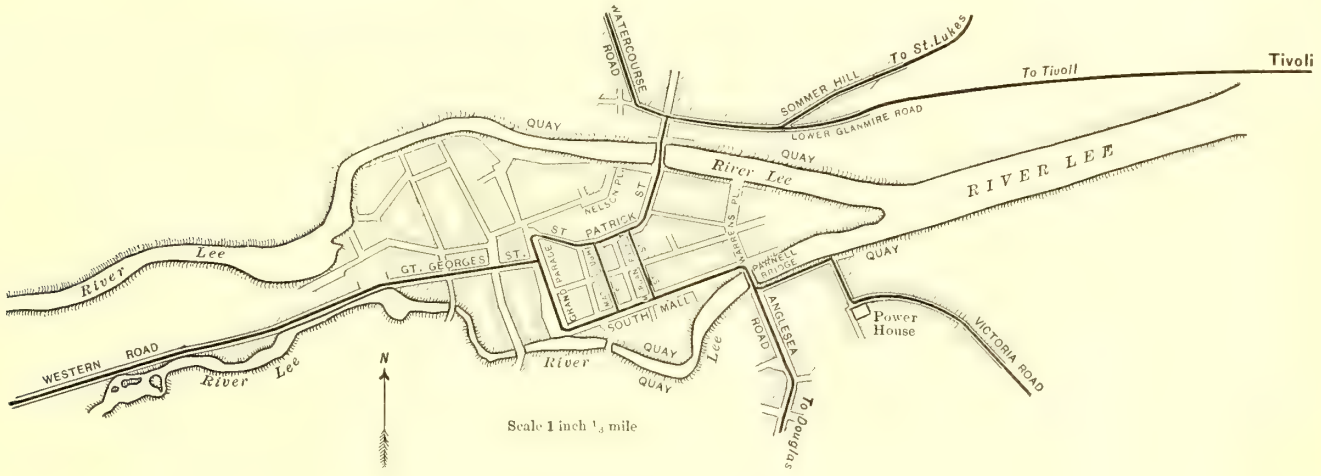
To find the current delivered by M c.m., the values of scale *C* are multiplied by

$$\frac{\text{M}}{1{,}000{,}000}.$$

Electric Tramway System of Cork, Ireland

The tramways in Cork have been recently equipped with electric power, and a general map of the system is given on this page. As will be seen, the street railway connects the center of the city, which is on an island formed by two branches of the River Lee, through the principal streets, with suburbs. The longest branch is to Douglas, a village about 2 miles south of Cork. The tramway crosses the river twice, once over Parnell Bridge, a steel swing bridge, second over Patrick's Bridge, built of stone.

The rails in the city are laid on a bed of concrete, and the roadway is paved between the rails and for a distance of 18 ins. on each side. Outside of the city boundaries the concrete is replaced by creosoted ties, 6 ft. x 4½ ins. x 9 ins. The rails are of girder type, weighing 83 lbs. per yard, with fish-plates 26 ins. long, weighing 56 lbs. per pair. The tie-bars are of wrought iron, 2 ins. x ⅜ in., weighing 10½ lbs., and double screwed at ends. The rails are fixed to the ties by thirty dog spikes and fourteen fang bolts and chips to each rail length. The switches and frogs are cast steel, made by Millar & Co., and Dick, Kerr & Co., Ltd.



MAP OF CORK TRAMWAYS

The rails form the return circuit, and are electrically connected at each joint by two No. 000 B. & S. Chicago bonds, 35 ins. long. At every switch or crossing there are two 13-ft. bonds spanning the steel casting, and there are also for each point of this kind four 35-in. bonds, connecting the rail with the casting. At each crossing there are four No. 000 B. & S. 35-in. bonds. The rails are cross bonded every 240 ft., and where there is double track, the two tracks are also cross bonded every 240 ft. These track cross bonds are placed half way between the rail cross bonds.

Where the double track is equipped with center poles the cross bonds between the two tracks are 7 ft. long, and where it is equipped with side poles they are 5 ft long. All the cross bonds on single track are 42 ins. in length. In all the loops on the single line there is a cross bond between the two tracks.

The return circuit is continued over the river at Parnell Bridge by four 0.5 in. cables, connected by bonds to the rails on either side of the water, this arrangement being necessary to avoid any interruption in the circuit when the bridge is swung open.

Center poles with double-bracket arms are used in principal streets, and side poles with single-bracket arms are employed on rest of line. Span wire construction has been installed in only a few places. The poles are 31 ft. long and

are composed of three sections. The joints are overlapping, and the sections are shrunk on while hot.

In the principal streets an arc lamp is fixed on every alternate pole. These lamps are of the inclosed arc type, connected up five in series; but consecutive lamps are not put on the same circuits; thus every other of ten consecutive lamps are on one circuit, while the remaining five are on another. The switches and resistances for the lamps are contained in the bases of the poles, so that, if necessary, a resistance can be placed in the circuit instead of a lamp. Each circuit can also be controlled from any lamp in its circuit.

The trolley wire is of hard-drawn copper and is double throughout. The portion of the trolley wire over the swing part of Parnell Bridge is supported on special poles and brackets fastened to the movable part of the bridge. The connections on the trolley wire are heavy spring clips, which allow the bridge to be moved in either direction.

The power house is situated in Albert Street, 220 ft. from the river. The building is of brick, with pile foundation.

The boiler room contains three Babcock & Wilcox boilears, each having 2531 sq. ft. heating surface and capable of evaporating 8000 lbs. of water per hour. The normal working pressure is 150 lbs. The stack is of steel, self-supporting, and 130 ft. high. It has a 7-ft. internal diameter, and it is lined with 4½-in. fire brick. The stack is erected on piled concrete foundations. The thickness of the steel plates at the base is 7-16 in. Each plate is 4 ft. x 6 ft. and there are three plates to the ring.

The feed water heater employed was supplied by the Wheeler Condenser & Engineering Company. The feed water is heated by the exhaust from the feed pumps, and the condenser pumps. The feed pumps are of the Blake & Knowles type, 6 ins. x 4 ins. x 8 ins. The steam cylinders of these pumps are fitted with an improved outside valve gear, so that they can be adjusted to the full length of the stroke under all conditions of speed. The steam connections of these pumps are so arranged that in case any repairs are required, either pump can be worked independently of the other.

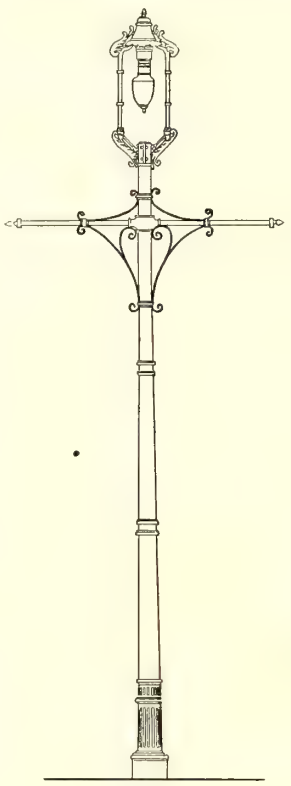
The hot well is situated in boiler house and is fitted with baffle plates, the divisions in which can be filled with coke and straw, if desired, for the purpose of intercepting any oil that may be discharged into it. It is also fitted with suitable outlets, so arranged that, by opening a valve and filling the tank, the oil, which will be found floating on the surface, can be run off. The feed water, before entering the boiler, can be passed through two Edmiston filters, capable of filtering 16,000 lbs. of water per hour. These filters are arranged on a twin system, fitted with the necessary valves to enable the filters to be used on either range of feed pipes.

The steam piping is of steel, with heavy screwed steel flanges, and is so arranged that any engine can be fed direct from the boiler immediately behind it, or, by means of the main, from any boiler. Valves are inserted to enable any faulty section in the piping to be cut out. This piping is also fitted with an automatic atmospheric valve, which, in the event of any back pressure, due to the failure of the condensing plant, will immediately allow the engines to exhaust direct into the atmosphere. The piping on the atmospheric side of this valve is of thin steel, riveted together in spirals.

The engine room contains three McIntosh & Seymour tandem compound condensing engines, running at 135 r.p.m., fitted with expansion governors and separate exhaust valves on both high and low pressure cylinders. The high-pressure cylinder is steam jacketed, and exhausts into a receiver, in the interior of which are fixed three copper coils, which can be heated with live steam. These engines are direct coupled to 6-pole 200-k.w. compound-wound generators, giving 500 volts at 135 r.p.m.

There are two condensers of the Wheeler Admiralty type with engines in the center, air-pump at one end and circulating water-pump at the other end. Each condenser is capable of dealing with 12,000 lbs. of steam per hour. The condensing water is taken direct from the river through from the water works, which can be employed to start the 12-in. cast iron pipes. There is also an auxiliary supply pump in the event of the suction pipe being emptied through the retaining valve not being perfectly watertight.

Adjoining the engine room is the accumulator room. This contains 236 Tudor cells mounted in three tiers. Each cell containing six positive and seven negative plates. The capacity of the battery is 770 amp. hours, the normal rate of discharge 110 amps. and the maximum rate 210 amps. The battery stands are of pitch pine with acid proof paint, and are mounted on large oil insulators. This battery can be charged either from traction or lighting bus bars, as desired, the necessary volts for charging being supplied by a booster, which can also be driven from the traction or lighting bus bars.



POLE

The switchboard is situated at the end of the engine-room, and contains three generator panels, fitted with automatic circuit breakers, with magnetic blow-outs; also the necessary switches, so arranged that the generators can be connected direct to either the lighting or traction bus bars; also two battery panels, fitted with the necessary regulating switches and magnetic blow-outs, and so arranged that the battery can be either charged from, or discharged to, either the lighting or traction circuits, as desired; also two balancer panels, so arranged that, if desired, the balancer can be driven, in the day time, direct from the traction bars, or used as an ordinary balancer, the two motors being in series across the outers, the junction being connected to the neutral. In this case the set is run up to give its correct voltage by means of the motor placed in the center, and the electrical connections are disconnected after the balancer sets are connected to the system.

The switchboard is also fitted with a panel containing the necessary instruments required by the Board of Trade for purposes of testing.

There are eighteen top seat cars, capable of seating forty-four passengers, manufactured by the Brush Electrical Engineering Company, Ltd., mounted on single Peckham trucks, manufactured by the Peckham Truck Company. The motor equipment consists of two G. E.-60 motors with series parallel controllers. The motors had to be specially designed for this work, on account of the very narrow gage, namely, 2 ft. 11½ ins. In other respects the car equipment follows standard practice.

The repair shop is 70 ft. x 18 ft., and contains the necessary machine and smiths' tools likely to be required for the maintenance of the cars and machinery.

The Cork Electric Tramways & Lighting Company,

Ltd., which operates the system, supplies current for lighting and miscellaneous power purposes, as well as for electric tramway service. The lighting distribution is on the three-wire system, with 460 volts between the outers. The mains are all of Messrs. Callender's manufacture, and, in the majority of cases, consisting of jute-covered, lead-sheathed, tape-armored cables, laid direct in the streets. Altogether, over 20 miles of cable, including both lighting and traction systems, have been laid, the distance between the feeding points, of which there are two at present, and the station being just under half a mile.

In their course from the power station to the feeding points, the cables cross the River Lee, and as there is only a swing bridge at this location, the cables had to be laid in a trench excavated in the bed of the river. Callender's vulcanized bitumen wire-armored cable was employed here, as being adapted as most suitable for the purpose. Four additional spare feeder cables, each of .7 in.-sectional area, have been laid across the river to cope with future extensions. The vulcanized bitumen cables are brought together in a pit on each side of the water, where they are connected to the ordinary jute-covered, tape-armored cable laid in the streets.

The greater proportion of the distributing cables in the center of the city are of the three-core type; the largest distributor used has a sectional area of .15 in. In all the outlying districts three single distributing cables are used, and, in addition to their armor, they are further protected by a covering layer of bricks. At the crossing and junction points of the system Callender's disconnecting boxes are fixed, and, of these, nineteen are at present installed.

The supply of current for light, etc., was started about the beginning of September, and since then about 130 customers have been connected to the mains. The service of the company now stands as follows:

Number of customers applied for	217
Lamps applied for	11,622
Motors applied for	18
Total horse power	113
Total applied for in 8 c.p. equivalents	14,447

The public arc lighting has not yet been permanently started. There will be altogether about 100 lamps.

The tariff for lighting current is 5d. per unit for the first two hours, and 1d. afterward, on the Brighton system of charging. The present tariff for motive power is 4¼d. per unit, and 1d. afterward, also on the Brighton system.

CONTRACTORS, ETC.

The British Thomson-Houston Company, Ltd., was the contractor to the Cork Electric Tramways & Lighting Company, Ltd., for the work as a whole—construction, building, machinery, etc.—in connection with the system, and supplied complete electrical equipments of the power station and cars.

The following were the chief sub-contractors to the British Thomson-Houston Company, Ltd.:

Permanent Way, Power House Buildings, Etc.—W. M. Murphy, Dublin.

Engines.—R. W. Blackwell & Co., London.

Boilers.—Babcock & Wilcox, Ltd., London.

Auxiliary Apparatus, Pumps, Condensers, Etc.—Wheeler Condenser & Engineering Company, and Blake & Knowles Steam Pump Works, Ltd., London.

Battery.—Tudor Accumulator Company, Ltd., London.

Traveler.—Jessop & Appleby, Leicester.

Cars.—The Brush Electrical Engineering Company, Ltd., Loughborough.

Peckham Trucks.—R. W. Blackwell & Co., London.

Overhead Line Construction.—R. W. Blackwell & Co., London.

Feeders and Cables.—Callender's Cable & Construction Company, Ltd., London.

Arc Lamps and Hoods.—General Electric Company, Ltd., London.

Alderman Fitzgerald, of Cork, was sub-contractor to W. M. Murphy for the buildings in connection with the power house.

Recent Improvements in San Francisco

The favor with which the many electric lines constructed by the Market Street Railway Company during the past five years have been received by the traveling public, and their ability to cope with the requirements of grades and heavy travel having been fully demonstrated, the company decided to reconstruct other lines to the electric system, which work has been completed during the year just passed.

The Park and Ocean Line, formerly operated by steam motors, from Stanyan and Haight Streets, along H Street (the southern boundary of Golden Gate Park), to the ocean beach, has been converted to the electric system. The double track, about 4 miles in length, has been rebuilt, using 62-lb. T rail, spiked to redwood ties 6 ins. x 8 ins. x 8 ft., space 2½-ft. centers, with fish-plate joints resting upon joint plates. The tracks are cross bonded every 300 ft. Center-pole construction has been used for the electric conductors the greater portion of the way, though for a short distance, at the town end of the line, iron side poles of the Market Street Railway standard pattern have been used. The center poles, which are spaced about 109 ft. apart, are set in concrete, extending about 12 ins. above the surface of the ground. Fig. 8 trolley wire has been used, of 330,000 c.m. cross sectional area. All span, anchor and strain wires are of silicon bronze, on account of the salt atmosphere met with.

The line, which has many grades of about 2½ per cent, one of which is over a mile in length, is operated mainly with single-truck cars of the combination open and closed pattern, which run direct to a central part of the city, though on Sundays a few cars of the double-truck pattern (also combination open and closed) are run between the ocean beach and Stanyan Street only, to accommodate the passengers transferring to and from the lines having their terminals at the latter point. Since the conversion of this line to the electric system the travel on it, which is almost entirely of a pleasure character, has greatly increased.

The Eighth Street line, formerly operated as a horse line, between Market and Bryant Streets, a distance of about 3100 ft, has been rebuilt to an electric road. The double track has been relaid with 45 to 51-lb. girder rail, on chairs spiked to redwood ties 8 ins. x 8 ins. x 8 ft., spaced 2½-ft. centers, with the rail joints cast welded. Ordinary side-pole construction has been used, the poles being of the 5-in., 6-in. and 7-in. tubular iron, Market Street Railway standard pattern. To avoid an extra number of poles upon the street, at various places the iron side poles were omitted, and the suspension wires secured to 40-ft. and 50-ft. wooden poles, already in place, for carrying the wires of other companies.

San Bruno and Precita Avenue and Army Street: The unused horse-car tracks on Army Street, between San Bruno Avenue and Folsom Street, have been rebuilt to the electric system, as also a single electric track constructed on Precita Avenue, between the same streets, with the intention of extending the Folsom Street line out to the former street and San Bruno Avenue, a distance of about 2½ miles, returning to Folsom Street via Army Street. The single tracks constructed on Army Street and Precita Avenue are each about 2500 ft. in length, and built of 51-lb. girder rail, spiked direct to ties spaced 2½-ft. centers, with rail joints cast welded. Ordinary wooden side-pole construction was used on this portion of the route.

The reconstruction of the San Bruno Avenue horse-car track is now under way, the T rails of the present track being relaid on new ties spaced 2½-ft. centers, with rail joints cast welded and rails cross bonded every 150 ft. with No. 0, B. & S. Chicago bonds. Wooden side bracket poles are to be used in the overhead construction. The reconstruction of the line has been treated as of a somewhat temporary character on account of the unfinished condition of the street and the prospect of many future changes in its grade, etc.

Taylor Street: The horse car, double tracks, on Taylor Street, between Market and Ellis Streets, a distance of about 1250 ft. have been reconstructed for electric service, using 70-lb. girder rail, laid on chairs spiked to 6-in. x 8-in. x 8-ft. ties, spaced 2½-ft. centers, with fish-plate joints. The overhead work is of the standard Market Street Railway pattern, with iron tubular side poles. This track, which was constructed for the immediate use of the Park & Ocean through line, may possibly be used in connection with other lines in the near future.

During the year the company has put in several hundred cast-welded joints on its Ocean Avenue, Kearny and Sacramento Street lines, with excellent results. While a few of the joints put in last year on the Solano, Folsom and Twenty-second Street lines had to be renewed on account of breakage, no such trouble has been experienced with those of this year's construction.

Sixteen cable cars, no longer required on account of the conversion of certain cable to electric lines, have been reconstructed to single-truck electric cars of the standard combination open and closed pattern, with very satisfactory results. These cars have been equipped with motors taken from larger cars, as noted below.

The electrical equipment of twenty-five double-truck cars has been improved by substituting two G. E.-1000 motors for the two W. P.-50 motors formerly used, and which were found to be hardly adequate to the requirements of grades, heavy loads and frequent stops. A portion of the W. P.-50 motors so removed have been used in equipping the smaller cars of the single-truck pattern, previously referred to.

The Kentucky Street car house has been enlarged during the year, and its capacity increased from forty to eighty cars, the company now having storage capacity at its three electric car houses for 300 cars.

The pipe line, running from the bay to the main electric power station at Bryant and Division Streets, for supplying salt water for condensing purposes, has been extended to the cable power station at Market and Valencia Streets, and the non-condensing power plant at that house remodeled to one of a condensing type by the addition of a new low-pressure cylinder, condensers, pumps, etc. The electric light system of the company has been extended until, from its own power station, all of its sixteen car houses and power plants are now lighted.

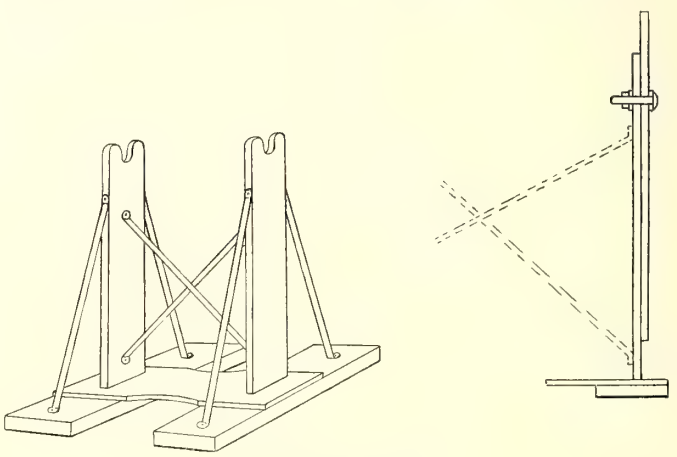
The introduction of electric motors to operate drill presses and grind-stones at the car houses has been attended with economical results. It has been found that a small motor, absorbing 10 cents' worth of current per day, will run a drill press faster and stronger than an able-bodied man can do it. Twice the work is now done with one man and a motor as was formerly done by two men.

Home Made Armature Rest.

The accompanying engravings illustrate a stand for holding armatures while repairs are being made, used at the Fifty-second Street shop of the Brooklyn Heights Railroad Company. The stand, with the exception of a few iron braces, is made entirely of wood, and so should be quite inexpensive to build. The idea seems to be a good one, as the device will apparently withstand extremely hard use for a long time before having to be consigned to the scrap pile.

The method of making the stand is as follows: Two upright pieces on which the armature shaft rests are made from a board, either ash or oak, and 1¼ ins. thick. Each side should be cut about 7 ins. wide and 36 ins. long. One end of each piece is securely fastened to a connecting base board, cut from the same plank but 12 ins. wide and 38 ins. or 40 ins. long. The edge of this latter piece is cut out crescent shape to give a more finished appearance to the completed stand. When this has been done it should be fastened to two pieces of plank, each 3 ins. x 9 ins. x 36 ins., which will support the frame from the floor.

The two upright pieces are braced with ½ in. round bar iron as explained by referring to the illustrations. It will be noticed that two braces hold these pieces from spreading out, and two fastened at the edge of each one near the



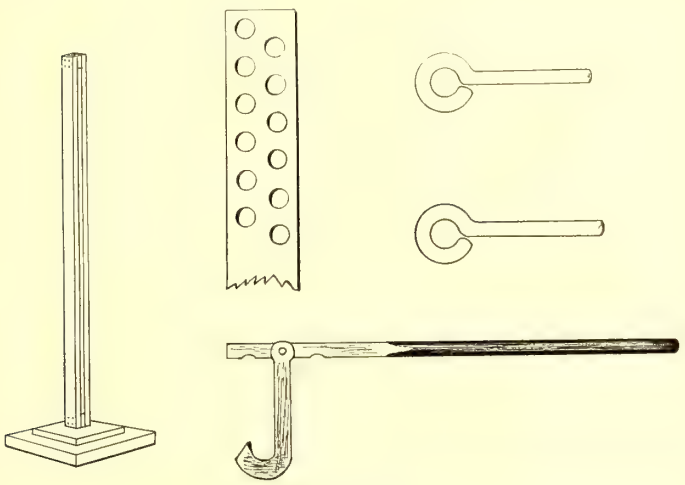
ARMATURE REST

top and at the ends of the pieces resting on the floor hold it from falling over. After these have been added the top edge of each upright piece must be hollowed out to fit the shaft, and the stand is complete ready for service. To increase the height or width two additional pieces may be fastened with two bolts to the uprights on each side as explained in the engraving on the right.

At the same shop two traveling cranes, operated by hand power, are employed to raise car bodies from their trucks, but these will be found in most all large shops having modern improvements for doing repair work. But the jack used for handling small car bodies appears to be very useful and a device which would be found very convenient in smaller shops. The following illustrations will explain how to make it. First cut two strips of hard wood 1½ ins. x 8 ins. x 8 ft. long, and have two rows of holes 1½ ins. in diameter bored in each piece. The distance between the holes is about 6 ins. The centers of the holes in one row should come opposite the center of the space between the holes of the other row, and the holes in each strip should correspond with those in the other. The two strips are then bolted together at each end, leaving a space between of about 3 ins., or sufficient to allow the lever, also illustrated, to pass easily in or out. When this has been completed the uprights should be fastened securely to a base, which can be made from a block of wood 4 ins. or 5 ins. thick and 18 ins. square, or made from two pieces nailed together, one about 4 ins. thick and 16 ins. or 18 ins. square, the other 2 ins. thick and 14 ins. square, as shown in the cut.

The lever is made from one piece of bar iron 2 ins. diameter and 6 ft. or 7 ft. long, one end being flattened for a distance of about 2 ft. to a thickness of 1¼ ins. This lever

rests on two iron pins passed through the holes made in the jack, and to keep it from slipping off these pins it is slotted sufficiently deep at these points to hold it in place. Two slots are made on the part of the lever which was made flat, as mentioned above; the first slot is about 1½ ins. or 2 ins. from the end and the other about 6¼ ins. from the first. At the center between these two slots is pivoted the hook for engaging with the car body; this is forged to the form shown. The two pins are made from round bar iron 1¼ ins. in diameter, one end of each being bent in a circular form to facilitate handling, as well as to keep it in place in the jack. It should here be mentioned that the strips of wood of jack having the holes in them can be considerably strengthened by placing bands of iron on the edges; this tends to keep the wood from splitting at these points.



CAR JACK

To raise or lower a car with this jack is simply a matter of changing the position of the pins. Thus to raise the car two jacks are placed at one end with the hooks engaging underneath the platform, one on each corner. The lever is then pressed down on each jack and the pin on each thus released is placed in the next hole above. The lever is again raised and that pin placed in the next hole above. Continuing this operation raises the car body from the truck on one end until a sufficient height is reached where the car body can be held in that position in some convenient way, perhaps by resting it across a timber placed on two barrels outside the track to allow the removal of the truck. The jacks are then taken to the opposite end of the car, which is raised and held in the same manner. Reversing these operations lowers the bar body. It only requires the services of two men to operate this jack.

Special Report to The Glasgow Corporation on Latest Developments in Electric Traction

The following is an abstract of a memorandum by General Manager John Young, on electric traction, in view of practical experience gained in Glasgow and elsewhere during the last two years, and with special reference to the present proposal to equip electrically the lines from Glasgow Cross to Govanhill and Coplawhill Car Works. It was prepared at the request of the convener of the tramways committee:

"Two years ago—in 1896—deputations from the tramways committee reported strongly in favor of electric traction, and to-day it is further ahead of its rivals than ever. At that time the system of distributing the current by means of a slotted conduit in the center of the track was only being experimented with. Mechanically it seemed successful, but considerable doubt existed as to the commercial success of a system so costly to construct. On the other hand, the overhead, or trolley system, had for several years been abundantly proved a commercial success, and to have completely revolutionized tramway traveling wherever it had been adopted. Your deputations, therefore, felt that the only choice left them was to recommend the corporation either to give a demonstration of the overhead system on one of the tramway routes, or simply to wait further developments. The former was the recommendation which was subsequently given effect to, and the overhead construction on the Springburn route, especially in West Nile Street, where rosettes are used, instead of side poles, shows the system practically at its best, and I do not think any slight improvement it may admit of would alter any one's opinion of the system generally.

"It is only within the last fortnight that the horse cars have been entirely displaced by electric cars on the Springburn route, and the power station plant has not yet been completed so as to be taken off the hands of the contractors. Our figures for operating can, therefore, scarcely be said to have settled down to normal. The results, both as regards efficiency and economy, are, however, very satisfactory. For the week ending Saturday last, Nov. 12, the total operating expenses for the electric route were, as near as may be, 6½d. (13 cents) per car mile, while the receipts amounted to 1s. 4½d. (34 cents) per car mile. I do not wish to attach too much importance to the increased traffic, although there can be no doubt electric traction does very appreciably increase the revenue. Apart from this consideration, important as it is, financial success is assured by the fact that, during the first full week of operating our small electric installation working only at half its power, we can show a saving on working expenses, as compared with horse traction, of 2d. (4 cents) per car mile.

"The position we find ourselves in at present is this: We have with difficulty kept pace hitherto with the unprecedented increase in our tramway traffic, and still we find ourselves pressed to give traveling facilities to meet this increasing demand upon us. It would be unfortunate at this time of day to propose to build more stables or horse cars. The only little present relief we can otherwise have, until a general scheme for electric traction has been adopted, is to electrically equip the route in continuation of High Street from Glasgow Cross to Govanhill, and across Coplaw Street to Coplawhill Car Works. An electrical connection between the car works and the power station at Springburn is absolutely necessary, at any rate. It is calculated that the engines and dynamos now in the power station can operate this extension, and, of course, better results will be shown when full advantage is taken of the power plant. Some extra boiler power will be required.

"The desirability of this extension is very apparent, but the question which, in view of the latest developments, has just arisen is: should this extension be on the overhead or underground system, or, rather, should we have a demonstration of the conduit system before finally discussing a complete scheme of electric traction for the city?

"Perhaps one of the most important communications upon electric traction which has yet been made public came into our hands a few days ago. It is the "Comparative costs and profits of cable, electric conduit, and horse tramway operation in New York city." This communication is published in this month's issue of the STREET RAILWAY JOURNAL, New York, and for the information of members I would ask you, with the sanction of the editor, to have it reprinted in the minutes. The figures contained in this article as supplied to the editor by H. H. Vreeland, president of the Metropolitan Street Railway Company, of New York city, seem to confirm the commercial success of the conduit system in that city of great traffic, and its great superiority to cable and horse traction.

"The report states that, for the year ending June 30, 1898, the operating expenses of the cable lines were 8.21d. per car mile; of the horse lines, 8.93d., and of the electric conduit lines, 5.11d.; while for the three months ending Sept. 30, 1898, which is more favorable to the electric conduit system, on account of its operation being more settled, the cable lines cost 8.77d.; the horse lines, 8.94d., and the electric lines, 5.03d. For comparison, I may interject here that last year it cost us in Glasgow 8.3d. to operate with horses. Upon examination of the detailed figures, it is evident that some little addition will soon fall to be made to the cost of operating the conduit on account of increased maintenance of permanent way and equipment when these have been longer subjected to tear and wear.

"Another very remarkable statement in the report is that 'during the twelve-months' period the cable lines operated at 47.7 per cent of their passenger receipts, the electric lines at 37.9 per cent, the horse lines at 65.3 per cent, and the entire system at 53.3 per cent. During the three-months' period the cable operated at 52.7 per cent of their passenger receipts, the electric lines at 38.6 per cent, the horse lines at 62.1 per cent, and the entire system at 50.9 per cent.' This very low percentage of 37.9 of the receipts has never before been reached, so far as I know. It, of course, points to very large traffic, as well as to economical working.

On our system last year the percentage of cost of operation to receipts was 74.49.

"I confess my surprise that the cable in New York, with its immense traffic, should have been so very far surpassed. With these figures before him, and also the significant fact that the cable system in Broadway, after a short history of five years, is now being superseded by the electric conduit, the writer of the article seems fully justified in saying—'There is no place for the cable in modern street railroading.'

"But it is the overhead and the conduit systems of electric traction that you are more immediately interested in.

"Your deputation, in their report of July, 1896, said: 'All other things being equal, a system which provides the power without any overhead construction is preferable.' No one will dispute this. I do not think it is possible, however, with the very much greater initial cost of the conduit, that the result can be economically equal to the overhead, but it may very properly be asked, in view of the latest experience: How near does it approach economic equality? This I have tried to estimate.

"The total length of the tramways owned by the Glasgow Corporation, including those recently constructed, although not yet opened for traffic, measures, in round figures, 37 miles of double track. This, of course, excludes the Govan Tramways, which are leased. Prior to 1894 the section of rail used weighed 79 lbs. per yard, and from 1894 to 1896, 89 lbs. per yard. Since 1896 a new section has been adopted, weighing 100 lbs. per yard. In both of the older sections (designed for horse traction) the groove is so shallow that, when new, the rail admits of a wear of only one-quarter of an inch until the flanges of our electric car wheels touch the bottom of the groove. The new 100-lb. section gives a wear of three-quarters of an inch before the same thing occurs. Our experience in relaying and operating the Springburn route has practically dispelled any hopes that may have been entertained of the economy of bonding and wearing out any considerable portion of the old shallow-grooved rails.

"Of the 37 miles of double line in question, 22 miles are laid with 79-lb. rails, and 6 miles with 89-lb. rails, making altogether 28 miles; and 9 miles with 100-lb. rails. From what I have said, we may take it that, in the event of conversion to electric traction, the former 28 miles will practically require new rails throughout, while the present rails on the latter 9 miles will be suitable for the new form of traction.

"On this basis, I have made up the following relative estimates of the cost of conversion. These estimates do not include anything for feeders, rolling stock, equipments, buldings, power and transforming stations, etc., which are common to both the overhead and conduit systems, and which, for our present purpose, may be estimated at equal cost:

I. OVERHEAD

Renewing 28 miles of double track, and electrically equipping same, including overhead construction, bonding, and ducts for feeders, at £11,000 per mile	£308,000
Converting 9 miles of double track now laid with 100-lb. rails, at £4,500 per mile	40,500
	£348,500

"These figures for the overhead system are based upon the costs of converting the Springburn route.

II. CONDUIT

Renewing 28 miles double track, and electrically equipping same at £20,000 per mile	£560,000
Converting 9 miles of double track, using the present rails, at £18,000 per mile	162,000
	£722,000

"These figures for the conduit bear the same relative proportion to the overhead as do the figures in the very able report recently presented to the Liverpool Corporation by F. S. Pearson, engineer to the Metropolitan Street Railway Company, who designed and constructed the conduit system in New York now reported upon. Mr. Pearson's figures for conversion in Liverpool are, however, somewhat higher than those given here, both for overhead and conduit.

"There is, of necessity, considerable uncertainty in any estimate for constructing a conduit in the streets of the city, arising from the unknown number and character of water, gas, and other pipes and sewers, which may require to be removed, and special work at bridges, etc. In fact, the real cost will be determined by the amount of this extra work.

"According to the present estimates it would cost £373,500 (in round figures, £10,000 per mile of double track) more to convert the 37 miles of double track under consideration to the conduit than to the overhead system, or rather more than double. The greatest sacrifice for the conduit is, it will be observed, in lifting to the foundation the lines more recently laid with 100-lb. rails.

"To construct the conduit on a road on which there are no tramways at present would probably cost about £6,000 per mile of double track more than the overhead. This would apply to extensions.

"Taking an average running of 9,000,000 car miles per annum, or 122,000 per mile of single track, the interest and sinking fund on the extra cost indicated for conversion is practically equal to ½d. per car mile. There will probably be slight excesses on other points, such as maintenance, leakage, cleaning, etc., but, from all the evidence available, I think we may assume that the excess on all points would not, in any event, exceed 1d. per car mile. It should be observed, however, that, on the mileage in question, 1d. per car mile amounts to £37,500 per annum.

"Where the traffic is not great, this excess would be serious, or even prohibitive, and it would tend to check extensions quite feasible with the trolley.

"The interference with the streets would undoubtedly be very great during the reconstruction for conduit, but this would just require to be borne at its possible minimum. Where the street would require to be taken up for the overhead system, it would only be a question of degree. There is also the question of climate. Glasgow has more damp and slush than New York, but I have assumed that the maximum excess of 1d. per car mile over the trolley would cover all such points.

"If we, for the moment, suppose the more expensive conduit system to be quite practicable from an engineering point of view, then its commercial success would depend upon the prospective traffic and receipts. We are naturally most anxious to give the community the cheapest possible means of comfortable tramway traveling, and there is no doubt that, for cheapness and efficiency combined, the overhead electric system holds the field. It is, however, a question worthy of fair and full consideration, whether, if the conduit should prove equally efficient and reliable, and be considered safer, as well as less obtrusive (even if the preference be, to a large extent, sentimental), and if it could be operated at no greater extra cost over the trolley than 1d. per car mile, it should not have a trial at this stage. In other words: is the gain, which is almost entirely æsthetic, worth the difference? Were this the only question involved, I believe the available traffic on the thoroughfares of Glasgow would justify this extra cost over the trolley if by it one were sure of securing for the city the best all-round system. But we have not this assurance.

"The extra cost can be better afforded now that the electric power can be produced at what a few years ago would have been looked upon as merely a nominal addition to the cost per car mile run. It is fully anticipated that the new 70,000-h.p. station in Ninety-sixth Street, New York, for the tramway service of the entire city, through high-tension primary lines and low-tension secondary circuits, will reduce the cost of power to somewhere between 60 cents (30d.) and 75 cents (37d.), or practically one-third of a penny per car mile run. I believe this is possible of realization. Experience in Brooklyn, Chicago and Montreal, as well as in New York, justifies the expectation. I am also convinced that, with the wages and prices in this country, if the Glasgow Tramways committee lay down their own power station on similar lines, they will be in a better position to attain this result than the Metropolitan Street Railway Company, in New York. I may mention here that, from tests made so far, our cars on the Springburn route, which is hilly, and requires considerable sanding, seem to use about 1¼-kw. hours, or board of trade units, per car mile run, or about 1½ units, including currents used for lighting and heating the cars.

"Coming now to the question of the proposed extension from Glasgow Cross to Govanhill and Coplawhill, there is nothing, if it be not insufficient depth on the bridges, to prevent a portion of this extension being altered to the conduit system, and the working of the same cars over both systems, if the committee wish it. The cars would be fitted with the trolley for the overhead portion, and the plow for the conduit portion. The one would be thrown off, and the other on, at the junction—which would be a stopping place—without much detention. The changing may not be altogether desirable, but it is quite workable. One system, however, for the entire city would certainly be preferable. Otherwise there would be difficulty in determining where one system should end and another begin.

"If the available depth makes it practicable, and a demonstration of the conduit system is wanted, what I should suggest is this: proceed at once to equip the Govanhill route, as proposed, on the overhead system throughout, and arrange, at any time you think fit, to demonstrate the conduit system on the Dennistoun route from St. Vincent Place to the terminus. The current for this demonstration could easily be supplied from the present power station, via High Street, and the working costs kept quite separate. The Kelvinside cars could simply turn at St. Vincent Place, as in former times, and this would completely isolate the Dennistoun route for this purpose.

"The article referred to is reprinted from the Street Railway Journal, and is appended hereto. John Young."

LEGAL NOTES AND COMMENTS*

EDITED BY J. ASPINWALL HODGE, JR., AND ROBERT ERNEST, OF THE NEW YORK BAR.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

NEW YORK.—1. Construction of Connections—Necessity of Consent.

The construction of a connecting curve between two street railway tracks, being a necessary incident to the construction of the tracks themselves, is not within Const. art 3, sec. 18 (amendment of 1875), providing that the construction or operation of a street railroad shall not be authorized except upon the condition that the consents of one-half in value of the property bounded on, and the consent also of the local authorities having control of, that portion of a street or highway upon which it is proposed to construct or operate such railroad, be first obtained.

2. Same—Traffic Contracts.

Const. art. 3, sec. 18 (amendment of 1875), providing that the construction or operation of a street railroad shall not be authorized except upon the condition that the consents of one-half in value of the property bounded on, and the consent also of the local authorities having control of, that portion of a street or highway upon which it is proposed to construct or operate such railroad, be first obtained, does not extend to traffic contracts under railroad law, sec. 78, permitting railroad companies to contract with other companies to operate cars over the former's tracks.—(Kunz vs. Brooklyn Heights R. Co., 54 N. Y. Suppl., 187.)

MASSACHUSETTS.—Construction—Assessment of Damages.

Pub. St. c. 109, sec. 4, as amended by St. 1884, c. 306, allowing an assessment by selectmen for damages to abutting property caused by the construction of lines of "companies for the transmission of intelligence by electricity," and "electric light and electric power lines," does not authorize the selectmen to assess damages for the construction of an electric street railroad.—(McDermott vs. Warren B. & S. St. Ry. Co., 51 N. E. Rep., 972.)

VERMONT.—Municipal Corporations—Control of Streets—Construction of Statutes—Effect of Repeal—Proceedings Before Commissioners.

1. V. S. 1894, c. 170, provides (sec. 3936) that, before a street railway corporation shall begin the construction of such railway in a street in any city, such corporation must first obtain the permission of the aldermen of the city, and (sec. 3937) that, if such corporation fails to agree with the aldermen as to the location, manner of construction, or use of such railway, either party may apply to the railroad commissioners, who, after due notice to the parties, shall examine the premises, hear the parties, and decide the questions presented to them, and whose decision shall be final. By acts 1896, No. 148, sec. 53, subd. 44, it is provided that the city council of Burlington shall have power to impose and enforce the terms on which any street railway or traction company may use or occupy any street in such city, and to prohibit such use thereof until such terms have been complied with; and that, if the company and such city cannot agree on such terms, the company may petition the County Court, which shall thereupon hear the parties, fix such terms as shall be reasonable, and make all necessary orders for carrying its decision into effect. Held, that such later enactment by implication repeals the chapter referred to as to the city of Burlington, in so far as such chapter relates to the subject matter of the powers thus conferred on the city council.

2. An application to the railroad commissioners by a street railway corporation for permission to construct and operate such railway in a certain city was not "pending" at the time of the repeal of the statute under which such proceeding was brought, within the meaning of V. S. secs. 28, 29, saving from the effect of such repeal suits and proceedings in civil causes then pending, where such statute was repealed before notice of such application had been served.

3. The words "suit" and "civil cause," as used in V. S. secs. 28 and 29, relating to the effect of the repeal of a statute on actions then pending, do not include proceedings before a board of railroad commissioners, whose functions are merely administrative or ministerial, and whose decision is final.—(City of Burlington vs. Burlington Traction Co., 41 Atl. Rep., 514.)

* Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

LIABILITY FOR NEGLIGENCE.

INDIANA.—Street Railroads—Negligence Pleading.

1. A street railway company is not liable for failure to stop a car running at a proper speed, on approaching a frightened horse, where it does not appear that thereby the horse could have been controlled, or that the motorman had reason to apprehend the occurrence of an accident.

2. Averments that a street car was run carelessly and negligently, and run at a high rate of speed, making great noise, do not state facts showing negligence.—(Terre Haute Electric Ry. Co. vs. Yant, 51 N. E. Rep., 732.)

NEW YORK.—1. Carriers—Collisions—Questions for Jury.

In an action against a street railway company and the owner of a wagon for negligence, there was evidence that plaintiff sat on the east side of a south-bound car, near the rear. A short distance south of a street intersection, the car met the wagon, coming north on the east track in front of a north-bound car. To get out of the way of the car behind it, the wagon crossed to the west, and collided with the rear of the south-bound car, striking and injuring plaintiff. The gripman of the south-bound car ran it across the intersecting street at full speed, and the wagon driver first started to cross the west track when the car was about 75 ft. away. The wagon was a heavy one, and could not be stopped at once. Held, the issue of negligence was for the jury.

2. Same—Rule of Care Required.

The rule requiring a carrier of passengers to exercise all the care that human skill and foresight may suggest to secure their safety applies to street cars propelled by a cable.—(Keegan vs. Third Ave. R. Co. *et al.*, 54 N. Y. Suppl., 391.)

NEW YORK.—1. Damages—Fright.

Injuries from fright accompanying a physical injury furnish basis for recovery of damages.

2. Credibility of Witness—Interest.

The testimony of employees whose duty it was to inspect electric wires, one of which broke, that they were properly inspected, is that of interested persons; so that their credibility is for the jury.

3. Negligence—Electric Wires.

Plaintiff having been shocked by electricity coming from the ground after it escaped thereto from one of defendant's electric wires after it fell, the jury were justified in holding that the automatic device used by defendant was not properly adjusted, or was not in proper working order; there being evidence that, if it was, it would throw the current off the wire the moment it came in contact with the ground.

4. Opinion Evidence.

The inquiry being, not whether plaintiff's existing conditions might have been produced by the injury, but would her present condition be permanent, a witness, after detailing all the conditions he found present, may give his opinion, without giving a history of the case.—(O'Flaherty vs. Nassau Elec. R. Co., 54 N. Y. Suppl., 96.)

NEW YORK.—Excessive Damages—Personal Injuries.

Three thousand, five hundred dollars' damages for the fracture of the acromion process and of the humerus of a seven-year-old child, where the child suffered, and was likely to continue to suffer, from his injuries, are not excessive.—(Hutchinson vs. Atlantic Ave. R. Co., 53 N. Y. Suppl., 1076.)

NEW YORK.—1. Negligence of Passengers—Standing on Running Board.

A passenger who boards an open street car, where the seats are filled, but where there is standing room in the space between the seats, though uncomfortable and inconvenient, is not guilty of negligence per se in standing on the running board.

2. Same—Sudden Jerks—Negligence of Company.

The seats in an open car were filled, and passengers were standing in the space between the seats. Plaintiff boarded the car, and remained on the running board, where other passengers were standing. The conductor collected his fare without any remarks. It was customary for passengers to stand on such board when the cars were crowded. While going at from 6 to 8 miles an hour, the car gave a sudden violent jerk, occasioned by the sudden application of excessive motor power, which caused plaintiff to break his hold with one hand, swinging his body outward so as to strike a trolley pole. Held, to show negligence making the company liable.—(Hassen vs. Nassau Elec. R. Co., 53 N. Y. Suppl., 1069.)

NEW YORK.—Negligence—Personal Injuries—Damages—Excessive Recovery.

In an action for damages for personal injuries received through negligence on the part of defendant, a verdict for $10,000 was excessive, where plaintiff was not entitled to recover for loss of earnings or for medical attendance, but only damages for the pain and suffering she had endured, and for that which it was reasonably certain she would endure in the future, and where such in-

juries were not permanent, and there was no satisfactory evidence as to how long plaintiff would continue to suffer therefrom.—(Becker vs. Albany Ry. Co., 54 N. Y. Suppl., 395.)

NEW YORK.—Injury to Passenger's Clothes.

A passenger tore her dress in the door latch of a street car, and sued the company. She and her sister testified the catch was a sort of hook, and sharp as a knife, and was worn smooth and bright at the edge. The company's employees testified that it was a new car; that the catch was the same as used on their other cars; and that there was nothing wrong with it, but it was in good order, and they knew of no better appliance for its purpose; also, that each car of the company carried 500 to 600 passengers per day, and no such accident had ever happened before. Held, that she could not recover.—(Atwood vs. Metropolitan St. Ry. Co., 54 N. Y. Suppl., 138.)

NEW YORK.—1. Courts—Constitutional Law—Municipal Court of New York.

Const. art. 6, sec. 18, provides that the Legislature shall not confer on an inferior local court of its creation any greater jurisdiction than is conferred on county courts by the article; section 14 provides that county courts shall have the power possessed at the adoption of the constitution, and original jurisdiction for recovery of money, etc., where defendant resides in the county; Code Civ. Proc., sec. 341, provides that a domestic corporation actually located within a county is deemed a resident of the county; Greater New York Charter, secs. 1358, 1364, divide the boroughs composing the city into districts, and specify the district in which municipal courts shall be held; section 1370, subd. 2, provides that, if defendant be a corporation, action must be brought in a district in which plaintiff resides, or in which defendant transacts business, or has an office or agency; and subdivision 4 provides that, if action is not brought in the proper district, it may be tried where brought, unless transferred on motion of defendant. Held, the jurisdiction of a municipal court over a defendant corporation being expressly limited to a corporation resident in a borough, which, under the charter (section 2), consists of the whole or part of the county, that the provisions of the charter are not in excess of legislative authority, as extending the dominion of the municipal court over more than one county.—(Irwin vs. Metropolitan St. Ry. Co., 54 N. Y. Suppl., 195.)

NEW YORK.—Defects in Tracks—Injury to Traveler.

An injury to plaintiff was caused by a loose street railway rail. The track had been inspected that morning, and ten minutes before the accident a car had passed safely over the rail, and the imperfection was not observable; and, shortly after it, it was discovered and repaired. Traffic on the street was heavy at that hour. There was no showing that the road was improperly laid, or built of poor material, nor that the defect was caused by the company's acts, nor that its method of track inspection was not proper, nor of any previous defect causing the company to apprehend danger from loose rails or spikes. Held, that the company was not shown to be negligent.—(Kelly vs. Metropolitan St. Ry. Co., 54 N. Y. Suppl., 173.)

INDIANA.—Special Verdict—Evidence.

The jury may not return the primary facts on evenly balanced evidence, where the burden of establishing the ultimate fact rests on the party in whose favor the primary facts are returned.—(Citizens' St. R. Co. vs. Reed, 51 N. E. Rep., 477.)

ILLINOIS.—Collision—Damages—Trial—Directing Verdict—Questions for Jury—Appeal and Error—Waiver of Error.

1. Where, at the close of plaintiff's evidence, defendant moves to take the case from the jury and direct a verdict for defendant, and the motion is renewed at the close of all the evidence, a written instruction directing the verdict must be presented with the motion.

2. A failure of defendant to present an instruction directing a verdict with his motion to direct is not supplied by his presenting such instruction with his series of general instructions.

3. Where defendant did not present a written instruction directing a verdict with his motion to direct, the error in refusing to direct was waived by his presenting such instruction with his series of general instructions.

4. It was not error to instruct that if plaintiff's intestate was injured by collision with a street car while exercising due care, and defendant omitted to do certain things, plaintiff could recover, as plaintiff was entitled to have the jury instructed on his theory of the case.

5. In determining the damages resulting from personal injuries to plaintiff's intestate, the jury should consider the nature of the injuries, his physical and mental suffering, and his loss of time.

6. Plaintiff's intestate, two years after receiving personal injuries, died of abscesses which formed on the liver, the cause of which was unknown. In an action for the injuries, held, that the question of the cause of his death was properly withheld from the jury.—(West Chicago St. R. Co. vs. Foster, 51 N. E. Rep., 690.)

MINNESOTA.—Injury to Pedestrian—Contributory Negligence.

Held, that the evidence conclusively shows that plaintiff, in attempting to cross two parallel street railway tracks (at a point not a street crossing), immediately behind a moving car on the track next to him, was guilty of negligence in not exercising reasonable care to ascertain whether a car was approaching from the opposite direction on the other track.—(Greengard vs. St. Paul City Ry. Co., 75 N.W. Rep., 221.)

MINNESOTA.—Contributory Negligence—Personal Injuries—Actions—Evidence—Questions of Fact—Excessive Damages.

1. A boy eight years and four months old got upon the rear platform of a street car, intending to ride thereon to his home, several blocks distant. While sitting upon this platform with his feet upon the car step, where there was no gate, the car started, and while it was running fast the boy became dizzy, fell off, and was injured. The motorman (who was also conductor) knew that the boy was on the car. Held, that merely getting upon the car and sitting down on the platform with his feet on the step was not prima facie evidence that the boy was a trespasser, and whether he was a passenger or trespasser it was not error for the trial court to submit to the jury the question whether it was negligence on the part of the acting conductor to permit him to ride, sitting in that position, while the car was running fast.

2. It was within the province of the acting conductor to compel this boy to go inside the car, or stop it, and put him off; and, if he did not do so, the jury had a right to say that the conductor was guilty of negligence, which was imputable to the company.

3. Held, also, that the rear platform of a street car running fast was a place of danger for this boy, riding thereon, and just what degree of intelligence and prudence could be expected of him was properly left to the jury to determine, as well as whether, upon all of the facts, he was thereby guilty of contributory negligence.

4. Held, further, that the damages awarded were not excessive.—(Jackson vs. St. Paul City Ry. Co., 76 N.W. Rep., 956.)

MINNESOTA.—Master's Liability to Employee.

The plaintiff was engaged in replacing defective wooden poles with iron poles, and placed a ladder, which he climbed, against one of the wooden poles, when the pole, by reason of its rotten condition, broke off at the ground, and he was injured. Held, that the rule that a servant cannot recover damages for an injury caused by the defect which he was employed to repair applied, and plaintiff could not recover.—(Broderick vs. St. Paul City Ry. Co., 77 N.W. Rep., 28.)

MASSACHUSETTS.—Crossings — Collision — Sufficiency of Evidence.

Evidence that defendant's car was going slowly; that plaintiff was nearly across defendant's track at the time of the collision; that plaintiff's view of the track in the direction of the approaching car was obstructed until he was within 15 ft. of the track; that plaintiff looked, but saw nothing, and heard no gong; that he had been going "a little faster than a walk," but "slowed up" before reaching the track, and that upon reaching the track he hurried his horse, is sufficient to warrant submitting to the jury the question of plaintiff's due care.—(Lahti vs. Fitchburg & L. St. Ry. Co., 51 N. E. Rep., 524.)

NEW YORK.—Injury to Child—Contributory Negligence.

A child between eight and nine years of age, who attempts to cross a city street in the middle of a block, either without looking for an approaching street car, or in blind and heedless disregard of its rapid approach, is guilty of contributory negligence.—(Weiss vs. Metropolitan St. Ry. Co., 53 N. Y. Suppl., 449.)

NEW YORK.—Injury to Passenger—Negligence—Question for Jury.

In an action to recover damages for personal injuries suffered by plaintiff in consequence of the defendant's alleged negligence, it appeared that while the plaintiff was riding as a passenger in an open trolley car of the defendant, in the evening a flashing or flaming shot out of the motor box or controller, from 2 to 6 ft. high, enveloping the motorman, and continuing while the car proceeded for some 100 ft. The plaintiff was so much alarmed that she leaped from the car, and received the injuries complained of. There was evidence on behalf of the defendant that the apparatus was a standard appliance, but the flaming on this occasion was of a very unusual character; and it appeared that dirt in the controller was likely to cause such results, that the car in question had not been inspected that day, and that after the accident the controller was found to be dirty. Held, that the facts required the submission to the jury of the question of defendant's negligence.—2. Same—Contributory Negligence.

Held, further, that the fact that other passengers remained in the car could not operate to conclusively establish contributory negligence on plaintiff's part in jumping.—(Poulsen vs. Nassau Electric R. Co., 51 N. Y. Suppl., 933.)

The Paris Exposition of 1900

BY FRANCIS E DRAKE,
Director of Machinery and Electricity, United States Commission.

Though occupying only about one-half the area of the World's Columbian Exposition at Chicago, the Paris Exposition of 1900 will have great opportunity for the satisfactory presentation of the arts of peace. The location of the grounds is practically in the heart of Paris on both sides of the river Seine, and affords an unrivaled opportunity for providing comfortably for great crowds.

The great main gate of the exposition will be at the historic Place de la Concorde, and will be capable of admitting 65,000 people an hour. Scores of other entrances will be provided, so that each section of the city may be amply accommodated.

On the south side of the river Seine the majority of the principal palaces and attractions will be installed. The Esplanade des Invalides, a rectangular tract lying immediately north of the Hotel des Invalides, will contain palaces devoted to the exhibition of general manufactures. This tract will be connected with the grounds on the north side of the river and the Champs Elysees by the magnificent new bridge of Alexander III., now under construction. From the Esplanades des Invalides to the Champs de Mars, along the left bank of the river, will be a row of official pavilions of the great nations, among which will be the building of the United States. Between the bridge of the Invalides and the Champs de Mars will be grouped the buildings devoted to the exhibits of the army and navy, and between the Champs de Mars and the river will be a building devoted to marine navigation and another containing the exhibits pertaining to forestry and fisheries.

On the famed Champ de Mars will be found the several great palaces of the Exposition, in which will be housed practically three-fourths of the exhibits. They will be built around three sides of the rectangle and will be named as follows: Palace of Agriculture, Palace of Electricity, Palace of Machinery, Palace of Transportation and Civil Engineering, Palace of Textiles and Textile Fabrics, Palace of Mines and Metallurgy, Palace of Chemical Industries and Palace of Education and Liberal Arts.

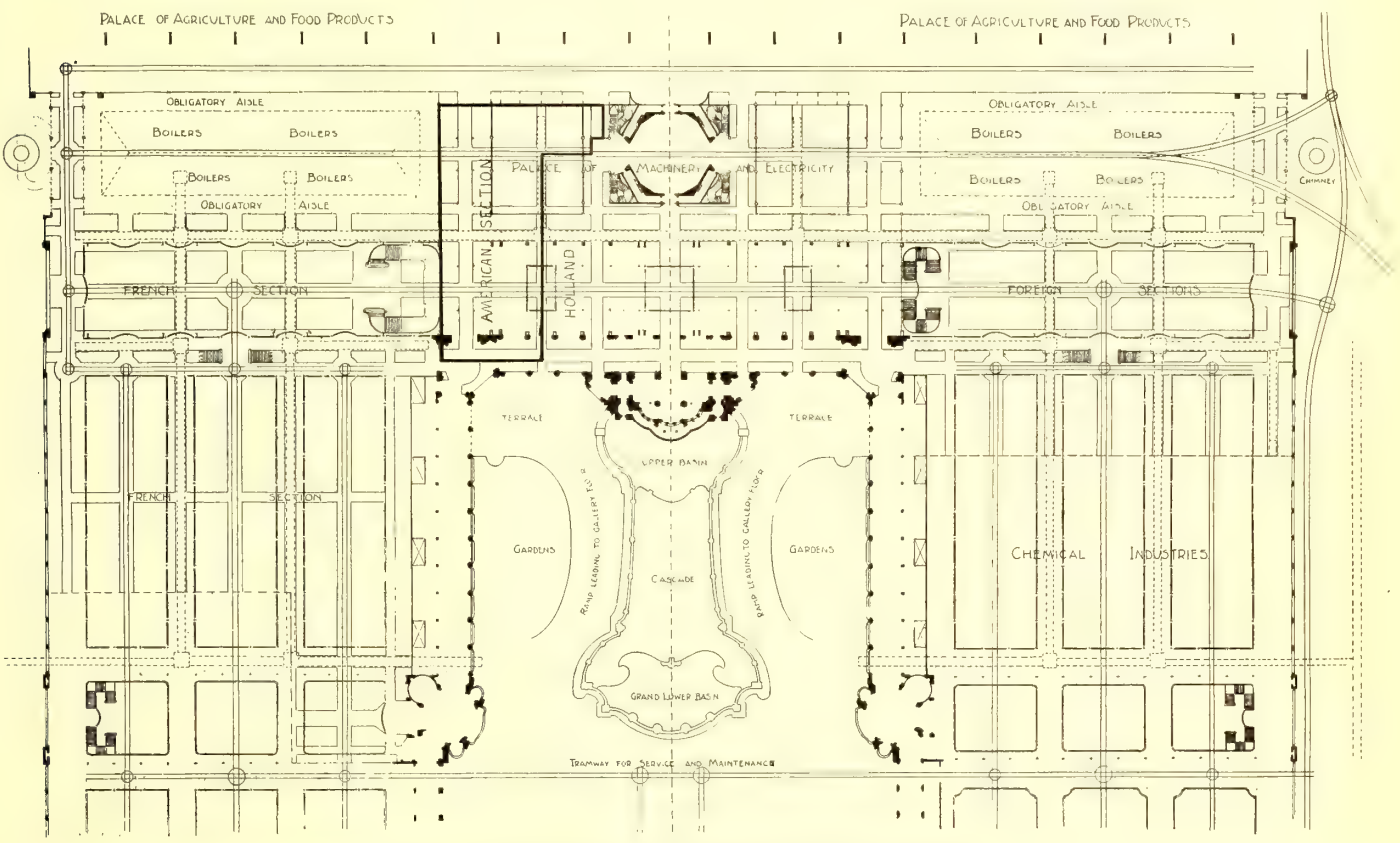
The great Eiffel tower, which was such a conspicuous attraction at the Paris Exposition of 1889, will remain at the north end of the Champs de Mars, and no doubt will excite the same general interest among the visitors to this great fair.

On the north or right side of the river will be found, beginning at the Place de la Concorde, in the order named, the two permanent art palaces, a section of Old Paris, Palace of Horticulture and Arboriculture, the Hall of Social Economy and International Congresses, and the Palace of the Trocadero and Trocadero gardens, where the exhibits of the colonies will be located.

At the park of Vincennes, 8 miles distant, will be located an annex to the exposition proper, where the railway exhibits will be placed, also the automobile, bicycle and similar displays. At this annex provision will be made for international athletic sports, and, owing to the attractive character of the park, thousands of people are expected to visit this annex daily. Ample means of transportation from the exposition grounds will be provided both by rail and boat.

MACHINERY AND ELECTRICITY

The part which machinery and electricity will play in the coming exposition is a more important one than ever assumed by these two great industries in former expositions. In a general way it may be said that but few important changes or improvements will be shown in the service of the Paris Exposition over the Columbian Exposition of 1893. The French classification, however, is a distinct advance over that of any previous exposition, inasmuch as it provides for the installation of the finished product together with the machinery and processes used in connection therewith. Under this classification collective exhibits will be most successful



PLAN OF ELECTRICAL BUILDING—PARIS EXPOSITION

in presenting to the visitors a clear understanding of the state of the art in that particular industry.

GENERAL SERVICE PLANT

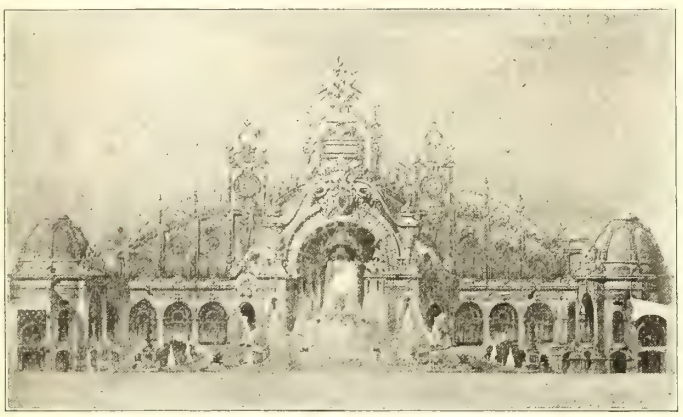
The great service power plant of the exposition will occupy a favorable position in the main group of buildings. It will be installed immediately adjoining the space allotted for the exhibits of electrical and other machinery, and any benefit which might naturally accrue to the builder of machinery installed in the service plant will be accentuated by reason of its being located in close proximity to the exhibits not offered for regular service. The capacity of the boiler plants for the service of the exposition will be approximately 20,000 h.p. The two plants will feed into one general system of mains and distributors, and either, or both, may be utilized at the same time, as occasion requires.

The engines and generators for this power plant will be placed in close proximity to the underground subways carrying the steam and other mains. Each power unit must be of the direct-connected type, the generator armature being mounted directly upon the extended shaft of the engine. The designation of these units, according to the exposition nomenclature, will be "electrogene groups." It is proposed by the administration to divide the total power comprised in the several electrogene groups required

equally among the French and foreign builders. From present indications, manufacturers will offer electrogene groups largely in excess of the requirements of the exposition. No actual contracts have as yet been made for them for either the French or foreign sections, except a nominal arrangement entered into some time ago with three German manufacturers, who desire to furnish equipment approximating 5000 h.p.

TRANSPORTATION DIVISION

The exhibit of automobiles or horseless carriages, trolley cars, railway trains, etc., will be made in the special pavilions provided at the annex in the park at Vincennes. A special track will be provided there for trials and tests, and for the daily speeding of auto-



FACADE OF ELECTRICAL BUILDING

mobiles, bicycles, tricycles, etc. The electric vehicle is at present very popular in Paris, and will no doubt come in for its full share of interest.

HISTORICAL EXHIBITS

In addition to the contemporary exposition, the official classification provides for the installation of a retrospective exhibit, which shall present an historical view of the progress in all branches of industry during this century. The department of electricity has been specially favored in this regard by the construction of a special salon d'honneur within the Palace of Electricity, where the retrospective exhibit covering the great field of electricity may be properly undertaken, and where the personal exhibits of the great inventors of the century and the collective exhibits of associations or individuals may, in their several ways, illustrate the evolution and advance of science.

ORGANIZATION AND CLASSIFICATION

For the information of those interested in the organization of the technical service under the director-general of exploitation it is desirable to state that the mechanical installations will be under the immediate direction of Monsieur Ch. Bourdon, professor of the Central School of Arts and Manufactures. The work of this department falls under two distinct categories. The first relates to the execution of the necessary installations for motive power, and may be subdivided as follows:

be subdivided as follows:

(a) Production of steam.
First—Installation of boilers.
Second—Construction of flues and chimneys.
(b) Distribution of water and steam.
First—Construction of Subways.
Second—Installation of steam mains, etc.
(c) Production of power.
Installation of electrogene groups.

The distribution of motive power is practically assigned to the service of electric installations.

The work under the second category is of an administrative order, and especially concerns the general conditions of exploitation of the boilers and electrogene groups and such other apparatus as is required for furnishing the steam for power service.

The total mechanical power furnished will be in the neighborhood of 20,000 h.p., of which 15,000 h.p. will be for electric lighting and 5000 h.p. for motor service. These figures, while not absolutely correct, are those used by the administration as the basis of the installation.

In the two power plants the boilers will be placed in two lines of batteries, with the boilers back to back. Ample space for general circulation of the public has been provided.

The location of the electrogene groups operating as generating units for the power plant will be within the regular exhibit space devoted to the department of machinery and electricity. Electricity will furnish the motive power for the operation of an intramural elevated railway, which will encircle the Champs de Mars, pass in front of the main palace on the Esplanade des Invalides, and along the Quay d'Orsay from the bridge of Alexander III. to the Eiffel tower.

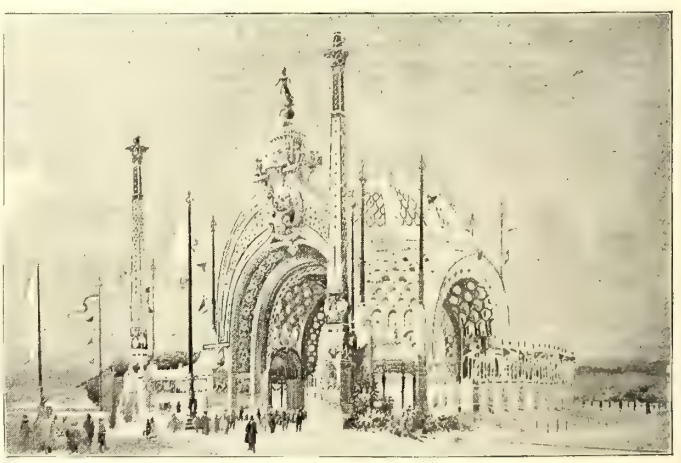
There will be no regular compressed-air service established by the exposition administration, but arrangements will be made with the City Public Service Company whereby compressed air mains will be brought into the exposition buildings and air service offered to the exhibitors at the regular city rates, less 10 per cent.

SERVICE POWER PLANT

The controlling minds of this great undertaking have not lost sight of the artistic side of questions surrounding the service power plant, and in the construction of the chimneys for the two boiler plants ample provision has been made for the æsthetic treatment of the exterior of the towering stacks which will conduct the gases from the furnaces.

Two monumental chimneys have been designed, each to be handsomely ornamented. The height of each will be 230 ft. above the level of the Champs de Mars, the inside diameter at the base 28 ft., and at the summit 23 ft. These chimneys are to be illuminated at night, and will thus trace a striking outline upon the dark background of the sky.

In appropriating funds for the power plant the administration has, upon the advice of the technical committee, provided a minimum sum, which may be said to be only about one-third of the allowance made for the use of power units at the Columbian Exposition of 1893. The great commercial rivalry between the principal nations of Europe has been a factor in determining the course of the administration. Many large concerns would have granted the use of engines and dynamos during the period of the exposition without charge, providing advantageous arrangement of space, etc., could have been assured them. It was after mature de-



PRINCIPAL GATE TO PARIS EXPOSITION

liberation, however, that the authorities settled upon a very normal compensation, which should apply alike to French and foreign manufacturers.

The details and conditions surrounding the tenders of electrogene groups are recited in the official specifications appended:

GENERAL CONDITIONS OF INSTALLATION AND EXPLOITATION OF ENGINE DYNAMO GROUPS

Art. I. General Requirements.—The electrical energy required for the Paris Exposition of 1900 will be produced by engine-dynamo groups, the steam engine of which will operate condensing; the generator armature to be mounted direct on the engine shaft, thus excluding all cables and belts.

The administration will contract either with one builder only for the combined group, or simply with the builder of the steam engine and with the builder of the generator.

Art. II. Technical Requirements.—The steam in the main pipes will have a mean effective pressure of 142 lbs. per square inch; this pressure may vary 10 per cent either above or below normal.

The electric current generated will be delivered to a switchboard furnished by the contractor. The following voltages will be permitted:

Continuous current.....125, 250 or 500 volts.
Alternating current.....2,200 volts with a frequency of 50.
Three-phase current.....2,200 volts with a frequency of 50.

Art. III. Special Requirements.—As the apparatus installed under these articles will also be considered as exhibits, the conditions of the general regulations of the exposition will apply to these groups.

The apparatus will be submitted to the examination of the international jury and admitted to compete for awards. In consequence of this particular stipulation the furnishing of these apparatus will be made under the same conditions as govern other exhibited apparatus, that is, nothing will be granted to the exhibitor as allowance for expenses except for the installation and exploitation of the apparatus, which remuneration is specified in Art. IX., below.

Art. IV. Conditions of Installation.—The installation of the apparatus will be made according to plans established by the builder and accepted by the director general of exploitation on a favorable report of the technical committee and annexed to each copy of the contract. The builders will conform to the regulations enjoined by the administration concerning public safety.

Foundations.—The administration will furnish the necessary floor space to the exhibitors, who will provide all foundations and accessory works at their own expense.

The materials employed for the construction of the foundations will remain, after the exposition is over, the property of the builders, who may remove or abandon them as they may elect.

Piping.—The steam engine builder will establish at his expense special piping to his engine from the main steam pipe provided by the administration. A throttle valve will be supplied by the engine builder at the junction of his piping with the exposition mains. The engine builder will also furnish and erect the feed-water pipes and evacuation pipes for the hot water of condensation, as well as all necessary valves, traps, etc., to be placed at the junction with the main piping. The pipes conveying live steam and cold water as well as for the outlet of the hot water from condensation will be placed in underground conduits connecting the engines to the underground galleries in which are installed the main distributing pipes. These main galleries and pipes will be established by the administration, and the private piping will be installed by the exhibitors at their expense. Special regulations will fix the details to be observed concerning valves and joints.

Switchboards.—Each generator will be provided with a switchboard having the necessary means of interruption and protection such as are usually employed, also current-measuring apparatus to be approved by the administration. The administration also reserves the right to require the use of current-registering apparatus.

For the alternating-current generators the contractors will be obliged to furnish and install the necessary transformers for the distributing stations, so that the current of these alternators may be rendered available.

ART. V. DURATION OF SERVICE.—The duration of service is that of the exposition itself, that is, from April 15 to Nov. 15, 1900, 205 days. The administration reserves the right to vary this period not exceeding thirty days, in which case no modification concerning the remuneration allowed will be made.

ART. VI. DAILY SERVICE.—The duration of each day's service and the duration of working hours will be determined by the director-general of the exposition according to service requirements. The builders agree to furnish at any time the maximum amount of power they have undertaken to supply.

The director-general of the exposition will establish between the several builders an equalization of work so as to permit proper working and resting periods for facilitating the visiting, cleaning and repairing of apparatus without causing any inconvenience to, or disruption of, the regular service.

ART. VII. MEASUREMENT OF ENERGY.—The administration, with the assistance of the contractor's employees and at his expense, will make such experiments and tests as are necessary to ascertain if the engines and generators are capable of furnishing the power stipulated in the private contracts. An official report will be made concerning these tests. At any time during the exposition period these tests may be renewed to verify the previous reports.

ART. VIII. FINANCIAL CONDITIONS.—The live steam required by the engines and water for condensing will be furnished by the administration free of charge. The builders will receive: (1) A fixed sum to remunerate them for a portion of the prime installation expense; (2) a sum proportionate to the number of hours of work at the normal rating of the group as accepted by the administration. These sums will be fixed according to the power of the units as determined in the private contracts and in accordance with the following tables (the amount to be contributed by the administration toward the first cost of installation is presented in Tables No. 1 and No. 2):

TABLE NO. 1.

Total allowance:	Engine.	Dynamo.	Together.
Total maximum contribution	$46,330	$19,300	$65,630
Amount allotted to the French section (Plant La Bourdonnais)	23,165	9,650	32,815
Amount Allotted to foreign section (Plant Suffern)	23,165	9,650	32,815

TABLE NO. 2.

Allowance per indicated horse power:	Amount allowed per horse power. Engine.	Dynamo.	Together.
For the first 1000 h.p.	$1.92	$ .78	$2.70
For 1000 to 1500 h.p.	1.37	.24	1.61
For all above 1500 h.p.	1.00	.18	1.18

In the event of the maximum horse power accepted by the administration from foreign builders being such as to make the total remuneration based on Table No. 2 greater than the total sum for this service as established in Table No. 1, a proportionate reduction will be made on the horse power allowance for each builder which shall be commensurate with the increase in total horse power over the limit established by the appropriation.

The capacity of the groups admitted for service will be so proportioned that this reduction will not exceed 50 per cent.

TABLE NO. 3.

((Sums representing the administration's contribution toward the expense of exploiting and operating the electric groups).

Allowance per i.h.p. per hour.	Per Horse Power. Engine.	Dynamo.	Together.
For the first 1000 h.p.	Cents 0.162	0.138	0.300
From 1000 to 1500 h.p.	Cents 0.067	0.057	0.124
Above 1500 h.p.	Cents 0.056	0.046	0.102

The administration guarantees to the builders a minimum duration of work fixed at 500 hours.

ART. IX. TERMS OF PAYMENT.—The remuneration above stipulated will be paid to contractors as follows: On July 10, 1900, payment of the number of working hours furnished from the beginning of the exposition up to and including June 15; on Sept. 10 for the number of working hours furnished from June 15 to Aug. 15; one month after the close of the exposition the balance covering the number of working hours furnished after Aug. 15. That portion of the remuneration allowed toward first cost of installation will be paid in thirds on the same dates.

ART. X. DATE OF DELIVERY.—The contractors agree to begin the foundations for the engines and dynamos not later than October 15, 1890. If at that time they have not taken possession of the space granted to them and are unable to show satisfactory progress in the construction of the apparatus and in arrangements for prompt delivery, thus assuring the administration of the fulfilment of their obligations, the right to cancel without indemnity the contract between the administration and the contractor is reserved to the exposition officials.

The contractors must complete the installation of their groups on or before March 15, 1900; on this date will begin the trials mentioned in Art. VII.

ART. XI. PENALTIES EXACTED FOR DELAYS.—In event of delay beyond the time fixed in Art. X. for the installation of the units, the administration will exact the following penalties and will deduct them from any sums which may ultimately be due to contractors from the exposition. (1) A penalty equal to the allowance corresponding, for the apparatus referred to, to the normal service of the group during a working day of seven hours; (2) a penalty on the allowance made for installation expenses, which will be calculated by multiplying the amount of this remuneration by a coefficient of reduction equal to the ratio of the number of days delayed to the total duration of the exposition.

ART. XII. CANCELLATION OF CONTRACT FOR EXCESSIVE DELAYS.—If the apparatus is not in condition to furnish a regular service beginning with May 15, 1900, the administration reserves to itself the right to cancel the contract made by the builder without indemnity being due to either party, and without remuneration for installation expenses to be paid by the administration.

ART. XIII. PENALTY IN EVENT OF INTERRUPTION OF SERVICE.—In case of interruption to the regular service, aside from the resting hours fixed by the director-general of exploitation, the contractor will have imposed by the administration for each day of said interruption a penalty equal to the allowance corresponding, for the apparatus referred to, to the normal service of a day of seven working hours.

If this interruption exceeds a period of ten days, a second penalty will be exacted and deducted from the remuneration provided by the administration toward the installation expenses, which penalty will be calculated by multiplying the amount of such remuneration by a coefficient equal to the ratio of number of days of delay to the total duration of exposition.

ART. XIV. EMPLOYEES.—The director-general of the exposition will retain the right to require the discharge of any agents or employees in the service of contractors for insubordination, incapacity, intemperance or want of probity.

ART. XV. MEDICAL SERVICE.—The builders, being considered as exhibitors, as stipulated in Art. III., will not be classed as contractors for the masonry work required; therefore, the amount of their contracts will not be submitted to the customary deduction of 1 per cent for medical service required in Art. XVI. of general conditions.

On the other hand the employees of the builders, in case of injury or accident, will receive only the "first help to the injured," the regulations of Art. III. and IV. of the "Arrêé Ministériel" not applying to them.

ART. XVI. GENERAL REGULATIONS.—The contractors agree to conform to all the regulations promulgated by the director-general of the exposition. They will be held responsible for accidents caused by their apparatus or employees.

Disagreements between the administration and contractors must be, previous to any definite action, examined by three competent members of the technical committee. One of these members will be chosen by the commissioner-general of the exposition, the second by the contractor, and the third will be chosen by the two first-named members.

The contractors agree to withhold any procedure or action at law until after having submitted the disagreement to the council of arbitration as above provided for.

In the main the general conditions of installation and exploitation of steam boilers are similar to those governing the engine-dynamo plant, but there are some special features which are presented in the following abstract:

SPECIAL CONDITIONS OF BOILER INSTALLATION

ART. I. GENERAL REQUIREMENTS.—The steam required for the production of motive power for the Universal Exposition of 1900 will be produced by two distinct plants; one, called "Usine La Bourdonnais," being reserved for French builders, will be placed in the court of 117 by 40 meters situated between the Palace of Electricity, Palace of Agriculture, Palace of Machinery and the passage along the Avenue de la Bourdonnais; the second, reserved for foreign builders, will be placed in a court situated next to the Avenue Suffren and called "Usine Suffren."

These boiler plants will be formed by groups of boilers, each group being able to produce under normal conditions a minimum of 22,000 pounds and a maximum of 44,000 pounds of steam per hour.

The administration of the exposition will not contract for more than one group with the same builder.

ART. II. SPECIAL REQUIREMENTS.—Same as Art. III., engine-dynamo groups.)

ART. III. CONDITIONS OF INSTALLATIONS.—(Same as Art. IV., engine-dynamo groups, with the following additions:)

Chimney Flues.—The main flues for smoke from both boiler plants will be established at the expense of the administration. Junction pieces will be prepared to receive the ends of the flues from the different groups of boilers. The private flues connecting the boilers to the main flues will be made by the contractors at their expense after the approval of the plans by the director-general of exploitation.

Smoke Stacks.—A large smoke stack will be established by the administration for each boiler house.

Steam Pipes.—The administration will furnish the main piping connecting the boiler houses with the engine rooms and the different parts of the exposition where steam is required, but each builder must furnish at his expense the connection from his boilers to said main pipes.

Feed Water.—The administration will furnish main feed-water pipes through which will be conducted the water required for the boilers, but contractors must connect their feed tanks or pumps to these mains.

Sewerage. General Sewer pipes will be established by the administration. The contractors will be required to make at their expense the connections to the sewers from the boilers, blow-offs, drains, etc.

Condensers.—To avoid the escape into the atmosphere of the steam used in the different auxiliary apparatus, the administration will erect independent condensers into which this steam will be evacuated.

Main overflow pipes for these condensers will also be established by the administration, but the contractors must connect their apparatus thereto at their own expense. They must also establish a security escape into the open air.

ART. IV.—TECHNICAL CONDITIONS.—The steam apparatus must comply with the conditions of French laws and the regulations concerning public security unless exceptions have been granted by the Minister of Public Works, that is, apparatus built according to legal requirements and subjected to official security tests established by law in the originating country may be accepted upon the proper recognition of such requirements and tests being in consonance with French law. The administration, on the advice of the technical committee, reserves the right to require such other safeguards or safety appliances as it may deem necessary for apparatus working near the public aisles and passageways.

The boilers and their accessories must be established and the conditions of regulation carefully observed for a normal working pressure of 156 lbs. per square inch.

Plans of Installation.—General and detailed drawings must also be submitted to the technical committee, this committee prescribing the conditions to which the builders must conform in the installation they undertake.

The committee may particularly require satisfactory arrangement concerning the installation of the boilers from the chimney flues, water pipes, steam pipes, etc. All feed pipes, etc., must be installed and maintained in perfect condition.

The furnaces shall be constructed so as to avoid the production of opaque smoke, the fuel adopted by the builder being carefully selected with this end in view.

ART. V. MEASURING AND CONTROLLING APPARATUS.—The builders agree to mount on their boilers such indicators, gages or verification apparatus as the director-general of exploitation may deem necessary, and to have such experiments made as the technical committee or jury of awards may demand.

The builders will furnish, mount and keep in repair at their own expense during all the time of the exposition a suitable water meter of one of the patterns accepted by the administration, to be installed on the pipe supplying the feed water to their boilers, readings of the meter to be taken every day by the inspector of mechanical service, who shall keep the key to such water gage; two seals will be placed by said inspector on the feed and outlet pipes of the meter.

The builders agree not to blow off the boilers except in the presence of said inspector, and will make sure that the evacuation and overflow cocks are closed in due time, so as not to show erroneous results concerning the evaporization.

A special steam outlet will be located between the boiler and the main throttle valve, according to the conditions to be prescribed by the director-general of exploitation, which shall permit the measurements of the water carried away by steam.

Arrangements will also be made for the reading of the temperature of the gases escaping from the furnaces and for analyzing them.

ART. VI. DURATION OF SERVICE.—(Same as Art. V., engine-dynamo groups.)

ART. VII. DATE OF DELIVERY.—(Same as Art. X., engine-dynamo groups.)

ART. VIII. DAILY SERVICE.—(Same as Art. VI., engine-dynamo groups.)

ART. IX. FINANCIAL CONDITIONS.—The feed water will be furnished free of charge, according to the conditions of Art. III. As explained in that article, the chimney flues as well as the general steam feed, sewerage and overflow

pipes will be furnished by the contractors at their expense, as well as dampers, cocks, gutters, and in a general way, all other accessories required.

The administration will furnish the boiler house. The fuel, necessary employees and all other expenses concerning the installation as well as for the exploitation and trials will be at the expense of the builders. The exploitation will therefore entirely be at the expense of the builders, particularly that which concerns fuel, employees, etc., and these expenses will be settled directly by them without any interference by or responsibility resting on the administration, which will in no case assume any expenses incurred inside of the grounds of the exposition by the builders engaged to furnish the steam.

Within the grounds no fuel, ashes, etc., shall be allowed to be stored, except in sacks.

The remuneration allowed to builders includes: (1) A fixed sum representing the administration's contribution toward the expense of installation of boilers and their accessories. This sum is fixed at $289.50 per 2200 pounds of productive capacity of steam per hour, as contracted for by the administration and appearing on the private contract of each builder. This productive capacity will be determined by the technical committee and will, in any case, not exceed 122 pounds per square ft. of grate surface.

(2) A sum representing the administration's contribution to the expense of exploitation, which sum is fixed at 85 cents per 2200 pounds of steam effectively produced from the opening to the close of the exposition and during the working hours fixed by the director-general of exploitation.

Art. X. Terms of Payment.—(Same as Art. IX., engine-dynamo groups.)

Art. XI. Penalties Exacted for Delays.—(Same as Art. XI., engine-dynamo groups.)

Art. XII. Cancellation of Contracts for Excessive Delays.—(Same as Art. XII., engine-dynamo groups.)

Art. XIII. Penalty in Event of Interruption to Service.—(Same as Art. XIII., engine-dynamo groups.)

Art. XIV. Accounts.—The administration reserves the right to take for the regulation of the accounts any steps necessary, or to make tests and trials so as to be informed as exactly as possible concerning the power produced by the boilers and accessories.

Art. XV. Regulations.—(Covered in Art. XVI., engine-dynamo groups.)

Art. XVI. Employees.—(Same as Art. XIV., engine-dynamo groups.)

Art. XVII. Responsibility.—(Covered in Art. XVI., engine-dynamo groups.)

Art. XVIII. Medical Service.—Same as Art. XV., engine-dynamo groups.)

Art. XIX. Disagreement.—(Covered in Art. XVI., engine-dynamo groups.)

INCLINED ELECTRIC ELEVATORS

A new feature of the exposition service is the "escalader," an inclined elevating way, constructed in the form of an endless carpet or belt, propelled by a drum at one end. No former exposition has made such generous provisions for means of carrying the public to the galleries, and as the typical "escalader" has been so recently brought into public use, nearly everyone in the commercial world will be anxious to see the results obtained with it. The extent to which the elevating stairway may be successfully used can scarcely be estimated at this time. They are said to be safe, easily installed, simple to operate, and their capacity is far in excess of vertical elevators so far as transportation from floor to floor of large crowds is concerned. Such devices have long been sought for large stores, elevated railway stations, etc. Privilege has been granted the commissioner-general for the United States to install a working exhibit of one or more of these "inclines" in or near some United States section.

The terms under which the inclined electric elevators are to be installed are essentially the same as those of other exhibits that find a place in the service plant of the exposition. There are special conditions, of course, and details of construction that may prove interesting to those considering this class of apparatus. The competition will be divided into two lots, one comprising thirteen elevators in the palaces fronting on Avenue Suffern, and the other fourteen in the palaces fronting on the Avenue de la Bourdonnais and Constantine.

The following abstracts from the official specifications cover the principal points of interest:

The inclined elevators, their electric motors, means of transmission and other accessories, will be established in conformity with the general regulations to the general design accompanying these articles.

The beams supporting the inclined elevators will be supported on the upper floor by one or two pillars resting on a solid mass of masonry level with the ground floor. They may also be supported at some point of their lines by one or two additional pillars, in line with the pillars of the palace proper.

The bay to be cut through the upper floor will be established by the administration at its expense. The contractors shall provide for a platform of a particular type acceptable to the aministration. The bay will be 6 ft. 6¾ in. in width and 32 ft. 9¾ in. long.

The apparatus will be constructed for one file of passengers, and the proportions will be as follows:

Width of carpet or elevating surface.....23⅝ in.
Distance between railings.....35 7-16 in.
Grade of incline per foot (approximately)..... 4 in.
Capacity of the elevators in passengers.....20 passengers
(Normally one person per yard.)
Capacity of elevator in passengers.....40 passengers
(At maximum of two persons per yard.)
Distance between the surface of ground floor and the surface of the gallery floor.....23 ft.

The apparatus will be installed for a minimum speed per second of 19 11-16 in. and a maximum speed per second of 23⅝ in.

The conveyor, properly speaking, will consist of an endless belt or platform constructed of pliable and yet resisting material, which will roll continuously and uniformly, and must possess both softness and necessary rigidity for the service to be performed.

When in operation the rolling surface must so move over the supports or rollers as to cause no perceptible or disagreeable effect beneath the feet of the passengers.

The devices for stretching this moving surface, or scheme for "taking up the slack," must allow for all the elongation which may be produced during the entire period of the exposition, so that it will not be necessary to dismantle any portion of the elevator during such time.

The entire inclined elevator must work absolutely without noise. All mechanical apparatus connected with the elevator which may need oiling or greasing must be so arranged as to avoid all possibility of contact with passengers or their garments.

The electric motor and the apparatus for driving the elevator must be placed as near as possible to the elevators.

All parts must be accessible, either from the ground floor or the platform on the gallery floor, for the maintenance in operation.

Proper arrangements must be made so that, in event of damage or accidents to the motor or mechanism, the rolling surface loaded with passengers cannot receive a descending movement.

The side rails will be also formed by endless cables, so constructed that they will present under the hands of the passengers a soft and clean support.

The upper part of this endless cable or moving side rail at the height of the hand will only be seen; the lower part will be inclosed by framework which will have a perfectly plain and smooth surface offering no possibility of accident to the garments of the passengers. These moving side rails must have precisely the same speed as the elevating surface proper.

The tests of capacity of the elevators will be made under a load of 7780 lbs., representing the weight of fifty passengers, uniformly spread over the lines of the elevator. This load will be retained as long as deemed necessary by the administration.

As it is impracticable to make the tests of capacity under a load equal to fifty passengers, which should be renewed in a continuous fashion, the device for stretching the endless belt or moving elevator will be arranged in such a manner as to give to it a tension corresponding to that which it would receive under the weight of fifty passengers or the equivalent of 7780 pounds.

Under this tension the maximum speed must be maintained continuously as may be required by the administration.

The electric current necessary for the electric motors will be supplied by the exposition without expense to the contractor.

The remuneration of the contractor will consist of a fee to be exacted of each passenger using the elevators; this fee shall be ten centimes per passenger.

A percentage of each fee for the right of the concession will be allowed the exposition, and the amount of such percentage is to be indicated in the proposition of the bidders; the liberality of this percentage will largely influence the choice of the successful contractors selected by the exposition.

The contractor will be authorized to collect from the public direct the fee of ten centimes for each passenger.

ELECTRICAL FEATURES

Among the special features of interest to electrical men will be the illumination of the grand entrance, and the big wheel. The latter is larger than the Ferris wheel at Chicago, and differs in many important details of construction.

Not all of the main palaces will be lighted at night. The Palace of Manufactures, Palace of Electricity, Palace of Transportation and Civil Engineering, Palace of Textiles, and perhaps one or two other palaces, will be well illuminated every evening. The great Hall of Fetes, which occupies a central position in the Palace of Agriculture, will be illuminated brilliantly whenever in use for evening gatherings. The Palace of Education and Liberal Arts, Palace of Mines and Metallurgy, Palace of Chemical Industries, and Palace of Agriculture will not be equipped for evening illumination.

It is the Palace of Electricity, to which all eyes will naturally turn at night, and, as its main facade reaches across the entire width of the open plaza in the center of the Champs de Mars, splendid opportunity will be afforded for the attractive treatment of the architectural features of the exterior of this palace. Immediately in front of the Palace of Electricity is the grand Château d'Eau, which, as planned, will assume the character of an immense fountain with a series of cascades, to be effectively illuminated by vari-colored lights, thus making a most brilliant and striking attraction for the evening. A very ingenious scheme has been undertaken in connection with this Château d'Eau. All of the water used in the power plant for condensing purposes is to be discharged through the Château d'Eau and the cascades surrounding it, thus making use of this water in artistic effects, and obviating the necessity of pumping from the river another great volume of water simply for fountain use.

The administration has considered well the necessity for making the gallery space in the various palaces as accessible to the public as possible, and provision has been made not only for numerous vertical elevators of steam, electric and hydraulic type, but for a large number of inclined elevating ways, or "rolling carpets," to carry the passengers easily and speedily from the crowded ground floor to the galleries, where many interesting and instructive exhibits will be installed. The limited ground area at this exposition makes necessary the husbanding of all available gallery space. On the Champs de Mars there will be installed fourteen of these elevators, or "escaladers," which will have a capacity each of not less than 3000 passengers per hour. A fee not exceeding two cents for each passenger will be charged for the use of these "escaladers."

Decision in the Series Parallel Controller Case

The United States Circuit Court of Appeals (Judge Shipman writing the opinion) on Dec. 17, 1898, decided in favor of the plaintiffs in the case of the Electric Car Company, of America, and the Thomson-Houston Electric Company vs. the Nassau Electric Railroad Company, for alleged infringement of the patent issued to George Herbert Condict. The exclusive right under this patent for trolley roads is owned by the Thomson-Houston Electric Company. The patent covers broadly the modern form of series parallel controllers, in which both series-parallel changes and resistance changes are combined, so that by the movement of the same controller handle, both modes of regulation are utilized, and the resistance changes supplement and assist the series-parallel changes.

The Court, in its opinion, said in part: "It cannot be denied that

Condict's combination of two existing systems for regulating the supply of the current to an electric car motor was previously unknown and that the invention was one of much importance. * * * It is also obvious that the mixed controller system is in use whether the insertion is preparatory to or accompanies the shifting of the motor switch, and that in all the forms used either by the defendant in this case or by the defendant in the Hartford case auxiliary resistance was brought in at the time of making the change to parallel. * * * There is and there must be a substantial use and an enjoyment, more or less partial, of the benefits of the Condict idea and system, although the insertion of the dead resistance takes place during the transitional positions which result in a change from series to multiple." Since the original decision, a petition for a rehearing was presented and denied by the Court.

Railway Men in the Late War

Caryl D. Haskins, late commander of the volunteer electrical corps of the Boston Battalion during the late war, has written the STREET RAILWAY JOURNAL in regard to a statement in the last issue in connection with the part taken by the Boston office of the General Electric Company in the coast defense. Mr. Haskins states that while quite a large portion of the staff of that office did take part in the harbor defense work, they did so not as General Electric men, but as individuals and members or officers of the Volunteer Electrical Corps, Boston Battalion. Fully two-thirds of the squad officers and a large proportion of the privates of the battalion were associated with electric lighting companies, construction companies, or other companies foreign to the General Electric Company, so that it is not the desire of the latter that the mistake of giving it all the credit should be made.

There was another unintentional injustice in the same article, to which Mr. Haskins calls attention. This was in the omission of the name of E. H. Hoyt. Mr. Hoyt, who is well known in street railway circles throughout the state, and is chairman of the street railway committee of the State of Massachusetts, served as a special staff officer in connection with the Boston Battalion of the Volunteer Electrical Corps through almost its entire period of service. He dropped all of his important interests, abandoning his duties as representative of the Massachusetts House, and devoted himself exclusively to harbor defense work in connection with the corps, entirely without recompense and to his own personal loss.

Insulating Paint Abroad

The insulating compounds of the Standard Paint Company, popularly known under the name of P. & B., are so extensively employed in this country that American readers will be interested to know that the company is enjoying a very large export trade. Indeed, so large has this trade become during the last few years that after a number of visits abroad Mr. Shainwald, president of the company, decided some time ago to build a branch factory at Hamburg, Germany. The erection of this factory was begun in July, 1897, and completed in 1898, since which time all the compounds and apparatus manufactured by the Standard Paint Company in this country have been supplied by the branch factory at Hamburg. These include not only the P. & B. paint, tape, varnish and other goods which pertain directly to the electrical trade, but also P. & B. rubberoid roofing, P. & B. building sheathing and insulating papers and P. & B. preservative roof and structural paints.

It is a good indication of the standing of this company's products that material which has proved so popular in this country is regarded as equally indispensable in the countries of Europe.

An Advertising Bureau

With the closing of this year, the Manufacturers' Advertising Bureau, of New York city, complets the second decade of its existence—a fact which demonstrates beyond question the value of a concern of its unique character to the progressive manufacturer. Established in 1879 by the present proprietor, Benj. R. Western, the bureau has grown steadily in public favor and commercial importance. Its clientage is a large one, and comprehends representative concerns in nearly every industry in the country.

The Manufacturers' Advertising Bureau makes a specialty of the trade journals, and Mr. Western is, perhaps, one of the best-informed gentlemen in the advertising business regarding this class of publications and their conditions and possibilities as business bringers. A booklet, having the attractive title, "Advertising for Profit," is issued by the Manufacturers' Advertising Bureau, and will be sent on application.

Prospects for 1899

The results of an investigation recently conducted by the STREET RAILWAY JOURNAL shows that a large number of street railway companies are planning to make extensions and improvements during the coming year. Details of some of the new work proposed are given below:

ARKANSAS

The Hot Springs Street Railway Company will probably extend its line about 2 miles.

ALABAMA

The Birmingham Traction Company will probably add to its power station equipment two 300-kw. direct connected generators.

The Mobile Light & Railroad Company expects to add a direct connected generator and engine to its power station and build new car shed and repair shops.

The People's Street Railway and Improvement Company, of Decatur, is planning to reorganize the company and build 4 miles of new track.

CALIFORNIA

The Oakland Railroad Company will reconstruct about 7 miles of cable and horse lines, equipping them with electricity, and will replace twelve grip cars with motor cars. The care are in process of construction.

The Market Street Railway Company, of San Francisco, has not yet fully decided upon further construction and reconstruction for next year, but is planning to do considerable new work. The company has a franchise for an electric line about 1 mile in length, which may possibly be built. There is also a possibility that all the remaining horse lines and steam lines will be equipped with electricity.

The Sacramento Electric, Gas & Railway Company will not build any new mileage during the year, but may make an extension of existing electric transmission lines for power and lighting.

The following roads report that no new work is in contemplation: Gerry Street, Park & Ocean Railroad Company, San Francisco; San Jose & Santa Clara Railroad Company, Santa Rosa; Central Street Railway Company, Santa Rosa; Santa Rosa Street Railroad Company, Santa Rosa; Union Street Railway Company, Santa Rosa.

CONNECTICUT

The Hartford Street Railway Company will build a ¾-mile extension.

The Norwich Street Railway Company will build a ½-mile extension.

The Norwalk Tramway Company will probably build a line from Norwalk to New Canaan.

The Putnam & Thompson Street Railway Company, in connection with the People's Tramway Company, of Danielson, Conn., will construct, early in 1899, 16 miles of single track, together with power station and building equipment.

The following roads report that no new work is in contemplation: Norwalk Street Railway Company, Norwalk; Middletown Street Railway Company, Middletown; Bristol & Plainville Tramway Company, Bristol.

DISTRICT OF COLUMBIA

The Columbia Railway Company will build 10 miles of new suburban line, equipped with the overhead electric system. It will also change the existing cable road to underground electric, will add two 750-h.p. Allis engines and two 525-kw. G. E. generators to its power station, and will increase its rolling stock by sixty motor cars, twenty of which will have double trucks.

The Capital Traction Company will reconstruct about 1¾ miles of double track to conform with the electric conduit system now used on the city lines.

The Washington, Arlington & Falls Church Railway Company will extend its present line for a distance of 3 miles.

FLORIDA

The Pensacola Electric Terminal Railway Company will probably equip 4 miles of steam dummy line with electricity, and will extend present lines about 2¼ miles.

The Palatka Heights Street Railway Company has no new work in contemplation.

GEORGIA

The Augusta Railway & Electric Company has recently completed a new 1½-mile extension, and has installed a 4-kw. 2-phase generator for electric lighting purposes. During 1899 a 400-kw. railway generator will also be added.

The Atlanta Railway Company expects to build 11 miles of new track and add about twelve more motor cars.

The following roads report that no new work is in contempla-

tion: Columbus Street Railway Company, Columbus; City Electric Railway Company, Rome.

ILLINOIS

The Alton Railway & Illuminating Company will build 5 miles of new line and will add five new 28-ft. motor cars. It will also build a new car house, and will install a hot water heating plant for the heating of its buildings. This company is now engaged in relaying 2½ miles of old track and making a ½-mile extension.

The Chicago City Railway Company is planning to make many additions and extensions early in 1899.

The Galesburg Electric Motor & Power Company will add two double-truck motor cars, new motors and new boilers to its present equipment.

The Streator Railway was sold, Oct. 8, and bought by C. C. Barr, who expects to place the property in first-class condition early in the spring.

The Springfield Consolidated Railway Company has not fully determined on improvements for the next year.

The Belleville Electric Railway Company will rebuild about 3 miles of track.

The Rockford Railway, Light & Power Company will build several extensions to present lines.

The City Electric Railway Company, of LaSalle, will make extensions in the spring and add one more generator to the power station. The present rolling stock will be repainted and thoroughly repaired.

The City Electric Railway Company, of Decatur, will probably extend to Fair Haven Park, a distance of ½ mile, next spring.

The following roads report that no new work is in contemplation: Aurora & Geneva Railway Company, Aurora; Calumet Electric Street Railway Company, Chicago; North Kankakee Electric Light & Railway Company, Kankakee; Kankakee Electric Railway Company, Kankakee.

INDIANA

The Union Traction Company, of Anderson, has recently completed its line from Alexandria west to Arestes, 3 miles, and is extending the same to Elwood, a distance of 7 miles further. The company will erect at Alexandria a power station completely new, with 600-kw. generators, with necessary engines and boilers.

The John S. Crumps Street Railway Company, of Columbus, has not decided on new extensions for the coming season.

The Kokomo Street Railway Company will add 1 mile of new track and four new motor cars.

The South Bend Street Railway Company will build a new line to Notre Dame College, a distance of 1½ miles, and will also make other extensions amounting to about 2 miles. A new power station will be erected.

The following roads report that no new work is in contemplation: North Vernon & Vernon Street Railroad Company, Vernon; Logansport Street Railway Company, Logansport; Terre Haute Electric Railway Company, Terre Haute.

IOWA

The Waterloo & Cedar Falls Rapid Transit Company will build 1½ miles in Cedar Falls, and will add to the power station equipment one 300-h.p. engine and one 250-kw. generator.

The Boone Electric Street Railway & Light Company will build 3½ miles of new track.

The Marshalltown Light, Power & Railway Company intends to equip some of its open trail cars with motors.

The Omaha & Council Bluffs Railway & Bridge Company has recently built a new power station, and has no further work in contemplation.

The Sioux City Elevated Railway Company is lowering its elevated structure and extending it on the surface a distance of eight blocks into the city, giving this company a surface line all through the business district.

KANSAS

The Atchison Railway, Light & Power Company has not fully decided what new work will be undertaken, but will probably make some extensions of track.

The Leavenworth Electric Railroad Company expects to build a new car barn, to be modern in every respect and to accommodate forty cars. New shops will also be added.

The following roads report that no new work is in contemplation: Citizens' Railway Company, Fort Scott; Topeka Railway Company, Topeka.

KENTUCKY

The Ashland & Catlettsburg Street Railway Company will increase the capacity of its power station.

The following roads report that no new work is in contemplation: Paducah Street Railway Company, Paducah; Frankfort & Suburban Railway Company, Frankfort.

LOUISIANA

The New Orleans City & Lake Railroad Company will equip with electricity two miles of horse lines and will add six new double-truck motor cars, and will rebuild twenty others.

MAINE

The Sanford & Cape Porpoise Railway Company will build a new line from Sanford to Cape Porpoise, a distance of 22 miles.

The Bangor, Hampden & Winterport Railway Company will extend its line about 8 or 10 miles.

The following roads report that no new work is in contemplation: Bangor Street Railway Company; Biddeford & Saco Railroad Company, Biddeford; Fryeburg Horse Railroad Company; Mousam River Railroad, Sanford.

MARYLAND

The Baltimore, Middle River & Sparrow's Point Electric Railroad Company intends to double its present steam power plant, add ten more cars, and extend its tracks possibly 6 miles.

The following roads report that no new work is in contemplation: Baltimore & Northern Electric Railway Company, Baltimore; Cumberland Electric Railway Company.

MASSACHUSETTS

The Palmer & Monson Street Railway Company will make several extensions to its lines.

The Braintree & Weymouth Street Railway Company expects to build from 4 to 8 miles of new line.

The Shelburne Falls & Colrain Street Railway Company will extend its line for a short distance.

The Boston Elevated Railway Company will build its new elevated structure during 1899.

The following roads report that no new work is in contemplation: Greenfield & Turner's Falls Street Railway Company, Greenfield; Athol & Orange Street Railway Company, Athol; Fitchburg & Leominster Street Railway Company, Fitchburg, Lowell & Suburban Street Railway Company, Lowell; Newton & Boston Street Railway Company, Newton; Newtonville & Watertown Street Railway Company, Newtonville; Wellesley & Boston Street Railway Company, Newtonville; Northampton Street Railway Company; Springfield Street Railway Company; Worcester & Marlborough, Worcester; Taunton Street Railway Company.

MICHIGAN

The Long Lake, Durand & Corunna Electric Railroad Company has recently been formed to build a line from Fenton and Durand to Corunna.

The Adrian Electric Street Railway Company will build ¾-mile extension.

The Escanaba Electric Street Railway Company will build 3½ miles of new track laid with 60 lb. steel T rails; 200-h.p. engines and generators will be added to the power station, and new carhouse and shops will be built. Two large interurban cars will be added to the rolling stock.

The Michigan Traction Company proposes to connect Kalamazoo and Battle Creek with an electric railway 23 miles long, with a spur 3½ miles from Augusta to Gall Lake. The road has been surveyed and part of the material is on the ground. It is thought operation will be commenced in June, 1899.

The Manistee, Filer City & Eastlake Railway Company will build about 3 miles of new track. This company has recently enlarged its power house and increased its power house equipment. The company is also opening a large park on the shore of Lake Michigan.

The following companies report that no new work is in contemplation: City Electric Railway Company, Port Huron; Muskegon Railway Company; Menominee Electric Light, Railway & Power Company; Detroit, Fort Wayne & Belle Isle Railway, Detroit; Detroit & Pontiac Railway Company, Detroit.

MINNESOTA

The St. Cloud City Street Car Company will extend its line 1½ miles to the Great Northern Passenger Depot.

The following companies report that no new work is in contemplation: Twin City Rapid Transit Company, Minneapolis; Lakeside Railway Company, Duluth.

MISSISSIPPI

The Meridan Street Railway & Power Company is adding new boilers to its station equipment.

The Greenville Street Railway Company has abandoned its old property and the track has been taken up. but it is the purpose of

the company to establish a new road some time in the near future.

The following road reports that no new work is in contemplation: Bluff City Railway Company, Natchez.

MISSOURI

The Hannibal Railway Company proposes to build at least 2 miles of new road to Oakwood, and possibly 10 miles more to Palmyra. The present line will also be extended about 3 miles. A new power house will be built and equipped, and new rolling stock and equipment will be added.

The Brooklyn Avenue Railway, of Kansas City, now operated by cable, will be converted to the overhead electric system and 15 miles of extensions (also electric) will be built during the spring. Work will be commenced as soon as the weather permits. A new bridge will be built over the Belt Railway tracks, a new power house erected, and new rolling stock and equipment will be purchased.

The Northwest Electric Railway Company, of Kansas City, is preparing to rebuild its entire line.

The Clinton Street Railway Company is endeavoring to secure capital to equip the road with electricity.

The following roads report that no new work is in contemplation: Electric Railway, Light & Power Company, Sedalia; St. Louis & East St. Louis Electric Railway Company, St. Louis; People's Railroad Company, St. Louis; Citizens' Street Railway Company, Cape Girardeau.

MONTANA

The following road reports that no new work is in contemplation: Bozeman Street Railway Company, Bozeman.

NEBRASKA

The Nebraska City Street Railway Company expects to change from horse traction to electric traction in the latter part of 1899.

The following roads report that no new work is in contemplation: Benson Railway Company, Benson; Lincoln Traction Company, Lincoln.

NEW JERSEY

The Atlantic City Electric Railway Company expects to make some additions to power station equipment.

The Bridgeton & Millville Traction Company is planning an extension to Cedarville, a distance of 4 miles.

The Union Traction Company, of Rutherford, has the construction of 7 miles of new line under consideration, but it is not decided definitely when the same will be built.

The Bergen County Traction Company, of Undercliff, expects to complete its extension to Hackensack, a distance of about 4 miles.

The Trenton Passenger Railway Company will build 2 miles of new line.

The Ocean City Electric Railroad Company recently completed 5 miles of new line and installed new equipment in its power station. No new work is contempleted for 1899.

The following roads report that no new work is in contemplation: Brigantine Transportation Company; Camden, Gloucester & Woodbury Railway Company, Camden; North Hudson County Railway Company, Hoboken.

NEW HAMPSHIRE

The Laconia Street Railway Company will extend its line about 5 miles along the lake shore.

The Exeter Street Railway Company will build from Exeter to Epping, a distance of 6 miles, and from Hampton to North Hampton, a distance of 3 miles, in the spring, and will add about 400-h.p. engines and generators to the power station.

The following road reports that no new work is in contemplation: Nashua Street Railway.

NEW YORK

The Brooklyn Heights Railroad Company has contracted for 150 thirteen-bench open cars and 5000 tons of 9-in. steel girder rails. This rail, when laid, will complete the change of the entire Brooklyn Heights system from horse traction with various kinds of rails to electric traction with standard 9-in. construction.

The Elmira & Horseheads Railway Company will complete a short extension to a new park which it will open to the public in June, 1899, and will also rebuild 3 miles of the present line with 60-lb. T-rails.

The New Paltz & Wallkill Valley Railroad Company will probably add some small motor cars.

The Metropolitan Street Railway Company, of New York City, is now equipping existing horse lines with the underground electric system, and this work will probably be completed during 1899.

The Kingston City Railroad Company may possibly add six or eight new cars to its equipment.

The Hornellsville Electric Railway Company is planning to erect a new power station, and equip some with gas engines.

The Dunkirk & Fredonia Railway Company is endeavoring to secure franchises for building 1 1-3 miles of new track.

The Auburn Street Railway Company will make an extension of its lines about 9 miles in length.

The Syracuse, Skaneateles & Moravia Railroad Company is a new company recently incorporated, and expects to build several miles of track in the spring.

The Green County Traction Company, of Coxsackie, has recently been incorporated, and intends to build a new line in the spring.

The Buffalo, Hamburg & Aurora Railway Company intends to build a new line 21 miles in length in the early spring.

The Saratoga Traction Company will extend its present line to Ballston Spa.

The following roads report that no new work is in contemplation: Bennington & Hoosick Valley Railway Company, Hoosick Falls; Rochester Railway Company, Rochester; Ossining Electric Railway Company, Sing Sing; Oneida Railway Company, Oneida; Niagara Falls, Whirlpool & Northern Railway, Niagara Falls; The Niagara Falls & Suspension Bridge Railway Company, Niagara Falls; Herkimer, Mohawk, Ilion & Frankfort Electric Railway Company, Mohawk; Middletown-Goshen Traction Company, Middletown; Fonda, Johnstown & Gloversville Railroad Company, Gloversville; Citizens' Street Railway Company, Fishkill-on-Hudson; Cortland & Homer Traction Company, Cortland; Buffalo & Niagara Falls Electric Railway Company, North Tonawanda.

NORTH CAROLINA

The Intermontaine Railroad Company, of Asheville, will put in a new plant to be operated by water power.

The following roads report that no new work is in contemplation: Wilmington Street Railway Company, Wilmington; Winston-Salem Railway & Electric Company, Winston; Charlotte Electric Light & Power Company, Charlotte.

OHIO

The Ashtabula Rapid Transit Company has recently completed a number of improvements, including a number of new turnouts, a signal block system and additional shops and car barns. The car barn is heated by steam.

The Oakland Street Railway Company, of Dayton, will make a number of improvements in its property.

The Lima Railway Company will build a ½-mile extension.

The Citizens' Electric Railway, Light & Power Company, Mansfield, is remodeling its power station equipment.

The Tuscarawas Electric Company, of New Philadelphia, is considering the advisability of building a line from Uhrichsville to Cadiz.

The Springfield Railway Company will rebuild 1 or 2 miles of present track and will extend its line about 1½ miles. It also intends to build a new car barn with capacity for thirty-five cars and to add six new cars to the present rolling stock.

The Tiffin, Fostoria & Eastern Electric Railway Company is engaged in finishing its line. All power station equipment has been ordered, but the company may wish to purchase a few more cars.

The Toledo Traction Company will probably lay some additional double track and add one or two railway generators. It may possibly also purchase a few more open cars.

The Cleveland & Eastern Railroad Company is constructing a new line, but new cars, motors or electrical equipment have not yet been ordered.

The Akron, Bedford & Cleveland Railroad Company will double track a considerable portion of its line.

The Worthington, Clintonville & Columbus Street Railway Company is considering the advisability of operating trail cars on its lines.

The Pennsylvania & Ohio Railway Company, of Ashtabula, is a new company which intends to build 45 miles of electric railway. It is also intended later on to continue the line to Erie, Pa., a distance of 26 miles. Part of this road has already been constructed, and as soon as the spring opens the work will be pushed through as rapidly as possible.

The Cleveland, Medina Southern Electric Railway Company will build a new line from Cleveland to Wooster.

The following roads report that no new work is in contemplation: Sandusky, Milan & Norwalk Electric Railway Company, Sandusky; Salem Electric Railway Company, Salem; Tuscarawas Railroad Company, New Philadelphia; Lorain Street Railway Company, Lorain; the Price Hill Inclined Plane Railroad Company, Cincinnati; Cincinnati, Newport & Covington Railway Company, Cincinnati; Chillicothe Electric Railroad Company, Chillicothe.

OREGON

The City & West Portland Park & Motor Company, of Portland, intends to extend the present line 12 miles and equip its existing steam line with electricity.

PENNSYLVANIA

The Beaver & Vanpool Electric Street Railway Company will make a short extension of its line.

The Schuylkill Valley Traction Company, of Norristown, will probably make a number of improvements and extensions.

RHODE ISLAND

The Newport Street Railway Company is asking permission from the city to build a small extension.

SOUTH CAROLINA

The following road reports that no new work is in contemplation: Charleston Street Railway Company, Charleston.

TENNESSEE

The Electric Street Railway Company, of Clarksville, has completed surveys for a new line to New Providence, 2½ miles in length.

The Memphis Street Railway Company expects to build about 2 miles of new track and to construct a car barn and office building, with paint, carpenter and machine shops, etc. The buildings will be 320 ft. x 300 ft. and 105 ft. x 150 ft.

The Nashville Street Railway Company will probably buy some new motor cars and rails for 4 or 5 miles of track.

TEXAS

The Dallas Rapid Transit & Terminal Railway Company is now in process of reorganization. The road will be completed in January, 1899, and several changes and considerable improvement are contemplated.

The Dallas & Oakcliff Electric Railway Company contemplates making some changes, but has not fully decided upon them as yet.

The Austin Rapid Transit Railway Company contemplates a short extension of its line. This company is replacing the old pine ties with mountain cedar ties.

The Uniontown Electric Railway Company expects to make an extension of two miles in the spring.

The Titusville Electric Traction Company will add one new 325-kw. G. E. generator and one new Atlas Corliss engine and boiler.

The Connellsville, New Haven & Leisenring Street Railway Company will build 3 miles additional track from Leisenring to Vanderbilt, and also renew 4 miles of old roadbed with new track. track.

The Pennsylvania Traction Company, of Lancaster, is planning to build about 17 miles of extensions.

The Quakertown Traction Company is planning to build a line from Quakertown to Perkasie and Doylestown, a distance of about twenty miles.

The following roads report that no new work is in contemplation: Paris Railway Company, Paris; Citizens Railway Company, Waco; San Antonio & Magoffin Street Railway Company, San Antonio; El Paso & Juarez Avenue Street Railway Company, El Paso.

UTAH

The following roads report that no new work is in contemplation: Ogden Electric Railway Company, Ogden; Salt Lake Rapid Transit Company, Salt Lake City; Salt Lake City Railroad Company, Salt Lake City.

VERMONT

The following road reports that no new work is in contemplation: Rutland Street Railway Company, Rutland.

VIRGINIA

The Portsmouth Street Railway Company has under consideration an extension of its line.

The Lynchburg & Richmond Street Railway Company will construct an extension 1½ miles long; 90-lb. girder rail in paved streets, and 55-lb. T rail in unpaved streets will be used. This company intends to greatly improve and beautify its park covering about thirty acres, and will put in attractions of various kinds.

The Staunton Street Car Company may extend its line about one mile in the spring. This company is now remodeling its open cars, making combination cars of them, with removable vestibules.

The following road reports that no new work is in contemplation: Richmond Traction Company, Richmond.

WASHINGTON

The West Street & North End Electric Railway Company, of Seattle, expects to extend its line to Army Post, a distance of two miles.

The Seattle & Rainier Beach Railway Company is remodeling its rolling stock and roadbed.

WEST VIRGINIA

The Charleston Street Railway Company expects to build a 1½-mile extension to Ruffner, purchase a rock crusher and rock-ballast all its track outside of paved streets; also to relay about 1½ miles of old 50-lb. T rail, and lay new 62-lb. T rail on new ties.

The following road reports that no new work is in contemplation: Consolidated Light & Power Company, Huntington.

WISCONSIN

The Fox River Electric Railway Company, of Green Bay, expects to extend its De Pere line about two miles into the city of De Pere, and cross the river to the West Side. This company has ordered one new double-truck car, and will probably order two more during the year.

The following roads report that no new work is in contemplation: Sheboygan Light, Power & Railway Company, Sheboygan; La Crosse Street Railway Company, La Crosse; Ashland Light, Power & Street Railway Company, Ashland.

CANADA

The Montreal Island Belt Railway Company will make extensive extensions during 1899.

The St. Thomas Street Railroad Company will make a ½-mile extension and purchase new cars.

The Halifax Electric Tramway Company will build three miles of new track, and add a 300-kw. rotary transformer to the power-station equipment.

The Belleville Traction Company has six miles of extension under consideration.

The Quebec, Montmorency & Charlevoir Railway proposes to build a double track-line from Quebec to Montmorency Falls, a distance of 6.27 miles, and change a 30-mile steam road to electric traction.

The British Columbia Electric Railway Company, of Vancouver, will make several extensions during the coming year.

The following roads report that no new work is in contemplation: Niagara Falls Park River Railway Company, Niagara Falls; Oshawa Railway Company, Ontario; London Street Railway Company, London.

New Law Requiring the Licensing of Private Detectives

A law of considerable interest to street railway companies hiring private detectives or "spotters" has recently been passed by the New York Legislature, through the efforts of A. L. Drummond, general manager of Drummond's Detective Agency, of New York city. This statute requires all private detectives and private detective agencies to take out a license before they can do detective work of any kind. A penalty of a fine of $500, or imprisonment for a year, or both fine and imprisonment, will be imposed upon all offenders of this regulation. The principal reason for the law was the number of unexperienced and irresponsible people who were going into the detective business. Under the new statute, the license fee is $20 a year, and every applicant must have five reputable freeholders of his county to sign his application, and in addition to this he must give a bond of $2,000.

The strong points urged for the new regulation are as follows: At a small cost a man becomes a licensed detective, and he must be a very poor sort of a man and detective who cannot get five reliable indorsers as to his qualifications. It is thought that the requirement of a bond will also be a very valuable feature, as it gives clients something to fall back upon should a detective commit any fraud. This bond, of course, can be sued upon.

The law covers all special policemen, special peace-officers, special watchmen, and other private detectives of any character.

NEWS OF THE MONTH

The Boston Elevated Railway Company has decided to adopt the service stripe system for all uniformed employees. One stripe will be worn for each five years of service; motormen will wear silver braid; conductors, inspectors, starters, etc., gold; emergency linemen, scarlet, and switchmen and subway watchmen, green. A number of the large street railway systems throughout the country are introducing service stripes for employees.

The Traction Company Centennial Band, which is a social organization of employees of the Toledo (Ohio) Traction Company, gave a very successful and enjoyable entertainment recently. The band, which consists of twenty-five good musicians, rendered a musical programme, after which a dance was given. Thomas H. McLean, general manager of the Toledo Traction Company, was present, and with Mrs. McLean led the grand march. Refreshments were provided at the expense of Mr. McLean.

The new electric line from Elkhart to Goshen, Ind., which is owned by the Indiana Electric Railroad Company, was opened on Dec. 19. There now remains only a ten-mile stretch between Elkhart and Mishawaka to give a continuous line of 40 miles from Goshen to South Bend, Ind.

The Cicero & Proviso Street Railway, of Chicago, Ill., was granted a fifty-year franchise by the Cicero Town Council on Dec. 20. The companies to be benefited by this ordinance are the Cicero & Harlem Street Railway Company, Cicero & Proviso Street Railway Company, Ogden Street Railway Company, Suburban Railway Company, and the Chicago Telephone Company.

The Third Avenue Railroad Company, of New York, for the quarter ending Sept. 30, 1898, reports gross earnings of $594,807, as against $699,052 for the corresponding quarter of 1897, and $726,980 in 1896. This is a diminution in gross earnings of $104,245 during the past year, and of $132,173 during the last two years. The net earnings, after paying operating expenses, were $243,221 in 1898, as against $338,790 in 1897, and $377,040 in 1896, and the surplus for stock, after paying charges, is $150,827 in 1898, as against $246,970 in 1897, and $290,261 in 1896.

The annual report of the Railroad Commissioners for the State of Maine for the year ending June 30, 1898, shows an increase in gross earnings in 1898 over 1897 of $49,342. The Portland Railroad Company earned the largest sum per mile of road, $9,762, and the Augusta, Hallowell & Gardiner Railroad Company operated its line at the lowest percentage of operating expenses to earnings, 54 per cent. Only one person was killed and but thirteen injured by the street railways of the State during the year, seven of the latter being in a single collision, and the other six from their own carelessness, nearly all in getting on or off cars while in motion.

The just issued report of the Railroad Commissioners of Connecticut for the year ending June 30, 1898, shows that the capital stock and funded and floating indebtedness of the street railways of the State amount to $51,610 per mile of road. The largest capitalization per mile is that of the Meriden Electric Railroad Company, $92,507. The average gross earnings per mile of road operated were $5,254, and per mile run were $.1945. The largest earnings per mile of road were made by the Fair Haven & Westville Railroad, $12,460, and the largest earnings per car mile were made by the Waterbury Traction Company, $.2698. The largest operating expenses per car mile were $.171, those of the Norwich Street Railway Company, and the smallest were $.0856, those of the Bridgeport Traction Company, the average for the State being $.1271. But ten people were killed by the railways of the State during the year, and 128 injured. The capital stock was increased by $680,600, and the bonds by $930,000 over the totals of the previous year. The gross earnings were reduced by $607,242, and the net earnings by $242,328. The dividends were reduced by $85,350, and the interest paid, by $143,852.

A syndicate has acquired, for $1,472,000, the entire street railway system and street railway concessions in Havana, Cuba. It is officially stated that the owners of the Metropolitan Street Railway Company, of New York City, are largely interested in this deal, and that the work of giving Havana one of the finest street railway systems in the world will certainly be commenced in the spring, or as soon as certain minor legal details are settled.

The Union Elevated Railroad, of Chicago, which operates the loop terminal, held its annual stockholders' meeting on Dec. 5, and re-elected directors. No financial statement was given out, but the result of operation for the year ending Nov. 30 is locally estimated as follows:

Revenue from 23,556,000 passengers on the Metropolitan road at one-half cent	$117,780
Revenue from 18,702,000 passengers on the South Side road, at one-half cent	93,510
Minimum charge, Lake Street line	62,500
Minimum charge, Northwestern line	62,500
Total earnings	$336,290
Interest on bonds	$210,000
Surplus on stock	$126,290

This surplus is equivalent to about 2.5 per cent upon the stock.

The ordinance extending the franchises of the Chicago City Railway Company for fifty years has been defeated in the Council.

S. Dana Greene, who is head of the sales department of the General Electric Company, and who served on board the "Yankee" in the Spanish-American War as lieutenant (junior grade), has been detailed for duty as aide to Governor-elect Roosevelt, at the latter's request. Lieut. Greene now occupies the position of lieutenant commander in the naval militia and chief of staff to its captain. He comes from an ancestry, direct and collateral, distinguished in the army and navy of the United States. He is the son of Captain S. Dana Greene, who was first lieutenant of the "Monitor" when she fought the "Merrimac," and who was in charge of her during almost the entire engagement, owing to the accident to Commander Worden. His grandfather, General George S. Greene, is the oldest living graduate of West Point, and his uncle, Major-General Francis Vinton Greene, U. S. V., is in command of the Seventy-first Regiment New York Volunteers.

The officers of the First Regiment of United States Volunteer Engineers gave a dinner on Dec. 8, at Sherry's, New York, in honor of their colonel, Eugene Griffin. Most of the officers of the volunteer regiment were present. Lieut.-Col. Hodges acted as toastmaster, and with a few well-chosen words presented Col. Griffin with a handsome silver loving cup from the officers of the regiment. In acknowledging the souvenir, Col. Griffin reviewed the work of organizing and equipping the regiment, and mentioned the efficient services performed by the engineers in Porto Rico. The latter work included a detailed topographical survey of the main highway of the sea through Ponce to Aibonito; a survey of the Aibonito Pass, showing the locations of the Spanish batteries and entrenchments; a detailed hydrographical survey of the harbors of Ponce and Guanica; a rebuilding of several fine masonry bridges, and the building of a dock and commissary storehouses. An ice and refrigerating plant, a reservoir and a fort were also erected by the regiment. Following Col. Griffin's speech, a number of other addresses were made, and steps were taken looking to a permanent organization of the officers of the engineer regiment.

Important Changes in the General Electric Company

W. J. Clark, of the General Electric Company, has accepted the position of general manager of the company's foreign department, with headquarters in New York.

In the reorganization of the foreign department, D. Mazanet, who, for five years, has held the general managership, and who has piloted it from its small beginning to its present position as one of the foremost departments of the company, becomes managing director of the Mexican General Electric Company, with headquarters in the City of Mexico.

In view of the importance which our recent foreign acquisitions and our improved relations with foreign countries, will give to our commerce, especially in the field of electrical development, the scope of the foreign department will necessarily be greatly widened, and this department will undoubtedly become the foremost in the company. It will have charge of commercial relations between the General Electric Company and all countries outside the United States.

Mr. Clark's wide experience in foreign commercial matters peculiarly fits him for his new position. He has traveled through

Europe, as well as in the countries south of us, and his familiarity with foreign methods and manners will stand him in good stead. His book, "Commercial Cuba," recently published, is already generally acknowledged to be the standard authority on Cuban commercial affairs. He will be greatly missed from the railway department, in the management of which he made a unique record, and his hosts of friends in the American street railway field will regret to hear that he is no longer to be in active charge of the home business.

Americanizing a Railway in Porto Rico

The incorporation in Albany on Dec. 27 of the San Juan & Rio Piedras Railroad Company, with a capital of $300,000, brings to a focus an interesting enterprise which has been carried out by a syndicate organized by the well-known engineering firm of J. G. White & Company, to obtain a foothold in the transportation industry of Porto Rico. Some months ago Mr. Young, an engineer connected with this firm, was sent to Porto Rico on a tour of investigation, and found a valuable railroad property, seven miles in length, connecting San Juan with a rich residential district, practically the only one in the city. An option was secured by Mr. Young, and the property was shortly after purchased by the White syndicate.

This road was formerly owned by Mr. Pablo Ubarri, a Spaniard, resident in San Juan, and was originally built as a steam road in 1880. The line extends from a point near the center of San Juan, to a distance of seven miles through the suburban territory of Puerte de Tierra and the residential suburbs of San Tource, Martin Peña, and Rio Piedras. The entire Rio Piedras district has about 12,000 inhabitants, but the town proper has about 3000, and contains the Governor's summer palace. The railroad, as constructed, runs along the side of the main military road, extending from San Juan to Ponce, but is separated from it by well-defined embankments, and is upon its own right-of way, so that practically any desired speed can be made without difficulty. The present gage is about 30 ins., and many of the ties that have been down for eighteen years are still in good preservation, being of the native hard woods of the country.

The new company proposes to widen the gage of the road, to electrify the same in the best possible manner, and also to extend the road by a loop around the principal plaza in San Juan, and when the new work is completed and modern cars are operated at frequent intervals it is expected that the line will be largely patronized. The company also has in view still further extensions and improvements, which make this railroad a most important one for San Juan and the island of Porto Rico. It likewise contemplates furnishing electric lights along the line of the road.

This steam road was purchased and taken over on Nov. 26, 1898, and has been operated by Messrs. J. G. White & Company, who are, as before stated, managers of the syndicate which secured and are promoting the enterprise. The incorporators of the new company are George H. Walbridge, Fernando G. Echeverria, H. H. Harrison, Edward Schmidt, Lathrop R. Bacon, F. Kingsbury Curtis, Philip H. McMillan, Augustus N. Hand and William B. Parsons, of New York City.

Consolidation Negotiations in Several Cities

Early in December a syndicate, headed by Alexander Brown & Sons, prominent bankers of Baltimore, and said to include the powerful New York and Philadelphia capital interested in the street railways of those two cities, made an offer to purchase the $3,500,000 capital stock of the Baltimore City Passenger Railway Company at a price of $90 per share, the shares being $25 par value. Acceptance of this offer was recommended to the stockholders by the president and directors of the Baltimore City Passenger Railway Company, and there is no doubt of the stockholders' decision. As a result of this purchase there are now two large competitive street railway systems in Baltimore—the Baltimore & Northern and the Baltimore Consolidated. The former owns about 135 miles of track and the latter 207 miles. There are now outstanding $9,172,000 of the capital stock of the Baltimore Consolidated Railway and $10,550,000 of its bonds, while of the Baltimore & Northern system there are $4,700,000 in outstanding bonds and $1,400,000 in outstanding stock, exclusive of the $3,500,000 of Baltimore City Passenger stock now purchased for the sum of $12,600,000.

About ten days after the above purchase was made it was officially announced that an agreement had been reached between the Baltimore Consolidated and the Baltimore & Northern companies for a general consolidation of the entire street railway system of Baltimore, but shortly after this a disagreement taking place before the final merger of interests, the consolidation was not effected.

The Brown Syndicate is known to include Harry Parr and G. R. Webb, of Baltimore, and Sidney Wright, of Philadelphia, while the Elkins-Widener-Dolan interests are believed to be also associated with Mr. Brown.

Another important street railway purchase, amounting probably to eventual consolidation, has taken place in St. Louis during the past month. It will be remembered that last summer a new company, the Central Traction Company, obtained a franchise to build about eighty miles of track in St. Louis. This franchise was passed by the Municipal Assembly, was vetoed by the Mayor, and was passed over his veto. It was extremely valuable, as it gave the new company the right to lease the tracks of any other street railway, and, in effect, to bring about a consolidation. It soon developed that the parties behind this new company were the Elkins-Widener syndicate, of Philadelphia, and Sellers McKee, of Pittsburgh.

On Dec. 7, the National Railway Company, of Chicago, which owns seven street railway properties in St. Louis, sold and transferred those properties to local capitalists, Messrs. Spencer & Orthwein, who had previously, about two years pefore, purchased the Southern Electric Railway property. Up to the present time it is not known whether these two gentlemen bought the stock for themselves or bought it on account of Eastern capitalists, but it is significant that at almost the same time, Messrs. Brown Brothers, of New York, who are closely associated with the Elkins-Widener syndicate, purchased or secured an option on the stock of the Lindell Railway Company, the general understanding in St. Louis being that the road has been sold. It is believed that the Eastern syndicate now controls every street railway in St. Louis except the Union Depot line, and that there is simply a question of price in negotiations for the latter.

In connection with these attempts at street railway consolidation there appear to be movements on foot in New York City, Brooklyn, Philadelphia, Baltimore, Pittsburgh, St. Louis and Chicago, to effect general consolidations of electric lighting, gas and street railway properties with a view to introducing economies in management, to utilize the waste products to better advantage, and to operate power stations with more economical load factors. It is now known, for example, that the New York Light, Heat & Power Company, recently organized, with a capitalization of $25,000,000, has been, and will be, closely associated in interest with the Metropolitan Street Railway Co. It has purchased the Empire Conduit Company, which has the monopoly of high-tension underground conduit system in the northern part of Manhattan Island, and the Mt. Morris Electric Light Company, and the surplus power of the new 70,000-h.p. station which the Metropolitan Company is building will be used for lighting purposes, together with many of the ducts now being laid in such quantities on the company's north and south railway lines.

Electric Equipment in Silesia, Germany

The Electricitats Gesellschaft Felix Singer & Co., Aktiengesellschaft, of Berlin, has recently received a contract from the Ober Schlesischedampf Strassenbahn-Gesellschaft for twenty electric motor cars with eighty motors for a gage of 785 mm. These will be used on some future extensions of this railway. This order makes a total of 208 motors which the Ober Schlesischedampf Strassenbahn-Gesellschaft has purchased from Felix Singer & Co.

Calendars for 1899

The coming of the new year has brought the usual number of calendars, but of a greater variety and more attractive than ever before. The number issued is extremely numerous, but some which have been already received deserve special notice. The most elaborate calendar this year is, without doubt, that issued by the Falk Manufacturing Company. This is a collection of six beautiful reproductions of well-known paintings, each accompanied by a calendar for two months. With this is a short story of each of the pictures by Prof. H. Ward Rhodes, Museum of Fine Arts, Washington University. The pictures are printed with a tint on heavy cardboard, and are extremely tasteful. The Okonite Company has also recently published an attractive calendar bearing handsome colored pictures. A beautiful calendar has also been issued by the American Electrical Works, of Providence, R. I., and others are being received with each mail.

Trolley Wheel for High Speed Roads

A trolley wheel especially designed for high speed roads, but also adapted for any kind of trolley road, has been put on the market by the Star Brass Works, of Kalamazoo, Mich., and is known as the Kalamazoo wheel. The peculiar feature of the wheel is that it will lubricate itself and is soft enough not to injure the overhead work. The hub is cast hollow and is filled with oil, which lubricates the bushings. All the long distance lines running out of Detroit are using this wheel. This service is a severe one, as a car is run from 30 to 40 miles an hour for long distances. The metal in the wheel is treated for electrical purposes by a method owned and controlled by the Star Brass Works, and gives, it is claimed, excellent results and entire proof against sleet. The wheel is supplied in a harp of special design, so made that the harp will not catch on anything in case the trolley leaves the wire.

Contracts Awarded by the Third Ave. Railroad Co.

A description was published in the last issue of the STREET RAILWAY JOURNAL as to the plans of the Third Avenue Railroad Company, of New York, for electrical equipment, and mention was made of a number of contracts. During December a number of other contracts were awarded by the company, including that for the steam plant and electrical apparatus. Bids were submitted by the different electric companies on specifications drawn up by Dr. Louis Duncan, consulting engineer of the company, and the contract was given to the Westinghouse Electric & Manufacturing Company, who will furnish all the electrical apparatus from its own shops; the Westinghouse Machine Company will furnish the engines, while the Westinghouse, Church, Kerr & Co. will execute contract for the construction of the entire steam plant. The total contract amounts to about $5,000,000, more than half of which is for the steam plant, and this does not include the building or the substructure on which it stands. Westinghouse, Church, Kerr & Co. are the engineers and architects for the building and furnished complete plans and specifications by which the contract will be let.

The power station for supplying current to all the lines of the Third Avenue Company, which comprise over 100 miles of track, will be on the Harlem River, between 216th Street, Ninth Avenue and 218th Street, and the distribution will be made at high tension to substations located in different parts of the city. The power house will be approximately 320 ft. long and 250 ft. wide, and will contain sixteen 3000 kw. alternating current generators, which will be driven by engines having a mechanical rating of about 4000 h.p., but a maximum capacity of at least 50 per cent over this. Thus the station will have a nominal rating of 64,000 h.p. and a maximum capacity of about 100,000 h.p., and is undoubtedly the largest station ever projected. The engines will stand in double rows in the engine room, 320 ft. long.

The boiler house will stand parallel to the engine house and will contain a double row of Babcock & Wilcox boilers in two decks. These boilers, if set in continuous battery, would be about 1000 ft. long. Coal will be received from an enormous coalbin overhead, from which the fuel will chute to the Roney stokers, with which the boilers will be equipped, and the ashes will be drawn from the hoppers under the boilers. The boiler plant will be generously supplied with economizers and the draft will be handled by a combination of natural and mechanical draft on a system more complete than has ever yet been installed, and involving the use of four tall stacks. The condensing apparatus will be so arranged that the engines will be served in sections, with special provisions for handling this part of the service with greater economy and reliability. The method of piping is most complete, and with numerous provisions for all contingencies.

Aside from the sixteen large generators, there will be much other electrical apparatus in the power station, including an enormous switchboard about 200 ft. long, exciting apparatus with separate switchboards, rotary transformers, not including the various substations throughout the city, all the apparatus for which will be furnished by the Westinghouse Electric & Manufacturing Company. In addition to the power station and substation apparatus, all the car equipment will also be supplied by the Westinghouse Company.

Spring Liner for Track Rails

The wisdom of employing a spring liner for track rails to relieve the anvil effect noted in rigid roadbed construction is already apparent in the new track construction of the Third Avenue (New York) Railway Company. The new construction, which was illustrated and described in the December issue of the STREET RAILWAY JOURNAL, has been completed from 124th Street as far south as Seventy-fourth Stret, and the striking contrast in the effect upon the car and rail is instantly noticed by the most unobserving passenger as the car passes from the old to the new section. The rumbling and bumping sound is eliminated and the cars ride with a most agreeable motion, as if one were floating in a boat on the surface of placid water. The result in the life of the rail will be watched with a great deal of interest, as the old rail, which was a 7-in. grooved girder, has been so hammered out as to be unfit for legitimate service, and this after a life of less than five years.

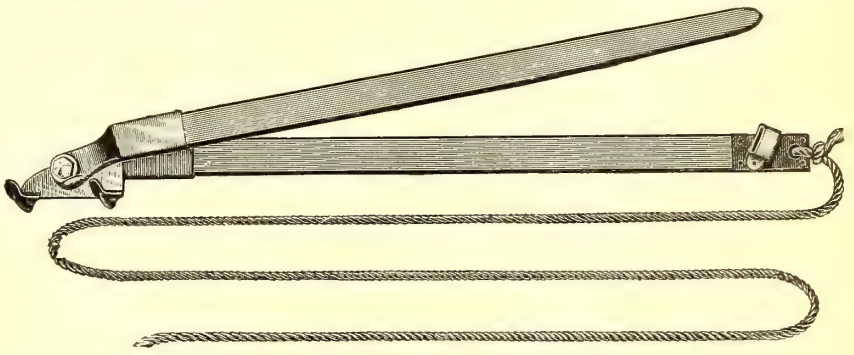
Railway Building Near Detroit

Of the many roads which go to make up the chain of interurban systems around Detroit a considerable number were constructed by the International Construction Company of that city, who certainly can feel a just pride in their record in Detroit. During the year 1898 this company contracted for the complete construction and equipment of the Detroit, Lake Shore & Mt. Clemens Railway, Detroit & River St. Clair Railway, Detroit, Plymouth & Northville Railway and the Mt. Clemens & Lake Side Traction Company. All these lines are in actual operation, or soon will be, and their aggregate length is over 80 miles. The companies were also largely financed by the International Construction Company.

The International Construction Company was also contractor for the Mill Creek Valley Street Railroad from Cincinnati to Hamilton, Ohio, and for the year 1899 has a large amount of work on hand, not only in the city of Detroit, but over the entire country. The company's offices occupy five large rooms in the Chamber of Commerce, and its drafting and engineering departments occupy three more rooms.

Trolley Wire Emergency Clamp

The accompanying engraving shows an emergency clamp or pickup manufactured by the Western Electrical Supply Company, of St. Louis, and used to handle broken trolley or other live wires. The handles are made of hard wood, which gives perfect insulation. Attached to the handle of this device is a piece of rope about 20 ft. long, which enables the conductor of the car to replace broken wire where it will be harmless until the linemen can place it in its proper position. For this purpose one of these clamps should be carried on each car.



TROLLEY WIRE EMERGENCY CLAMP

Line Material

L. A. Chase & Co., of Boston, will hereafter control the sale of "Pawtucket" line material. This material has a high reputation and is the standard on many roads. Notwithstanding the high grade of this material, Chase & Co. claim to be able to market it at prices generally obtained for the cheapest grades. This is due to the unsurpassed facilities for manufacturing this material.

The Electrical Exhibition Company has, at a meeting held Dec. 7, decided to conduct another electrical exhibition at Madison Square Garden during the month of May, under the auspices of and in connection with the twenty-second annual convention of the National Electric Light Association.

Switchboard Instruments for Street Railway Generator Panels

The selection of indicating instruments for the generator panels of a street railway switchboard is a matter of as great, if not greater, importance than the selection of the instruments for the feeder panels. The latter subject was discussed in the November

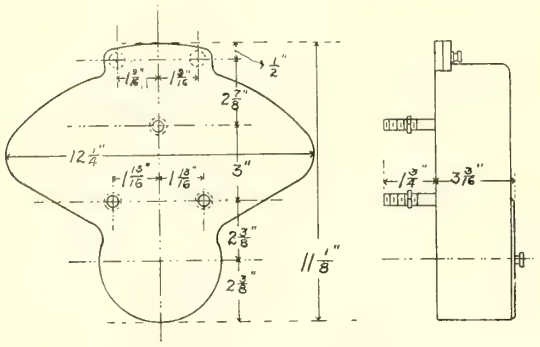


DIAGRAM OF VOLTMETER

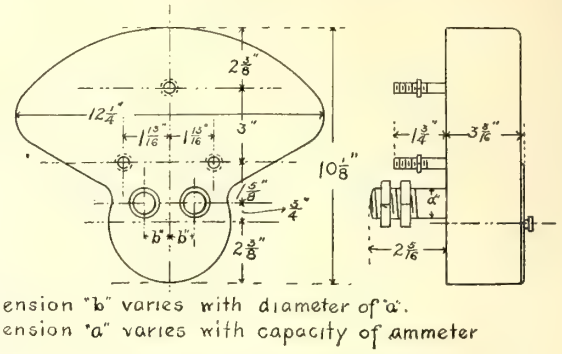
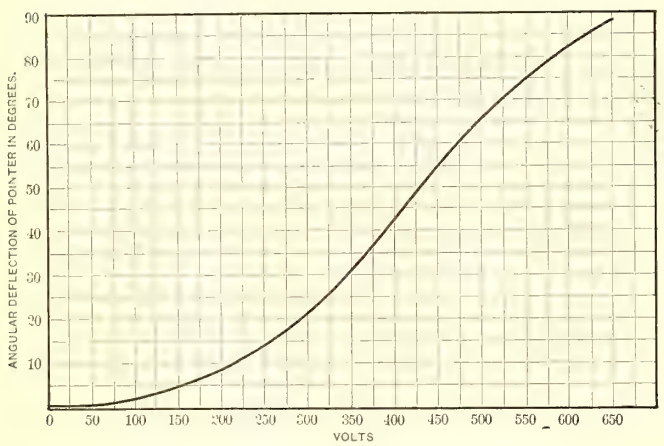


DIAGRAM OF AMMETER

issue, and much that was said in connection with feeder ammeters applies equally well to generator or summation ammeters. The principle employed in both cases is the same, the major difference being that of range, since one generator frequently supplies many feeders.

On the generator panel, however, it is the voltmeter, rather than the ammeter, which occupies the position of prime importance. The voltmeter indicates the potential of the generator, and, by proper deductions for line drop, the potential at the terminals of the car motors. Since street railway systems are invariably operated on the constant potential system and any abnormal variation of potential is followed by more or less serious trouble, it is important that the generator voltmeter should be accurate, durable and dead-beat, and if it lack any of these attributes it is not adapted for railway use.

To meet these requirements the Keystone Electrical Instrument

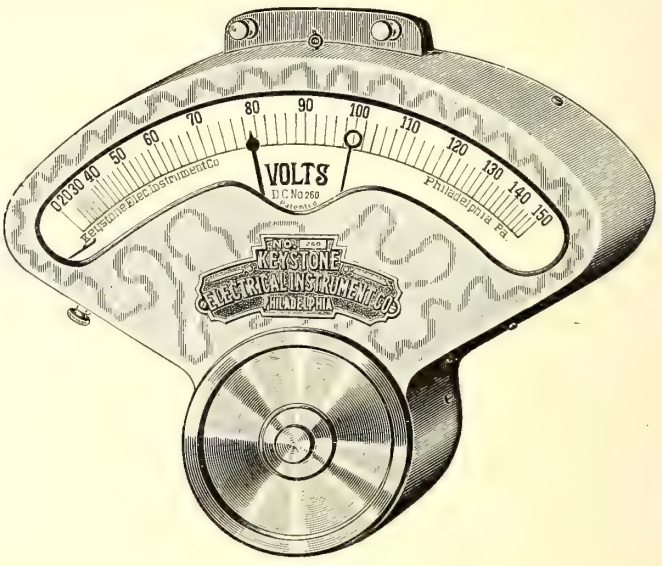


CALIBRATION CURVE OF VOLTMETER

Company, of Philadelphia, placed on the market, some years ago, a line of instruments designated by them as its Type "K." The engravings presented herewith show the external appearance of this type of instrument and, diagrammatically, its dimensions. As may be noted, the case is of graceful design and the scale long, with clearly marked and open divisions around the normal working point. The scale shown is that of an instrument reading to 150 volts, but if each scale division is multiplied by 4 it will represent its appearance when calibrated for a maximum potential of 600 volts. The finish of the case is brass, grained and lacquered by hand.

The system employed in the voltmeter is electro-magnetic, a system concerning which much has been written pro and con, but which has survived all attacks made upon it, and to-day is recognized as the one which, if scientifically designed and properly constructed, meets the exacting requirements of modern engineering practice. The general principle of the voltmeter and the methods employed in its construction and calibration, follow the lines laid down previously for feeder ammeters. Careful provision is made to protect the instrument from the influence of external fields, and the design is such that variations of temperature produce no variations in indications. This latter point is accomplished by employing a special alloy wire in the instrument, the temperature coefficient of which is negligible, and, in addition, providing a generous area of cross section, so that there can be no perceptible heating in the windings of the instrument due to the flow of the very small actuating current.

Calibration is effected by comparison with a standard voltmeter which never leaves the laboratory, and this standard is kept in absolute check by the galvanometer, bridge and standard cell method, now so well known in laboratory practice. In alternating current work comparison is made with a standard voltmeter employing the dynamometer system, and the windings of the switchboard instrument under calibration is so carefully proportioned between inductive and non-inductive resistance that errors due to self-induction and capacity, under normal variations of frequency, are quite negligible. Absolute compensation for any variation of frequency may be obtained by the employment of an inductive shunt across the terminals of the actuating solenoid. This method is described in a patent recently issued to the Keystone Electrical Instrument



VOLTMETER

Company, and provides for compensation between direct current and alternating current of any frequency.

One of the most important features in any indicating instrument is the curve of calibration, and attention is called to the curve shown herewith which was taken from a voltmeter now in use, calibrated for a total potential of 650 volts. From this curve, it will be noted that the lower portion of the scale is suppressed, and the calibrated portion, or working range, is from 100 to 650 volts. Values below 100 volts are never used in practice, and the suppression of this portion of the scale permits wider divisions around the normal working point. The curve is fair and follows accurately known laws with a total absence of irregularities. This last point is of prime importance, for an irregular calibration curve indicates arbitrary calibration and a system improperly designed or proportioned. Such a system is sure to give inaccurate results and to possess inherently objectionable features.

The calibration curve of any instrument can be found by removing the scale plate and finding the center, from which the arc of the circle forming the base of the division lines is described. Then by plotting the angular distance between the division lines, ex-

tended to the center, as ordinates with their coresponding values in volts as abscissae, the curve may be laid down.

Generator ammeters and summation, or total output, ammeters may be constructed on either the series or shunt principle, depending on the current to be measured and the local conditions governing the construction of the switchboard. For alternating current of large volumes the series transformer presents many advantages. This series transformer consists of a primary of one turn, cut in on the bus-bar and clamped or bolted to it, and a secondary of a number of turns of finer wire. The ammeter is connected across the terminals of the secondary and receives a current of from 10 to 25 amps. with a drop of a small fraction of a volt. The total current in the secondary circuit of the transformer is so proportioned to the current in the primary circuit that the effects of self-induction and capacity balance one another, there being sufficient current in all cases to provide ample force to properly actuate the ammeter system. The ratio of the current in the primary to that of the secondary in this series transformer must, however, be carefully determined under variations of load and variations of frequency, and these adjustments are always made by the instrument maker, then the ammeter can be calibrated in terms of the primary, or bus-bar, current.

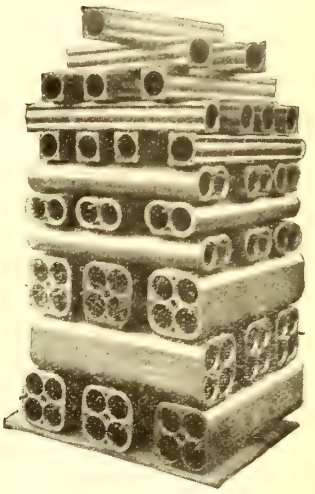
Voltmeters for high tension alternating current should be placed in the secondary of a regular step-down trasformer, which accurately transforms the bus-bar potential to a working potential of from 100 to 120 volts. All voltmeter transformers should be carefully tested by the instrument maker to determine their exact ratio and their variation, if any, under varying frequency and varying primary potential.

It is now considered good practice in high potential alternating circuits, using two or three phase transmissions, to place an independent voltmeter in each leg in order to obviate the dangers and annoyances incident to switching such high potentials on one instrument by means of a voltmeter switch when reading the voltage of each leg.

Modern practice in electrical engineering demands of each piece of apparatus employed in an installation accuracy, efficiency and durability, and if these are of importance in the generating, transmitting and translating devices, they are of far greater importance in the measuring instruments employed to determine them. Great care should be exercised in the design and construction of measuring instruments, and an equal amount of care and thought should be given by the designer of the plant to the proper selection of this important part of his installation.



TERRA COTTA CONDUITS READY FOR SHIPMENT



ONE, TWO AND FOUR-DUCT CONDUITS

The Manufacture of Terra Cotta Conduits for Electric Wires

Terra cotta, or baked clay, is one of the most enduring substances known, as the clay tiles and tablets from the ruins of ancient temples testify, being found by recent explorations in a perfect state of preservation. It is interesting to note in this connection how the potter's art, the most ancient of all arts, is now contributing to the safe and successful use of electricity, the most recently developed of nature's forces.

It is not the province of this article to tell how all conduits of this character are produced, but only as found in the works of the Potomac Terra Cotta Company, which are located at Terra Cotta, four miles out from Washington, D. C., on the line of the Baltimore & Ohio Railway. The plant includes clay beds, whence the material is mined, an extensive building for housing the machinery, and drying floors and kilns for the burning and vitrifying. The surface of the region is abruptly rolling, and the clay deposits, which are seemingly inexhaustible, are found in irregular veins located from a few to several feet below the surface, appearing to have been thrown up from a lower level by some internal upheaval. The deposit is in streaks of red and white, the red predominating, and in process of mining nuggets of iron ore are frequently found, ranging from a few ounces in weight to several hundred pounds. The method of mining is simple, as it is only necessary to remove the layer of gravel and sand, which covers the clay, which is very hard and dry, so that it is readily broken from the face of the vein by means of heavy iron wedges. The material, which is in lumps of various sizes, is transported a short distance to the mill in tram-cars or carts, and is dumped directly into a hopper at the side of the building, which is located against a bank, so that the road is slightly above the basement floor. From the hopper the material falls directly into a grinding mill, which consists of an open trough, about 10 ft. long, in which revolves a horizontal shaft. The latter is provided with heavy radial knives placed spirally, which cut or pulverize the lumps into smaller grains, and discharge the material at one end after the manner of a spiral conveyor. From this the material falls upon a belt conveyor, by which it is elevated to the grinding mill, and as it passes along the conveyor an attendant picks out from the mass all lumps of iron or stone.

The grinding mill consists of a rapidly revolving cylinder with grooves cut lengthways in the surface, and reduces the material still finer. From this mill the material drops directly into a pair of chilled crushing rolls, which are spaced less than 1/16 in. apart, and serve to crush the material into a fine powder. From this machine a belt conveyor distributes the clay along the floor of the basement of the building, when it is moistened by means of a hose, and piled up against the side walls, where it is left from five to seven days, or until thoroughly soaked or "tempered," which is the term employed. The amount of moisture depends upon the character and size of the product to be moulded. For instance, the material for large sewer pipe sections is necessarily more plastic than for smaller pieces. When sufficiently tempered the clay is delivered to the pug mill, which consists of a steel cylinder 8 ft. in length and about 18 ins. in diameter, in which is a revolving shaft carrying, over most of its length, spiral knives, and near the end a beater, which is similar to the flukes of a propeller. This serves to force the clay through the cylinder, and as the material emerges, the mass is sliced up by means of revolving knives, which run parallel to the end of the cylinder; from this the clay is immediately taken up by a bucket conveyor, and lifted to the top or third floor of the building, where, by means of short belt conveyors, it is conveyed to the cylinders of the forcing presses.

There are two vertical presses in which the steam cylinder is placed directly above the cylinder which receives the plastic mass. Three piston rods convey the power from the steam cylinder to the head of the press; the steam cylinders in each press are about 3 ft. in diameter, and have a stroke of about 4 ft., and operate under a pressure of 120 lbs. The diameter of the forcing press is from 20 ins. to 30 ins., and the material is fed in at the side after the follower is lifted. Suitable dies are attached to the base of the forcing cylinder, depending upon the character of the product. For making the four-way ducts the four dies are attached to a suitable interior frame-work, and are each about 12 ins. in length, cone shaped to within 3 ins. of the lower end, for which distance they are uniform in diameter, either 3 ins. or 3¼ ins., depending upon the size of the duct required. There are also rods placed in the dies, which serve to form the cavities designed for the dowel pins, and also for the small central duct. The conduits are made in one, two and four-duct sections, and are usually about 30 ins. in length. The four-duct sections when burned weigh about 80 lbs.

Sewer pipe, of sizes, up to 30 ins., is forced in the same manner, the dies being rounded off on the inner surface, so that the material spreads out and emerges in a perfect ring, which is cut into any desired length. In the process of forcing the sewer sections or conduits, a balanced platform, carrying a square board, known as a "shod," is placed directly under the die, which descends by the weight of the section as fast as it emerges from the die. When of sufficient length it is cut off by means of a wire, when the section still standing on end is transported to the drying floor. The sewer sections are readily shifted about the floors by means of long-handled trucks with small wheels. These trucks have, at their outer extremity, in line with the handles, iron bars bent in such shape as to be readily slid under the base or shod on which the section rests. Cleats on the under side of the shod raise it sufficiently above the floor to allow the bars of the truck to be inserted, when, the handles being slightly pressed down, the section is lifted, and can be safely shifted about. Flat two-wheel trucks with handles are employed for handling the conduit sections. The two upper floors of the building, which is T shape, one wing being 200 ft. in length, and the other 100 ft., are employed for drying the sections. This process requires from four to six days, steam pipes being attached to the ceiling of both floors to provide a suitable drying temperature.

For turning the sewer sections in the process of drying a semi-circular frame of slats is provided with curved runners on one side, and iron bar extensions on the other. This is called a cradle, and by inserting the bars under the shods on which the section rests the whole is gently lifted and turned on the rockers, end for end. Just before it is placed in position an attendant removes the shod, and puts it at the other end when the section is slid against it, and is brought to an upright position. The operation is performed very rapidly.

As soon as the sections are ready for the kilns they are lowered to the ground floor by means of balanced elevators, with which each floor is served, and the weight of the material as it descends serves to raise the alternate platform, so no power is required for the operation. Three boilers, two of 50 h.p. and one of 125 h.p., provide the steam for the drying processes, also for driving a 100-h.p. Atlas engine, by means of which the grinding machines are operated.

We are now ready to follow the sections of material to the kilns, of which there are twelve, and which are circular, some being 22 ft. in diameter, and others 26 ft., with two 30 ft. All are dome shaped, and bound about by hoops of steel plate 5 ins. in width. One of the newest, a 30-ft. kiln, has the dome finished in steps, and four hoops at the crown. It is built extra strong to support the expansive pressure of the dome, and, it is believed, will last for many years. In the process of setting the kilns the sections are transported from the dry house by means of trucks, or on the shoulders of the laborers, and are placed on end, with one section above another, until the whole interior is filled. The furnaces are placed at intervals in the outer rim of the kilns, and soft coal is burned in them. A double interior flame wall is provided about 6 ft. in height, between which and the outer wall the heat from the furnaces is delivered and passes to the dome, thence downward through the floor into the flues beneath, through which the smoke is conveyed to large chimneys, one of which answers for two kilns. The fire is started gradually and increased until the contents of the kilns are brought to a white heat, and continues from five to seven days, when the fires are removed. The furnace is then sealed up and the material is left for about the same length of time for gradual cooling. Just before the firing process is completed a cheap grade of salt is sprinkled into the furnaces, about a wheel-barrow load being required for a kiln. The fumes of the salt, uniting with the heated clay, serves to glaze the surface of the material inside and out, with the hard, impervious coating which is characteristic of this class of product.

The business of the Potomac Terra Cotta Company was established about twenty-five years ago, and until ten years ago the company was engaged in the manufacture of sewer pipe exclusively. This concern claims the distinction of having been the first terra cotta factory in this country to begin the manufacture of material for electric conduits, and filled its first conduit contract in 1887, the order being from the United States Electric Lighting Company, of Washington. One claim of superiority made by the manufacturers for their conduit which is known as the "Mason" is that of perfect vitrifaction, due to the use of a clay that vitrifies at a high temperature, rendering it non-absorbent, while it is indestructible by the elements when properly made. Another feature, and for which the company owns letters patent, is the provision of minor openings, designed for the reception of iron dowels in the ends, which secure perfect registration of the ducts in the process of laying. The dowels are about ½ in. diameter, and are provided on one side with a barb, which prevents a settling too far into the chambers designed for them. As the conduits are glazed inside, as well as out, little or no friction resistance is offered to the drawing in of the cables, and there is no chafing of the sheath. The conduits are thoroughly burned, have a dark chocolate color, and are unusually strong for this class of material. Being manufactured in standard lengths of 30 ins., they are easily handled, and not liable to breakage in handling or shipping. The affairs of the company are under the direction of George Mason, after whom the conduits are named.

A Handsome Vestibuled Car

The car shown in the accompanying illustration is, perhaps, one of the handsomest electric cars for regular service now in use on any road in New England. It is one of three which have just been built for the Newton Street Railway Company, of Newton, Mass., by the Laconia Car Company Works, of Boston.

The car is 25 ft. over end sills, and 35 ft. over bumpers. It is fitted with vestibules at each end, has reversible seats, and the windows are heavy plate glass, with double sash, similar to those on the finest steam cars. The interior of the car, including the vestibules, is finished in the choicest of mahogany panel work, with mahogany doors. There are eighteen reversible plush seats 32 ins. wide. The car is wired for twelve incandescent lights, and at each window post is a push-button for signaling the conductor. The car is mounted on Brill No. 27 trucks.



CAR FOR NEWTON, MASS.

A New Type of Surface Contact System

The Campbell Electric Traction Company, of Towanda, Pa., has recently put on the market a new type of surface contact system. In this system the conduit, which is about 6 ins. x 9 ins. in cross section, and air and water tight, rests on the top of the ties, and its upper surface is flush with that of the paving. The bottom and sides of the conduit may be of either wood or iron, as preferred. The top consists of 8 ft. metal sections, thoroughly insulated from the rest of the conduit and from each other. The interior of the conduit is hollow, and at the bottom on the inside lies a continuous rail, carrying the 550-volt current. Contact between this rail and the insulated sections on the surface of the street can only be made by a specially designed trolley or traveler that runs in the conduit, and is controlled in its movement by a pair of strong electro-magnets on the car. As the car moves along, the trolley on the inside of the conduit travels at the same rate, being always in position under the magnets at the center of the car. Consequently there can be no live section, except that over which the car is situated.

New Horizontal Engine, with Direct-Connected Generator

One of the latest designs of direct-connected units has been brought out by the B. F. Sturtevant Company, of Boston, Mass. This unit is unusually compact and neat, and has been built with special attention to the requirements of all conditions of service. The frame of the engine with the attached oil guard and removable side plates practically inclose the running parts, prevent the throwing of oil and decrease the annoyance from dust. The valve is of the balanced piston type, with snap rings, and operates in a removable bushing. The regulator, which is of the most delicate construction, secures the closest possible regulation through a range from zero to three-quarters cut-off. Continuous sight feeding arrangements are provided for all bearings. The engine is of the automatic horizontal center-crank type.

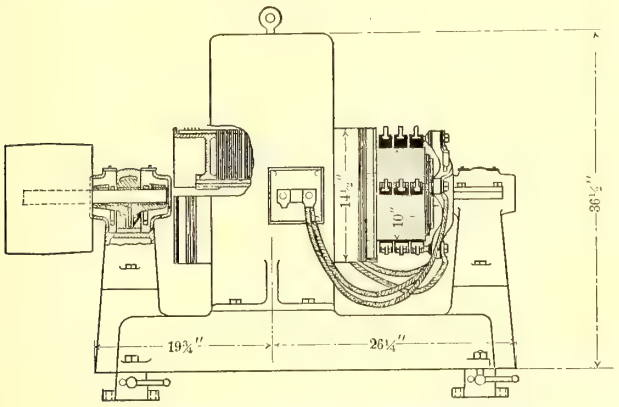


FIG. 3.—SIDE ELEVATION OF GENERATOR

The magnet frame of the generator is of cast steel, and the shaping of the pole pieces and proportioning of magnetic field and armature is such as to insure absolutely sparkless operation under all changes of load, from no load to 25 per cent overload. The temperature rise after a full load run of ten hours is guaranteed not to exceed 90 deg. Fahr. The bearings, which are ring oiling, are built upon the ball and socket principle.

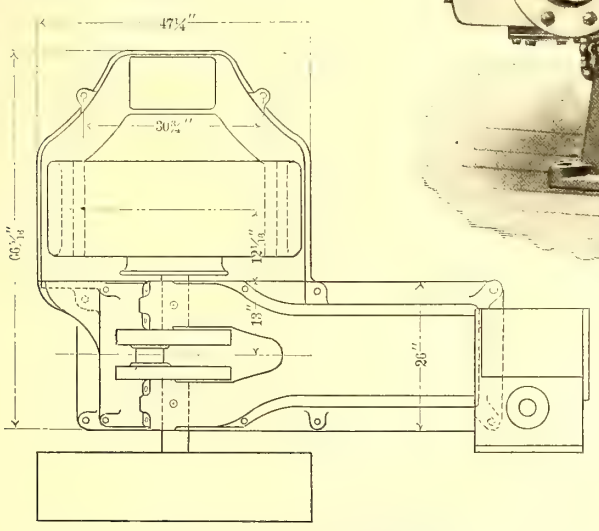


FIG. 2.—PLAN OF DIRECT CONNECTED UNIT

In Fig. 1 is shown the Sturtevant horizontal center-crank engine direct-connected to a four-pole generator. This unit is built with the engine cylinder of various sizes, ranging from 6 ins. x 8 ins. to 13 ins. x 12 ins. These are standard combinations, but any special combinations can be made to meet any requirements. Fig. 2 shows a plan view of a 11-in. x 10-in. horizontal engine connected to a 30-kw. generator. Fig. 3 shows the side elevation of the Sturtevant M P-4 generator. This unit is provided with a substantial bed, which serves to render the entire foundation extremely rigid.

The Thompson-Walker Surface Contact System

This system has been worked out by Prof. S. P. Thompson, the well-known writer on electrical subjects, in connection with Mr. Miles Walker, and upon invitation, an experimental line at Willesden was recently inspected by F. H. Fernie, representative of the STREET RAILWAY JOURNAL for Great Britain. The line is about 200 yards in length, and contains a sharp grade and curve. The electro-magnetic system is employed, as shown diagrammatically in Fig. 1, the magnets being excited by a piece of iron carried on the car. To understand the principle employed, some preliminary explanation is necessary.

If an iron plungeboard with extended ends like No. 2, in Fig. 2, is surrounded by a solenoid of wire carrying the current, it is possible to choose the size of the heads so that the tendency of the plunger to assume a central position is balanced by the attraction of the solenoid on the iron heads. With properly chosen heads the solenoid exerts no force whatever on the plunger. Gravity being the only force upon it, it will, of course, take up the position shown. If now a piece of iron is placed over it, as shown in No. 3, the plunger may be raised by the attraction between the two. In case a very heavy plunger is used it is possible to support part of its weight by merely increasing the size of the lower head by a small amount. It is thus possible to construct a simple piece of mechanism whose movement is entirely dependent upon the presence of a mass of iron in its neighborhood, and which cannot be moved by the solenoid itself, even though the magnetizing current carries the iron up to the saturation limit. This has been converted into the operating part of the switch.

Though the force of attraction is sufficient to lift a fairly heavy plunger and operate a switch, it is desirable to have something more than this, i. e., a switch which will, notwithstanding its massive moving parts, close in an exceedingly short space of time, as well as a very great acceleration upon the moving parts during the first part of their motion. This is obtained by the inventors by merely separating the upper head from the plunger by a short air-gap, and arranging matters so that the mass of iron comes over the switch before current is put through the magnetizing coil. As soon as current passes, the attraction upon the head is so great that the plunger gets up a high velocity before the two come together, with the result that the switch operates as though it had been hit with a hammer. A very simple device, a mere film of oil acting as a cushion, can be employed to prevent the switch from being injured by the concussion.

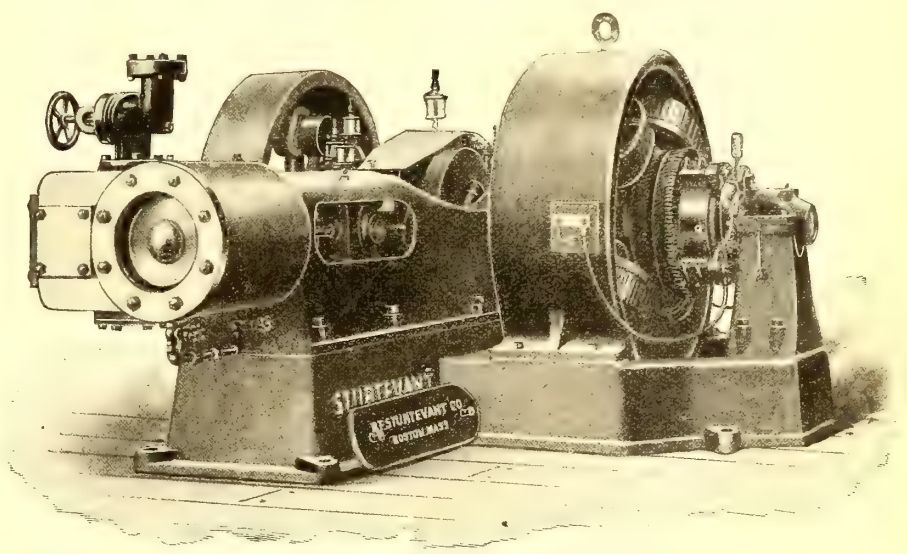


FIG. 1.—DIRECT CONNECTED UNIT

The connection of this operating part to the contact points of the switch has been the subject of some very varied experiments. If the safety of the street passengers could be made dependent upon nothing else than the falling of the plunger when the mass of iron is removed, it was thought by the inventors that as great perfection would be attained as could be hoped for from any moving mechanism. The attachment of any gear at once introduces the risk of friction and the simplicity of the issue is destroyed. For that reason, as well as for cheapness and convenience, the method shown in Fig. 3 was decided upon, though there are some simpler modifications of it still under experiment. The diagram, which is intended to illustrate the principle only, shows, in the first place, the cast-iron box which is laid in the street. This is surrounded by a gunmetal stud *S*, faced with a phosphor--bronze wearing cap.

This stud is insulated from the iron box by a sheet of micanite. A non-porous road material is placed around the stud to make up the level.

The box is filled with oil, which besides performing the function presently to be considered, maintains very high insulation throughout. The switch is attached to the stud and comes away with it in one piece. Being only about 4 ins. in diameter no difficulty is found in making a perfectly watertight joint.

The next point to consider is the method of making electrical contact. The requirements of switchpoints for disconnecting surface-studs are given by the inventors as follows: When closed the contacts should be of low resistance and capable of carrying 100 amperes easily. They should be incapable of fusing or sticking in any way, and should require only a small force to operate them. They should retain their shape and efficiency unimpaired for a long time without requiring attention. It will be observed that the current through the stud ceases as soon as the skate parts company with the stud as the car moves forward. Hence in the operation of the car as the switch-plunger falls it does not have to break the main current, that having already ceased. Yet although the switches are not required in the ordinary course to break a large current, it is desirable that they should be able in case of accident to do so without injury. After experimenting with different forms of contact it was found that nothing fulfils these requirements so completely as a properly designed mercury contact. Mercury contacts are, therefore, used throughout these switches.

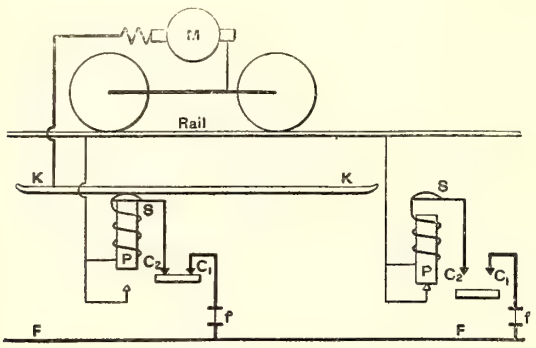


FIG. 1.—DIAGRAM OF CIRCUITS

The yoke of copper which dips into the mercury is supported by a brass tube which floats in the oil and fits loosely into a fixed brass tube which acts as a guide. When the plunger rises it takes the oil from under the float, which accordingly falls and connection is made. When the plunger falls the float rises. As the plunger moves quickly the oil has not time to leak past the sides, notwithstanding the very loose fit of the parts and the force upon the yoke piece is very great. At the same time a long movement is obtained.

To operate the switch contacts requires a fraction of an ounce. The forces which operate on the moving plunger (which slides freely in a brass tube in oil) are over 80 lbs. at the commencement of the stroke, and are several pounds at the end. The sliding plunger itself weighs 3 pounds. There is, therefore, a margin of safety of many hundred per cent. As the car passes on, there is a breaking of the magnetic and also of the electric circuit, adding to the security. There is yet a third line of defense to the public in that the switch is actually earthed, if when the car passes on the switch fails to open: for then the plunger earths the switch. In that event the fuse would be blown, effectually protecting the public from the possibility of a stud being left alive in the roadway.

It will be seen from Fig. 3 that three cups are employed; the two outer being connected to the main and the stud respectively. The main cup is inclosed in a metal sheath (not shown) permanently connected to earth, so that it is impossible for current to reach the stud except when the yoke is down. It will be seen from Fig. 3 that when the plunger is down it earths the center cup, so that if from any accident whatever the yoke piece fails to open the switch after a car has gone past, the plunger puts the stud to earth and blows the fuse between it and the main. Either shunt or series coils may be used to connect up the switch boxes. In practice a shunt coil is preferred because the slightly increased expense is more than compensated for by the smallness of the bulk. Only one skate is employed, and this is in the center of the car. This gives much greater facility in going round curves than where two skates and two rows of studs are necessary.

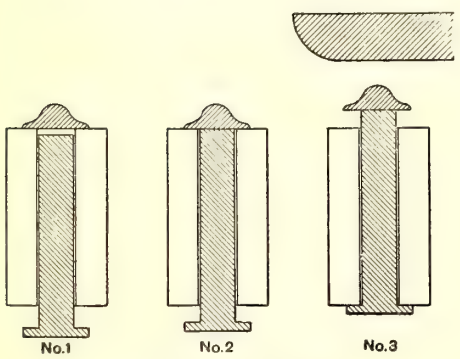


FIG. 2.—PLUNGERS

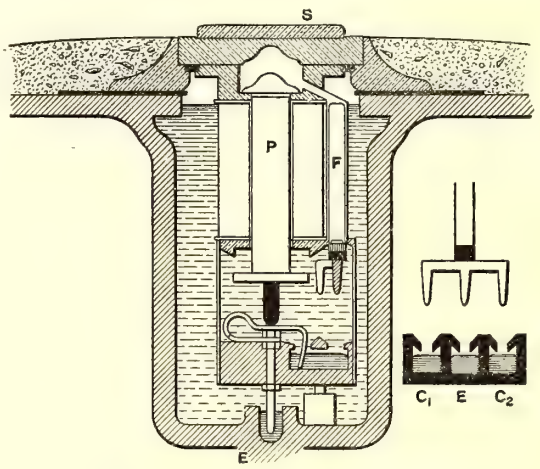


FIG. 3.—SECTION OF CONTACT BOX

New Electric Railway in Virginia

Contracts for the construction of the Norfolk & Atlantic Terminal Railroad, which is to run from Norfolk to Sewell's Point, Va., have recently been let to the Tennis Construction Company, Stephen Gerard Building, Philadelphia. The road will be operated by the overhead electric system and contracts for the material required have been awarded as follows: Hamilton Corliss Engine Company, Hamilton, Ohio, engines; E. Keeler, Williamsport, Pa., boilers; Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., generators, motors, etc.; H. W. Johns Manufacturing Company, New York City, overhead equipment; Maryland Steel Company, Sparrows' Point, Md., steel rails.

Telephones for Street Railway Service

The advantages of a private telephone exchange for connecting the different departments or offices of large corporations are so obvious that the demand for these exchanges has greatly increased within the past few months. To meet this call the Viaduct Manufacturing Company, of Baltimore, Md., is manufacturing a full line of telephones and accessories for private exchanges, and special care has been given to the designing of telephone instruments for the use of street railway companies. These instruments operate independently of a central exchange. They are made in two patterns; one, which is shown in Fig. 1, is a desk telephone with a switch located in the base, and the other, Fig. 2, is a wall telephone, with a switch in the face of the case. By means of the switches calls are made to any of the other instruments on the system. The calls may be received with the switch on any point, but in order to talk with the new call it is necessary to place the switch upon the home stud. The use of these instruments avoids the necessity of a switchboard and attendant.

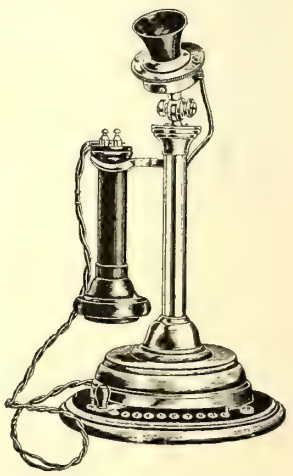


FIG. 1.—DESK TELEPHONE

This company also makes a portable telephone outfit designed for the use of the street railway conductors, who are required to report to the starter at the station from any point on the road. For using these instruments when no special provision has been made, contact is made by throwing the wire over the telephone line wire and making a ground connection, but where a metallic circuit is employed, contact is made with both limbs of the service. Where there is much telephoning to be done it is better to provide cut-outs at intervals on the trolley poles along the line, so that the plugs of the telephone instrument can be attached directly to the circuit. The portable outfit consists of a generator ringer, a re-

ceiver of hard rubber, the transmitter and two-cell dry battery. This is all inclosed in a neat case and provided with a strap for carrying. The outfit weighs only about 9 lbs.

Another specialty manufactured by the Viaduct Manufacturing Company for the use of electric railways is an alarm or signal for use in outlying districts. This instrument is fitted with a large vibrating gong, and is intended to be attached to a trolley pole. In this way the starter can signal the conductor of a passing car should he wish to communicate with him while on his trip. This signal can be used in connection with either a stationary telephone at the same pole to which the gong is attached, or else the conductors can be supplied with a portable outfit.

Storage Air Brake System

A new type of air brake has been in use for some time on the Detroit & Pontiac Railway, as mentioned elsewhere in this issue, and is giving excellent satisfaction there. It is placed on the market by the G. P. Magann Air Brake Company, of Detroit, Mich., and is illustrated in detail in the accompanying engravings. The system contains a number of novel features, one of which is that no compressing devices, either axle or motor driven, are carried on the car, but the air is compressed to the requisite pressure by means of a stationary steam driven compressor in the power station, and is then stored in reservoirs on the car for use. This, of course, reduces enormously the amount of apparatus required, and removes entirely the most complicated part of the air brake system to the station, where it can be directly under the supervision of the power house engineer. The chief claims made for this radical step are that it eliminates: first, any noise from the air-pump when the car is at rest; second, attention required to the pump and its motor, either on the road or in the car house; third, possibility of breakdown; fourth, greater amount of apparatus, and, fifth, the loss of valuable space in the car.

As in use on the Pontiac line, the air is first compressed at the power station to 225 lbs. per square inch by means of a Laidlaw-Dunn-Gordon reciprocating air pump located near the boilers and driven directly by steam pressure, and is stored in a large reservoir, from which it is piped to an adjustable coupling near the track. Each car carries two storage cylinders made of riveted sheet steel and tested under hydraulic pressure to double their working pressure. These cylinders have a capacity aggregating about 36 cu. ft. and are stored to 225 lbs. The time required for making connections, charging and breaking connections, is less than half a minute, and is done while the conductor is obliged to enter the office of the company at that point and make his usual report. The storage tanks on the car are piped through a reducing valve to a small reservoir which carries 40-lb. pressure, which is the working pressure. The usual connections are then made from this small reservoir to the jam cylinder through a 3-way controlling valve on the platform. The jam cylinder is of the differential type, air being admitted on both sides of the piston, which moves in two cylinders of different sizes. To stop the car the large-sized cylinder is exhausted, allowing the air pressure in the smaller cylinder to force the brake on. To release the brakes air is admitted to the large side forcing the brake off, making a positive release. This also allows the motorman to put on only the requisite braking pressure, any undue pressure being immediately relieved by air cushioning in the large cylinder. With 36 cu. ft. stored to an original pressure, 200 lbs., a large double truck interurban car on the Pontiac line ran six hours and twenty minutes, or a total of 96 miles, in a hilly region, and made 228 stops. When the car was run into the car house there was still enough air pressure to handle the brakes with ease, the gage showing 40 lbs.

The average reduction in pressure in the large cylinder for each stop is 0.8 lbs.

The equipment has been in constant use on the line mentioned for over nine months without requiring any repairs.



CHARGING AIR BRAKE RESERVOIRS—DETROIT



FIG. 2.—WALL TELEPHONE

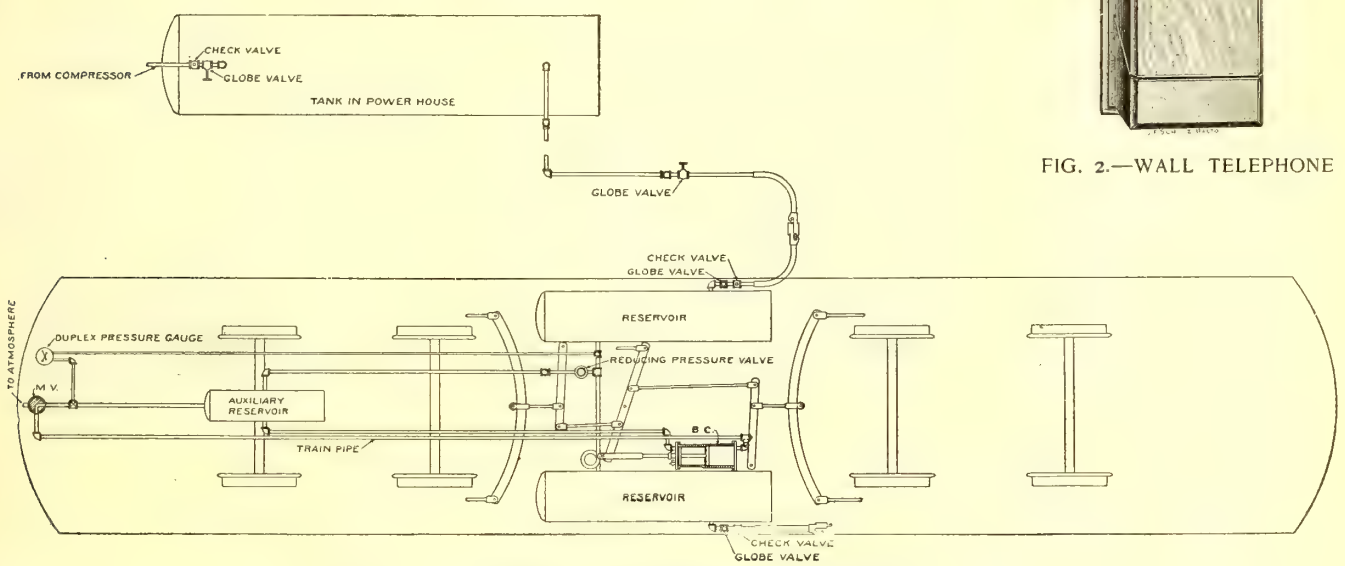


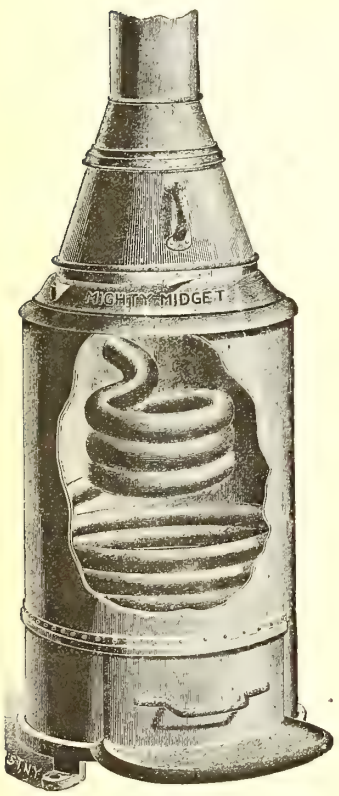
DIAGRAM OF AIR BRAKE EQUIPMENT FOR DOUBLE-TRUCK CARS

Hot Water Heaters for Electric Railways

The increasing use of long double-truck cars has brought the method of car heating by hot water for electric railway cars into considerable prominence. As mentioned elsewhere in this issue, the principal interurban railways in the vicinity of Detroit are employing for car heating an improved type of the Baker hot water heater, which has been so extensively employed in steam railroads for the last thirty years. The heater is made in a variety of sizes, that employed on the Detroit suburban cars being known as the "Mighty Midget." This type embodies all the features which have given these heaters their high reputation.

The generator coil forms a complete water cage for the fire, as the latter is entirely within it. This coil is seamless and is tested by high hydraulic pressure before installing. The pipe is 1¼ ins. in diameter and has a spiral length equivalent to 22 ft. 4 ins.

The water employed is saturated with salt to prevent freezing, and its course is first through the generating coil, thence upward into the water reservoir and expansion drum above the heater. It is thence downward through the radiating pipes which are run along the sides or under the seats of the car, then back to the generating coil. Salt is employed to keep the water from freezing, but it is found this does not exercise any deleterious effect on the inside of the pipes.



HEATER

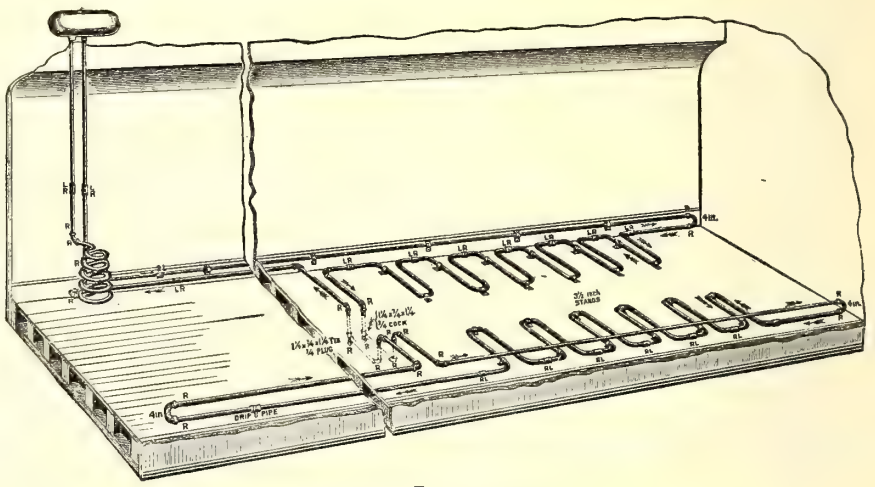
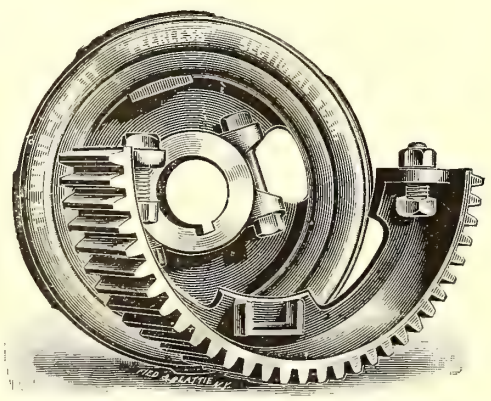
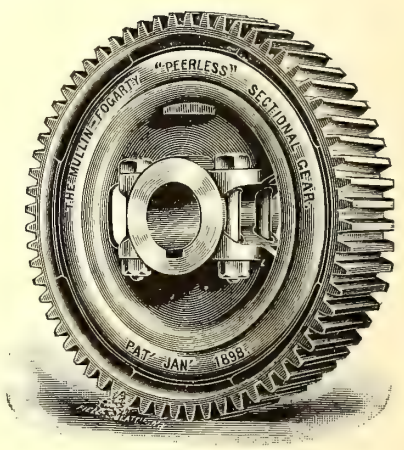


DIAGRAM OF PIPING



SECTIONAL GEAR WITH HUB AND RIM SEPARATED



SECTIONAL GEAR

Usually these heaters are placed in the front vestibule, and what little care is required by them is given by the motorman. The position of the heater on the car at this point does not take up any valuable space and serves to keep the vestibule warm. The diameter of this sized heater is 18½ ins., its height is 3½ ft., and its weight, boxed ready for shipping, is 520 lbs.

These heaters are giving splendid satisfaction in Detroit, Minneapolis, St. Paul, Milwaukee and other large cities where large cars are used, and seem adapted for electric car heating purposes, especially for long cars on interurban and suburban roads, such as exist in these cities and are becoming common in all sections of the country. These heaters are manufactured by William C. Baker, successor to the Baker Heating Company, New York.

The Electrical Installation Company, of Chicago, has been doing a large amount of construction work recently, notably in Kansas City, where it is changing the Broadway Cable line to electricity.

Sectional Gears

A new sectional gear, embodying a number of novel features, is shown in the accompanying illustrations. The invention consists of a cast-iron hub, or center-piece, to which are attached removable sections of any metal specified. These sections are interchangeable. When the hub, or center-piece, has been once keyed in place on the shaft it does not require any further attention, and when the teeth of the rim sections have become worn, these sections can be taken off and replaced by new ones in a few moments, thus making practically a new gear.

The hub piece and rim sections are beveled where they come in contact with each other in such a way as to make a perfect fit and prevent all lateral motion. To do away with the possibility of the rim revolving on the center-piece, a steel safety key is slipped in place between the rim and the hub, absolutely locking them. The advantages of an interchangeable construction of this kind will be evident to any one using gears, as it removes the necessity of taking off the entire gear as soon as a few of the teeth are worn out or broken. This construction also makes an extremely light wheel without, it is claimed, reducing the strength. One cut shows a complete gear with a solid hub, and the other, the hub and one section of the rim before being placed in position on the hub. These gears can be made of any shape and pitch with coiled discs for small sizes and with arms for larger sizes, if desired. They are manufactured by the Peerless Section Gear Company, of New York City.

The Worthington Water Tube Boiler

The Worthington boiler, which is illustrated herewith, has been used to considerable extent in electric light and other work, and has established a high reputation for compactness, accessibility and economy of fuel. The furnace extends under the entire boiler and is of proper height to permit the use of any kind of fuel. The tubes are lap-welded and each is straight. The circulation of the water, as will be seen, is upward in every tube with the exception of the two downtakes at each end of the boiler, which are not exposed to the gases. The course of the water is then, from the steam and water drum located above the tubes into which it is fed, through

the downtakes placed outside of the furnace to the mud drums at the base, thence by the tube connections into the lower series of headers, thence through the tubes over the fire through the upper series of headers, thence by the tube connections into the water and steam drum from whence it started.

As the tubes are short, their linear expansion and contraction are not perceptible and they can easily be cleaned. The headers are of steel or iron, according to the service required, and are arranged in the boiler close together, forming complete side walls. The furnace is lined with fire brick. The only other brick required, excepting in boilers of large units, consists of two foundation walls of proper depth, rising above the floor level about 12 ins.

From the fire the gases rise, percolating through the tubes, which are thus exposed directly to the action of the fire, and finally make their exit at the top on either side, as is most convenient.

The vertical space between the tubes is only about ⅜ in. No baffle plates are used, and, as the gases rise perpendicularly and without any sharp turn, the draft is good. It is estimated by the manufacturers that the boiler will run to its full capacity with about ⅛-in. draft, or about one-half that required by other boilers.

Another important feature of the boiler is the quality of the steam. As will be noticed from the design of the boiler, the circulation is excellent, and when the steam from the pipes is discharged into the steam drum the distribution is along the whole length of the drum and at the surface, and not underneath the water. The delivery is therefore quiet and the steam does not take up any of the water from the drum. As it impinges against a small baffle plate in the drum on entering the latter, the water held mechanically in the steam is separated from it.

The water enters the mud drum from the ends and leaves it from near the center. At the latter point, therefore, is a dead place where the mud accumulates and where the blow-off is located.

Owing to the fact that the heat is so directly utilized, the boiler requires a less grate surface than most other makes. Economy of floor space is an important feature of this boiler. This will be seen from the statement that the 25-h.p. boiler is 9 ft. 4 ins. in length, 8 ft. 9 ins. in width and has a total height of 10 ft. The amount of saving in floor space is figured at about 50 per cent. The boiler can be fired either at the ends or on the sides. The normal condition is the end method of firing and is the one shown in the engraving. Where desired, however, the end can be closed up and the boilers fired at the side. This is usually done on large boilers, because the boiler is made of sections, and beyond a certain depth it would be impossible to reach the end of the grate surface easily.

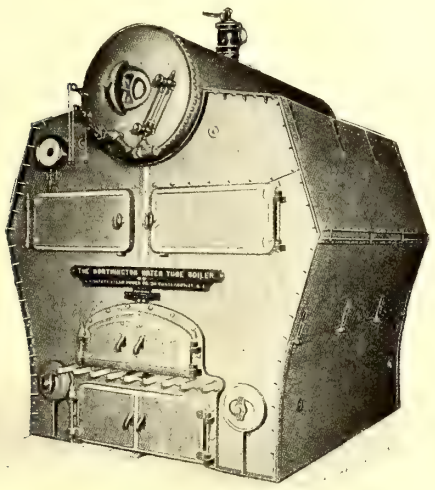
Where the boiler is fired on the side two or three of the headers are removed and the end is closed up.

The following are some figures secured from a test of boilers made in June, 1897, by Prof. D. S. Jacobus, of Stevens Institute of Technology, on boilers in the plant of the American Surety Building, New York:

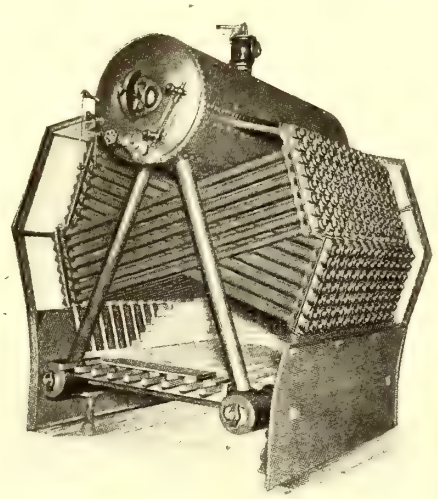
Builder's rating of h.p.			142
Heating surface, in square feet			1275
Grate surface, in square feet			36.35
Ratio of heating to grate surface			35.1
Number of test	1	2	3
Date of test	June 1.	June 4.	June 7.
Length of test in hours and minutes	10-17	12-12	11-11
Total Quantities—			
Coal consumed, not deducting moisture in same, in lbs.	10,664	6,556	10.881
Wood used in starting fire, in lbs.	159	159.5	150
Coal equivalent in wood at 0.4 x weight of coal, in lbs.	10,728	6,620	10,911
Ashes, in lbs.	1,651	1,149	1,857
Net combustible, in lbs.	9,077	5,471	9,084
Water evaporated during test, in lbs.	69,785	50,484	73,438
Water evaporated during test, in lbs, per hour	6,786.4	4,138.1	6,566.9
Average Quantities—			
Pressure of steam, in lbs per sq. in above atmosphere	94.55	92.72	95.56
Temperature of feed water, in degrees F.	65.14	64.45	64.34
Temperature of boiler room in deg. F., dry bulb.	79.17	87.18	80.02
Temperature of boiler room in deg. F., wet bulb.	68.91	78.50	66.59
Draught, in inches of water, in flue leading to chimney	1.057	0.814	1.124
Draught, in inches of water, in connection at top of boiler leading to flue	0.548	0.212	0.461
Percentage of ash in coal	15.39	17.36	16.97
Percentage of moisture in coal	2.06	1.80	2.00
Temperature of flue gases, in degrees F	504.4	440.4	524.9
Calculated Quantities—			
Factor of evaporation	1.191	1.191	1.192
Pounds of water evaporated per lb. of coal, not deducting moisture in coal (actual)	6.50	7.63	6.71
Pounds of water evaporated per lb. of coal, not deducting moisture in coal (from and at 212 F).	7.75	9.08	8.00
Evaporation in lbs. per lb. of combustible, not deducting moisture in coal (actual)	7.69	9.23	8.08
Evaporation in lbs. per lb. of combustible, not deducting moisture in coal (from and at 212 F).	9.16	10.99	9.63
Evaporation in lbs. per lb. of combustible from and at 212 F., deducting the moisture contained in the coal	9.38	11.23	9.87
Coal burned per sq. foot of grate surface per hour, in lbs.	28.7	14.9	26.9
Water evaporated per sq. ft heating surface per hour, in lbs.	5.32	3.25	5.15
Horse-power of boiler.—One h.p. 34½ lbs. of water evaporated from and at 212 F., per hour	234.3	142.9	226.9

Lubricating Compounds and Cups

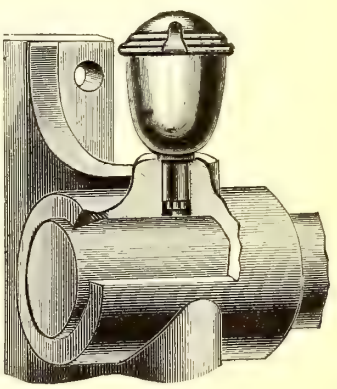
A lubricating compound, which is claimed to give absolute satisfaction under all conditions of temperature, wear, etc., is made by the Albany Lubricating Compound & Cup Company, of which Adam Cook's Sons, of New York, are the proprietors. This compound is known as Albany grease, and when it is used the manufacturers guarantee that it will absolutely prevent the burning out of armatures and overheating of bearings.



EXTERIOR OF BOILER



BOILER WITH SIDE REMOVED



LUBRICATING CUP

The Albany compound is usually made in four different degrees of hardness, figures being used to denote the different grades; No. 0 is very soft, being for use in extreme cold weather and on exposed journals; No. 1 is harder than No. 0, and is to be used on ordinary journals in cold weather, or on very cool or slow running journals; No. 2 is still harder and is a grade ordinarily used in moderate and warm weather; No. 3 is adapted to the use of all stationary, marine and tugboat engines, also shafting in warm weather. An extra grade, known as No. X, is also made. This is very hard, and it is stated will lubricate journals when no oil or other lubricant will work.

A special lubricating cup has been designed by Adam Cook's Sons, and they advise its use with their Albany grease, to secure the best results. The cup is shown herewith. As will be seen, the manner of attaching it is very simple, and it can be done by any mechanic. The Albany cups require the minimum of attention and very seldom get out of order. When filled with the lubricating composition they will run from one to four months, according to the power and velocity of the shafting, without refilling. They thus effect a great saving of labor, as well as in the cost of lubrication. With the use of Albany grease and these cups, no drip pans are required.

Combined Baggage and Passenger Car

The two great fertile valleys of Frederick and Middletown, in Maryland, have recently been connected by a street railway running through a gap in the mountains. The termini are respectively the cities of Frederick and Middletown. It is a matter of some interest to know that this electric railway takes nearly the same



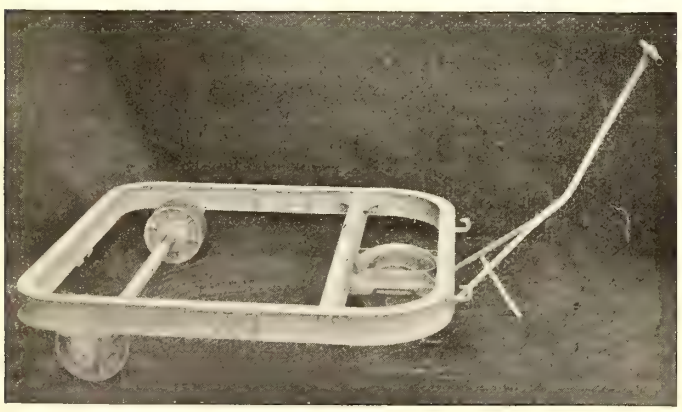
COMBINATION BAGGAGE AND PASSENGER CAR

line as the Great National Road of the early part of the century. Communication until the advent of the railway had been difficult between the two valleys, owing to high tolls and the steepness of the grades. The successful operation of the road is developing a baggage and express business in addition to the passenger traffic. The car illustrated shows the method which the road has adopted to carry on this business in an economical manner. The cars of the road are mounted on No. 21 E trucks, and the same truck is employed for the combination express and baggage car, which also has a passenger compartment. There is considerable advantage in combining the service, because it does not interrupt the regularity of the trips, as is the case where the car is exclusively devoted to freight and carries no passengers.

The car is 18 ft. long over end panels and 7 ft. 6 ins. wide at belt rails. There are two G. E. 51 motors for propulsion. The platforms are 4 ft. long and have vestibules with folding doors, and are plated with sheet steel. They are also provided with angle iron bumpers. The trim of the car throughout is of solid bronze. The passengers' compartment is 8 ft. 8 ins. long, and the remaining portion of the body is finished in hardwood with folding seats, making a baggage, express and smoking compartment. There is a sliding door in the partition between them. The oak side sills are of unusual depth and are plated to provide the necessary strength. Brill sand boxes and gongs are provided. Taken altogether, the car is a very neat and complete example of its type as adapted for use on interurban roads.

Hand Trucks for Buenos Ayres

In the STREET RAILWAY JOURNAL for November, 1898, was described the method by which meat is handled in the city of Buenos Ayres between the slaughter houses and the markets. Reference was made in the article to the trucks upon which the meat boxes



HAND TRUCK

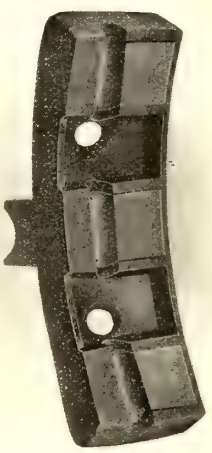
were handled on arrival at destination. The accompanying illustration shows one of these trucks. They are mounted practically upon three wheels, although the forward wheel is doubled, to facilitate turning. This forward wheel is set in a turn-table carried in ball-bearings, and the whole truck can be turned in its own length. While it is intended that these trucks should be moved by hand, a large portion of the work done with them is performed by means of mules, and the trucks themselves are arranged so they can be hauled in trains.

The handle of one truck is made of sufficient length to drop into the hooks at the rear end of the truck in front of it. The handles of the forward truck can be turned up against the meat box, or can be unshipped and the team attached to the two hooks seen in front of the trucks. The construction is exceedingly simple, and at the same time of the greatest strength. Hyatt's roller-bearings for each journal reduces the friction to a minimum. This is a small truck that might be used to advantage in repair shops, depots and other places where heavy weights are to be moved and when the roads do not have overhead trolleys for the purpose. The trucks illustrated were made for 6000 lbs. capacity, but they can be built for any desired load from 1000 lbs. up.

Remedy for Flat Wheels

The annoyance to passengers from "flat" wheels and the expense to the street railway company of renewing these wheels has made this problem of preventing "skidded" wheels one of the most serious that the manager has to meet. Various methods have been suggested as to the best way of dealing with the problem, one of the latest being the use of a brake shoe containing emery inserts. This shoe is designed to be substituted for the ordinary brake shoe on a wheel that has become flattened, and in this way to gradually true up the wheel without removing it or the car from service.

This shoe has been introduced by the Wheel Truing Brake Shoe Company, of Detroit, Mich., and is in every way similar to the regular brake shoe with the exception that in its face it contains pockets or compartments, every alternate one of which is filled with an emery mixture baked hard like the section of an emery wheel. When the wheel becomes flattened the regular brake shoe is removed and the wheel truing brake shoe is put on in its place. The car is then run as usual, and every time the motorman applies the brake, for the purpose of checking the speed of the car, the wheel is ground down a little and brought back to the proper shape. The shoe, of course, grinds only when the brake is applied, so that usually it requires a number of trips to true up the wheel and then the old shoes are replaced. It will be seen that in this way the new brake shoe acts upon the same principle as an emery wheel, with the exception that the emery is held stationary and the wheel revolves against it. The face of the shoe is a part of a true circle, and therefore the shape imparted to the wheel will be perfectly true. The time required to take off the old shoes and put on the wheel truing brake shoe is very short compared with the loss of time incident to running the car into the barn and jacking up for the purpose of grinding the wheels.



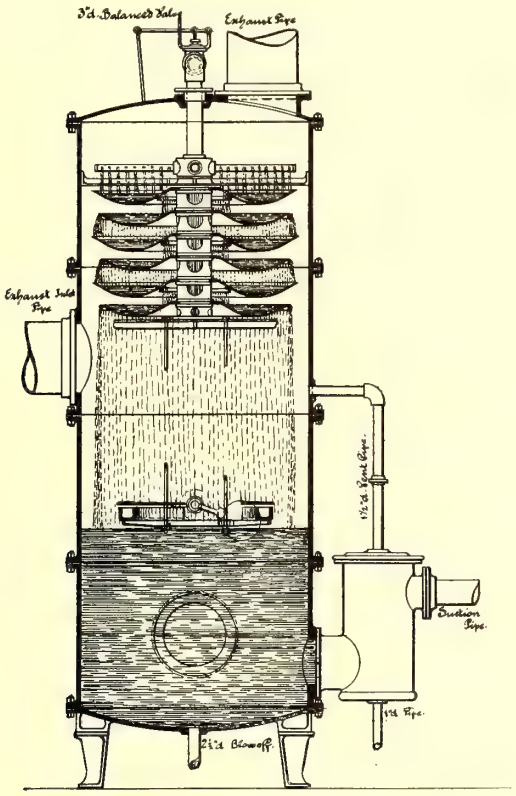
SHOE FOR TRUING FLAT WHEELS

These shoes have passed the experimental stage and are now in use on a number of roads. The Rapid Railway, running between Detroit and Mt. Clemens, Mich., was the first road to equip its cars with them, and it is stated that this company has not been obliged to remove any wheels, for the purpose of truing them up, since the time the new shoes have been in operation. The invention is patented in America and in all European countries, the later patents being the exclusive property of J. M. Griffin, the president of the company which is handling the shoe in the United States.

Open and Closed Feed Water Heaters and Purifiers

Steam users designate the two leading types of feed water heaters as open and closed. In the former the water is divided by means of open pans, so that the exhaust steam comes in direct contact with the agitated water. In the closed type the cold water is directed through a nest of pipes, and is heated by the surrounding steam. An open type of heater is shown in the accompanying

illustrations, Figs. 1 and 2. In this particular type the shells, as well as the interior parts, are made from cast iron, it being found that this metal is less liable to corrosion than steel or rolled iron. As will be noted, the interior construction consists of a series of round settling pans, mounted one above another on a central hollow shaft, but loosely, so that they can be readily turned and every part be brought before a side door in the shell, when they are easily cleaned or inspected. The water is admitted at the top through perforated branching pipes of brass, by which means the water is evenly sprayed over the whole surface of the upper pan, which is perforated, and from which the water flows in small streams to the pan below, then over the edges of the succeeding pans until it is accumulated at the bottom of the heater. Exhaust steam is admitted through the sides of the heater, below the pans, and ascends along the outer edge of the pans and through the perforated hollow shaft, so that it passes over the surface of each pan, imparting its heat to the finely subdivided water, causing rapid



SECTION OF HEATER

condensation, with little or no back pressure. In its passage all impurities are deposited in the pans or at the bottom of the heater.

A horse-shoe trough within the shell at the normal water level serves to skim off and discharge the oil or other floating impurities, while a sensitive float, consisting of a copper ball, operates a valve in the supply pipe, at the top, and thus regulates the supply of water. A small auxiliary cylinder, known as an oil separator, is attached to the side of the shell, and is connected by a pipe to the water in the base of the shell, but a little above the bottom. The suction pipe from the feed pump enters this auxiliary cylinder a little below the surface of the water, while a second pipe, or by-pass, connects the top of the cylinder with the steam space in the heater, and so designed that should the water, from any cause, fall to a level with the suction pipe, it would draw steam instead of water, or the oil that might possibly have gained entrance to the cylinder. Blowoff pipes for removing the sediment are provided at the bottom at both the main shell and the auxiliary cylinder. A water gage and thermometer complete the essential parts of the heater. The heaters as above described are known as the Pittsburgh feed-water heaters and purifiers, and for which James Bonar & Co. are general sales agents.

The same concern handles a closed type of heaters that are manufactured in various shapes, both with curved and straight pipes, which united different chambers, and providing large heating surface.

The open heaters are manufactured in sizes from 50 h.p. to 6000 h.p. Some of the shells, as shown by Fig. 1, are from 18 ft. to 20 ft. in height and 5 ft. to 6 ft. in diameter. The heaters of different types are manufactured in Pittsburgh under the direction of J. E. Schlieper, by whom they were designed and patented.

The "Sterling" Specialties

The beautiful white enameled dial of the Sterling Supply & Manufacturing Company is coming to be seen more and more often on the cars of American street railways, small as well as large, though hitherto a favorite among the larger companies chiefly. Its exclusive use by the Metropolitan Street Railway Company, of New York, is, of course, almost in itself a guarantee of its excellence and satisfactory qualities, since it is well known that every possible "leak" is avoided on the Metropolitan system, and no leak is so important as that of earnings. The Sterling trip and totalizing alarm registers are made with either the plain white numeral disc referred to, or the dial indicator, as may be preferred, and are arranged for either cord or rod connection, as desired. All of the auxiliary equipment devices are of the finest quality and most carefully made.

Nearly every one who rides on the Broadway cars in New York City wonders at the power and delicate adjustment of the brakes in use thereon, by means of which a car may be run in a crowded street at considerable speed, almost to the point of touching a wagon or another car in front, and yet may be instantly brought to a complete stop by a slight movement of the gripman's hand. The brake which accomplishes this result is the invention of Thomas Millen, master mechanic of the Metropolitan Street Railway Company, and is made by the Sterling Company. It is a simple hand brake with one essential peculiarity, namely, that the usual movement of the brake rod is multiplied in power through a gear and pinion working in the ratio of 5 to 2. On the gear axle is a double



GROUP OF HEATERS

sprocket wheel, which operates the brake levers by means of a chain. Another feature of the entire brake apparatus is that the brake shoes are run very close to the wheel, so that a slight motion only is necessary to bring them to full bearing, and the wear on the brake shoe is taken up in the chains connecting with the brake rod. There is a material saving also in the wear of chains as compared with the old-fashioned brakes. With the sprocket wheel used a chain usually wears several years.

Another well-known device made by the company is a street car fender also in use in New York and other cities. This is a track fender, not a dashboard fender.

The Sterling Company has recently enlarged that portion of its plant devoted to the manufacture of insulating material and commutator bars, and large quantities are being turned out to meet a greatly increased demand. The insulation is a special compound molded while in a plastic state under hydraulic pressure. It is hard, tough and impervious to weather, and has high insulating qualities.

In addition to these more important specialties, the Sterling Company also manufactures a large line of street railway supplies of various kinds, including the Sterling sand box, conductors' badges, the Sterling counter for counting reciprocating or rotary movements, including revolutions of wheel axles, machinery, etc., a wire measuring machine and a winding machine for recording revolutions of spindles and armature bobbins. With so large a number and variety of specialties, it goes without saying that the Sterling Company is of great use to street railway purchasers.

The Bloomfield (Mich.) & Orchard Lake Electric Railroad Company has been incorporated with a capital stock of $50,000. George L. Hendrie is the principal stockholder.

The Lord Baltimore Maximum Traction Truck

The design of this truck conforms to that of the well-known Lord Baltimore single and center bearing trucks. The pedestals are of steel and form part of the side frames; they are provided with housings to receive graduated coil springs, which rest on the axle boxes and carry entire weight, thoroughly cushioning all. The car body and load ride upon four half elliptic springs, two to each truck and suspended from the below the side frames by links and connected by posts to the truck bolster, the posts being held in place between and guided by the bars forming part of side frames and connecting the pedestals. They are of bolster construction, to which pivotal centers are fastened, the pivotal centers being located at or near the centers of driving axles; the weight of the entire structure is so proportioned that 66 per cent rests upon the driving wheels, and is applied to the wheels through bolsters and distributed upon centers of bolsters and self-oiling roller side-bearings revolving upon steel thimbles. These roller side-bearings, upon which car body chafe plates bear, are placed directly above centers of half elliptic body springs. The axle boxes are of most approved dust and oil tight pattern and provided with either felt or waste feed, as may be desired.

The driver and cross frames are bolted directly to the main pedestals and of such form that they will never be outside of track line in curving; the only function they perform is to carry bars supporting the motors upon outer ends, the motors being placed outside of drivers.

These end cross frames form stiff end ties for side frames, which are also securely braced diagonally between the wheels. The frames, taken as a whole, are as securely built as the best locomotive trucks and have all the advantages of stiffness and stability claimed for center-bearing trucks of the most approved design.

The brakes are applied between wheels and so constructed with proportioned levers that 70 per cent of the braking power is applied to the drivers; they are operated by levers acting from the pivotal points of trucks, avoiding the use of objectionable quadrants in applying brakes upon curves; all the working parts of the brake mechanism have large bearings provided with oil holes, work upon steel thimbles, are placed at center lines of trucks and not liable to receive mud or dust thrown up by the wheels. They are extremely powerful, and the braking power is equalized between the trucks by interposing springs in such manner that it will be divided equally between the trucks, and each wheel will receive its proper proportion of the braking power.

These trucks are thoroughly and carefully built in every particular, and special attention has been given to preventing shearing strains upon the bolts, and all parts are of steel and malleable iron, no cast iron being used except for wheels and brake shoes.

The trucks are manufactured by the Baltimore Car Wheel Company, of Baltimore, Md.

Transformer Design and Operation

Under the title, "Transformer Design and Operation," the General Electric Company issues a pamphlet from two important papers on the subject of electrical transformers. One is written from the standpoint of the central station manager by W. F. White, general manager of the Omaha (Neb.) Electric Light, Heat & Power Company; the other, by Prof. Winder Elwell Goldsborough, M. D., deals intimately with the question of transformer economy. The first paper, which was read before the American Institute of Electrical Engineers, is the record of long personal experience with the operation of transformers under actual commercial conditions, showing the relation of the many losses incident to the use of many small transformers to the earing capacity of the plant, and the very tangible economies realized as the result of the substitution of a few high efficiency transformers of large capacity. Mr. White gives examples of these economics reduced to dollars and cents. In his station a saving of $6,000 per annum in the cost of coal alone was realized as the result of the practical application of lessons drawn from his extended observation and experience.

Prof. Goldsborough's paper was read before the National Electric Light Association, and treats of the inherent economy of transformers of various design and construction. It contains many able arguments in favor of the use of high-grade transformers, and emphasizes the necessity of frequent tests as the only means of detecting leaks, losses and the general depreciation of transformers. Prof. Goldsborough gives examples of manufacturers' claims belied by careful test, but instances other cases in which guarantees have been exceeded, and urges upon station managers the wisdom of keeping as vigilant a watch on the efficiency of their transforming apparatus as upon the items of operating expense and maintenance if economical results are to be obtained.

To these papers the General Electric Company has added several maps showing graphically the significance of the substitution of a few large transformers for numerous small ones. The pamphlet is, as usual, well printed and illustrated, and should find a prominent place in the literature of every alternating current station and every educational institution. It will be sent free by the General Electric Company.

Personals

MR. JOHN B. HICKS has resigned his position as manager of the railway department for Pratt & Lambert.

MR. W. W. RUTHERFORD has been elected chairman of the Liverpool Tramways Committee and Alderman F. Smith has been appointed deputy chairman.

MR. GEORGE J. JACKSON, of New York, is spending the winter in London, looking after the interests of the recently incorporated National Conduit & Cable Company, Ltd.

MR. CHARLES H. KIRKLAND has made arrangements for handling in New York the supplies of the Bibber-White Company and the Crefield Electrical Works, both of Boston. Mr. Kirkland has been for some time in the sales department of the C. & C. Electric Company.

MESSRS. E. E. SOLDANA, N. T. HARRINGTON AND H. H. WATSON, of the E. P. Allis Company, have returned to America from Europe. Messrs. Soldana and Harrington have just completed the erection of two 500-h.p. engines at Madrid and three at Barcelona, Spain.

HON. GARDNER C. SIMS, who served during the war with Spain as one of the chief engineering officers on the "Vulcan," has returned home, to Providence. The "Vulcan," as is well known, was the repair ship for the fleet off Santiago, and as such rendered

MR. HENRY G. ISSERTEL, formerly manager of the Boston office of the Walker Company, has accepted the position of manager of the New York office of the Anchor Electric Company, which makes a specialty of high-grade switches. Mr. Issertel's headquarters will be at 26 Cortlandt Street.

MR. O. VON GOBEN, MR. FREDERICK TISCHENDORFER, MR. B. WINTER-GUNTHER and MR. PETERSEN, all connected with the Elektricitäts Aktien Gesellschaft vorm. Schuckert & Co., were in New York last month inspecting a number of electric railway plants, including the third-rail system in use on the Marine Railway at Coney Island. Mr. Tischendörfer will remain in this country about a month longer. The other three gentlemen returned to Nuremburg Dec. 10.

MR. A. BAKER, manager of the Nottingham Corporation Tramways, has been appointed to the post of "Chief Officer of Tramways" of London by the London County Council, and his appointment was ratified Dec. 13. Mr. Baker has shown conspicuous ability in the discharge of his duties at Nottingham, and much satisfaction is expressed at his acceptance of the post in London. It has been decided to call the London tramways "The London County Council Tramways," although only the initials, "L. C. C.," will be painted on the cars.

PROF. SIDNEY H. SHORT, of Cleveland, sailed for Liverpool on the Majestic, Dec. 13, for an extended tour in England and the Continent. In the course of his travels he will visit London, Paris, Frankfort and Berlin, besides many other places of interest. This is almost the first real vacation which Prof. Short has had for many years, and his intention is to devote his time chiefly to recreation, although he has already been invited to address a number of scientific societies in England, France and Germany on the subjects, particularly, of application of electricity to heavy railroading, and of high speed traction, on which subjects he is recognized as an authority of high standing. Prof. Short is accompanied by Mrs. Short, and they expect to return to America about the middle of April.

MR. JOHN YOUNG, manager of the Glasgow Corporation Tramways, has recently declined the office of Chief of the Tramways Department in London. Mr. Young's recent work in Glas-

gow is known throughout the tramway field, and his remarkable success in bringing the Glasgow Municipal Tramway service to its present state of efficiency has placed his name among the foremost tramway managers of the world. Mr. Young was born in 1845 at Fulwood, Renfrewshire. He received his early education at the Paisley Grammar School, and expected to take up the duties of a professional life. His love of the country led him to devote himself to the practical study of agriculture, and for a time he was in charge of his father's farms. It was from this position that in 1895 he was appointed Superintendent for Cleansing in Glasgow. Shortly after that time he became manager of the tramway systems of Glasgow, and under his guidance all the various departments of the tramways were thoroughly organized and equipped.

MR. FRANKLIN E. HUNTRESS has been re-elected for the third time from the Seventh Middlesex District to the Massachusetts House of Representatives. This is the first instance in the history of the city that a candidate has ever received three terms from his ward. Mr. Huntress was successful against the combined efforts of the local machines, and, though there was a large number of candidates, he carried his own ward and precincts over all others. He has served for two years on the committee on manufactures, which has supervision over the gas and electric lighting interests of the State. Mr. Huntress is a Republican, and though a candidate a number of times, he has never been defeated. He is a member of the local Republican organization, the Massachusetts Republican Club, the Middlesex Club, the University Club of Boston, and several fraternal organizations. He was graduated from Harvard University in the class of '89. In business he has been equally successful, and successfully introduced the Neal electric headlight, which has been adopted by the West End Street Railway, of Boston; the Brooklyn Heights Railroad, of Brooklyn, N. Y.; Metropolitan Street Railway, of New York City, and is in use on hundreds of roads all over the United States.

Obituary

MR. WM. E. HALE, treasurer of the Toledo Traction Company, of Toledo, Ohio, and also a prominent capitalist, died on Nov. 16, after a short illness. Mr. Hale made his home in Chicago, where he was connected with a number of large enterprises, and he was also a heavy stockholder in the Toledo Traction Company.

MR. FREDERICK CULVER WHITMORE, of the railway engineering department of the General Electric Company, died, at the early age of twenty-six years, of typhoid fever, at his home, in Hartford, Conn., on Dec. 7. Mr. Whitmore began his career with the Thomson-Houston Company, on the "students course," at the Lynn factory, from which he was advanced to the power and mining department, where he was engaged chiefly in design. In 1894 he was transferred to the Scranton, Pa., office of the General Electric Company, where he was general consulting engineer in power and mining work till 1898, at which time he returned to the home office, in Schenectady. His work at Schenectady was wholly with the railway engineering department, in which at the time of his death he was filling with conspicuous success an important post in connection with the design of special railway apparatus. Mr. Whitmore was a man of uncommon gifts, who possessed unlimited energy and enthusiasm in his work. He had, besides, a manly and straightforward character and numerous qualities of personal charm, which won him friends and gained him universal esteem.

AMONG THE MANUFACTURERS

W. C. NAGEL & CO. has been organized, with headquarters at Toledo, Ohio, for the purpose of conducting a general business in electrical machinery, supplies and construction.

THE BRITISH THOMSON-HOUSTON COMPANY has received the contract for the supply of six motor cars for the Liverpool Tramways at £554 9s. 6d. each, and sixteen trail cars with extra brakes at £587 4s. 6d. each.

THE NATIONAL INDIA RUBBER COMPANY, of Bristol, R. I., has recently published a catalogue and price list of its rubber-covered wires and cables, giving full details of all the sizes and characters of wire manufactured by them.

MESSRS. R. W. BLACKWELL & COMPANY, of Liverpool, have been granted the contract for the overhead construction for the Liverpool Tramways along the Aigharth Road, a distance of 2 miles. The contract price was £1,780 12s. 1d.

THE WEBER RAILWAY JOINT MANUFACTURING COMPANY, of New York City, has moved from the Cotton Exchange Building to the Empire Building, 71 Broadway, rooms 1813-1816, where it will be glad to receive inquiries and give information regarding the Weber joint.

THE MURRAY IRON WORKS COMPANY, of Burlington, Iowa, reports that the Sioux Corliss engine at the Omaha Exposition was awarded the gold medal over its competitors. This engine was in continuous operation, twenty-four hours per day, during the greater part of the exposition, furnishing all of the power used on the grounds.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, Mo., has published a handsome and complete catalogue of its electric railway supplies, entitled Catalogue No. 16. This pamphlet seems to be a regular cyclopædia of all overhead parts, track tools and other apparatus required in operating electric railways, and is well illlustrated.

THE STANDARD RAILROAD SIGNAL COMPANY has moved its works from Arlington, N. J., to Troy, N. Y., where it has erected a new and much more extensive plant. Henry Burden, 2d, of New York, has been elected vice-president, and Eugene Seitz, of Troy, N. Y., treasurer, of this company, to fill vacancies caused by the resignation of Henry Johnson.

THE CONTINENTAL CONSTRUCTION COMPANY, Wentworth Building, Boston, reports some good contracts in hand for new electric roads. This company embraces in its management and directory some of the most solid and influential men in New England, and its capital is reported as sufficient to enable it to carry out any contracts the company may make. The company's principal business is the construction and equipping of electric railways complete.

THE PENNSYLVANIA ELECTRIC COMPANY, of Marietta, Pa., was granted the highest award at the Omaha Trans-Mississippi and International Exposition for telephone apparatus. The company did not make any special effort to secure the award, merely sending a line of samples to the exposition, in charge of its local agent. The Pennsylvania Electric Company is now at work on an order for 2000 telephones for the Independent Telephone Company, of Lancaster County.

THE WESTINGHOUSE COMPANIES were awarded the contract for the electrical equipment of the Third Avenue Railroad Company last month upon the lines laid down in the STREET RAILWAY JOURNAL for December. This is probably the largest contract for electric railway equipments which has ever been given to any one company or set of interests, and means, it is understood, that Westinghouse apparatus will be used throughout in the power station, rolling stock and elsewhere on the line.

THE WHITNEY CAR WHEEL WORKS, of Philadelphia, announce that they have resumed the manufacture of chilled wheels at 901 Montgomery Avenue. Having their old patterns and chills, as well as the drawings and records of all former orders for the last fifty-two years, they will be prepared to duplicate shipments made heretofore, as well as to meet new requirements. The firm is composed of James S. Whitney, manager; Asa W. Whitney, superintendent, and H. F. Hannis, treasurer.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., is furnishing the steel work for the new electric power station of the Boston & Maine Railroad Company, at Portsmouth, N. H. The building is 118 ft. wide and 64 ft. long, divided into two rooms, one for the boilers and the other for the engines and electric generators. The side walls are of brick and the roof construction is fireproof. The trusses are of steel, and they support steel beams for the purlins, on which is to be placed a concrete roof.

THE PHOSPHOR-BRONZE SMELTING COMPANY, Limited, of Philadelphia, is sending out a postal card to all its customers reading as follows: "Owing to the high prices of copper, tin, etc., we hereby withdraw all quotations on phosphor-bronze, delta metal and other alloys in manufactured goods, ingots and castings. We shall be pleased to quote prices on detailed specification for prompt orders, or to receive any orders, which will be filled at such prices as are warranted by existing conditions."

THE LOMBARD WATER WHEEL GOVERNOR COMPANY, of Boston, Mass., reports that the demand for its gov-

ernors is constantly on the increase. During the last month the company received orders for upward of twenty governors to regulate forty-one water wheels, which will develop 15,750 h.p. More than half of this machinery will be used in electric stations—principally in power transmission plants—and electric railway stations, the balance being in textile and other manufacturing plants driven by water power.

THE ELECTRIC RAILWAY & MANUFACTURERS' SUPPLY COMPANY is the title of a new firm organized in the last few months at San Francisco by Allen St. J. Bowie and S. H. Taylor. The company is agent for the Ohio Brass Company, Eureka Tempered Copper Company, Solar Carbon & Manufacturing Company, Vulcanized Fibre Company, Positive Lock Washer Company, A. O. Schoonmaker, and several other prominent Eastern manufacturers, and it is its purpose to extend its lines in the electric railway field.

THE WESTINGHOUSE MACHINE COMPANY, of Pittsburgh, Pa., is sending out quite an elaborate catalogue describing the Westinghouse compound engine. The catalogue contains handsome half-tone engravings and a large amount of information of value to steam users. The manufacturers of the Westinghouse compound engine claim that, running non-condensing, it will deliver a horse power at the shaft for a smaller expenditure of steam than any other non-condensing engine of any type whatever running under similar conditions.

THE DETROIT AUTOMATIC SWITCH COMPANY, Limited, is just introducing a new device by which a motorman can turn a switch which he is approaching without leaving the platform. The device consists in inserting in the trolley wire a short insulated section, and the motorman can operate the switch by passing this with the current on. If he does not care to move the switch, he shuts his current off and drifts past the insulated section. This device has been in use for some time at the corner of Fourteenth and Warren Avenues, Detroit, Mich.

THE Q & C COMPANY, of Chicago and New York, is sending to the trade a very handsome catalogue descriptive of the Q & C valveless pneumatic tools for riveting, chipping, caulking, cutting stray bolts, chipping iron and steel castings, stone cutting, carving, lettering, etc. The Q & C Company has recently purchased the entire business of the Ridgely & Johnson Tool Company, of Springfield, Ill., and has added a pneumatic tool department to its already well-known list of special machinery and railway appliances. Pneumatic tools are now coming into quite extensive use, and the full line carried by the Q & C Company will undoubtedly create a large demand for this class of implements.

THE WATSON-STILLMAN COMPANY, of New York City, has made arrangements for issuing from time to time special or group catalogues containing a list and descriptions of hydraulic tools best adapted for some one particular use. It has recently issued its catalogue No. 50, which illustrates tools designed for steam railroad work, and it intends to publish within a short time catalogue No. 52, which will contain tools used by street railways. Catalogue No. 51 is just being sent out, and it is shown as the "Illustrated Index of Hydraulic Tools." This index is intended to show in a medium-sized book, the large variety of tools which this concern manufactures. Each cut shown represents from one to about twenty sizes of tools, and the illustrations are intended more as suggestions than anything else. Full and complete descriptions of any one of these tools or of any class of tools will be sent upon application.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., has just issued a second edition of its very suggestive pamphlet, Bulletin E, entitled "Draft Without a Chimney." The pamphlet will be sent on application. This company has also just issued its Bulletin G, which contains a description of the Sturtevant generating sets with automatic horizontal and upright engines. The generating set with horizontal center crank engine and four-pole generator manufactured by the Sturtevant Company is described elsewhere in this issue, but these sets are also made with horizontal center crank engines with six-pole generators, double upright engines with four-pole generators, single upright engines with four-pole generators, single upright engines with eight-pole generators and horizontal center crank engines with four-pole (marine type) generators. All of these sets have been very carefully designed, in order to secure the maximum amount of efficiency with the minimum amount of weight and size.

THE SAFETY THIRD-RAIL ELECTRIC COMPANY, of New York, has published from time to time very interesting and attractive printed matter describing the safety third-rail electric system, better known as the Murphy system. The latest pamphlet to be issued by this company is unusually artistic typographically, and, in addition, contains a great deal of information which will be eagerly read by all engineers, or others, interested in the development of an electric railway system to take the place of the overhead trolley in large cities on suburban and interurban railways and on steam railroads. The pamphlet just issued first describes and illustrates the principal third-rail, conduit and surface contact systems on the market, and points out some of their disadvantages. The safety third-rail system is then described, and the principal claims made for it are given in such a way as to show how the Murphy system overcomes the objectionable features in other systems.

THE HARRISON SAFETY BOILER WORKS, of Philadelphia, Pa., reports a very large number of recent sales of Cochrane separators. Among these may be mentioned: Standard Oil Company, Whiting, Ind., 6-in. oil-ammonia; De La Vergne Refrigerating Machine Company, New York, two 5-in. oil-ammonia; Buckeye Engine Company, Salem, Ohio, 5-in. vert.; Bailey Estate, Boston, one 3-in. and one 4-in. horz.; Montgomery, Ward & Co., Chicago, one each, 12-in., 7-in. and 4-in. horz.; Parke & Lacy Company, San Francisco, Cal., one each, 3½-in. and 5-in. horz., and one 5-in. vert.; Theo. A. Koch Company, Chicago, two 2-in. and one 6-in. horz.; Brown Bldg., St. Louis, Mo., three 4½-in. and one 3-in. horz.; Washington Coal & Coke Company, Star Junction, Pa., two 6-in. horz.; Fred. W. Wolf Company, Chicago, 4½-in. horz.; Jung Brewing Company, Cincinnati, Ohio, one each, 5-in. and 6-in. oil-ammonia; Buffalo (N. Y.), Bellevue & Lancaster R. R., 8-in. horz.; Cleveland, Cincinnati, Chicago & St. Louis R. R. Company, Urbana, Ill., one 5-in. and two 3-in. vert.; So. Covington & Cincinnati Street Railway Company, Newport, Ky., 4-in. horz.; Edison Electric Illuminating Company, Brockton, Mass., two 6-in. horz. A few of the recent sales of Cochrane feed-water heaters and purifiers are as follows: Raritan Copper Works, Perth Amboy, N. J., 1000 h.p.; Montgomery, Ward & Company, Chicago, 1000 h.p.; Chicago & Great Western Railroad Company, Oelwein, Iowa, 500 h.p.; Boston Packing & Provision Company, Cambridge, Mass., 200 h.p.; St. Clair (Pa.) Coal Company, 1500 h.p.; U. S. Glue Company, Carrollville, Wis., 1500 h.p.; Armour Elevator "D," Chicago, 1200 h.p.; Rush Run Coal & Coke Company, Rush Run, W. Va., 500 h.p.; Isaac Braithwaite & Son, Kendal, England, 100 h.p.; Phœnix Iron Company, Phœnixville, Pa., 2000 h.p.; Diamond Ice Company, Wilmington, Del., 200 h.p.; C. W. Boynton, Chicago, 100 h.p.; O. S. Kemmerer, Nazareth , Pa., 50 h.p. (special).

New Publications

Tourists' Guide to New Orleans. Published by the New Orleans City & Lake Railroad Company. 14 pages.

This is a neat little folder containing a map of all the street car routes in New Orleans and directions for reaching all the principal points of interest.

Graphite. Vol. 1, No. 1. December, 1898. Published by the Joseph Dixon Crucible Company, of Jersey City, N. J. 4 pages.

This is a periodical which will be issued from time to time by the Joseph Dixon Crucible Company, and will be sent to all users of graphite or others interested. Graphite now enters very extensively into most of the arts, sciences and trades, and is, in fact, employed in some form by every civilized nation in the world.

President's Address Before the American Society of Mechanical Engineers. 15 pages. Published by the American Society of Mechanical Engineers.

This is a copy of the address delivered by President Charles Wallace Hunt before the above-mentioned society. In his address Mr. Hunt carefully reviewed the latest engineering practice in America and abroad, and spoke of the duties, pleasures and usefulness of the engineer of to-day.

Report of the Sixteenth Annual Meeting of the Street Railway Association of the State of New York. Published by the New York State Street Railway Association. 144 pages.

This is the printed proceedings of the sixteenth annual meeting of this association, which was held at the Manhattan Hotel, Brooklyn, N. Y., Sept. 13-14, 1898. The report is very complete, giving all the papers read, all the discussions and all the speeches both at the meetings and at the banquet. The pamphlet also contains the annual report of the secretary and treasurer, and a copy of the constitution and by-laws of the association, together with a complete list of all the members.

Trade Catalogues

Pneumatic Tools. Published by the Q & C Company, of Chicago and New York. 46 pages. Illustrated.

Hydraulic Tools. Published by the Watson-Stillman Company, of New York City. 44 pages. Illustrated.

The Safety Third-Rail System. Published by the Safety Third-Rail Company, of New York City. 16 pages. Illustrated.

The Westinghouse Compound Engine. Published by the Westinghouse Machine Company, of Pittsburgh, Pa. 94 pages. Illustrated.

List of Street Railway Patents

U. S. PATENTS ISSUED NOV. 22 TO DEC. 20, 1898, INCLUSIVE

Prepared for the STREET RAILWAY JOURNAL by THOMAS DREW STETSON

WEEK ENDING NOV. 22, 1898

Rolling Stock.—Henri J. Caillet, Paris, France. No. 614,697. Three claims.

Car Fender.—John D. Hodges, Chicago, Ill., assignor of five-sixths to James Bellew, Frank H. Repetto and Patrick J. King, same place. No. 614,654. Four claims.

Claim.—2. The combination of the rule-jointed fender frame, pivots upon which it swings and which constitute the hinge between its joints, the buffer, its bearing rods terminating in about a line with said hinge, a thrust rod in contact with the headed rear end of one of said bearing rods, and mounted in the rear section of the fender frame, a lever actuated by said thrust rod, a latch bolt with which said lever engages, a spring acting upon said latch bolt in opposition to the lever, and a latch hanger into which said bolt takes.

Indicator for Railway Cars.—Edouard Cros, Paris, France. No. 614,700. One claim.

Means for Driving Railway, Tramway or Automobile Cars.—Gustave Dupont and Maxime Johannet, Paris, France. No. 614,709. Four claims.

Claim.—3. In a motor vehicle, the combination of a front and rear axle of two counter shafts, a field magnet and armature mounted on each, a main shaft geared to both counter shafts, a reversible clutch on the main shaft and a single circuit including the armature of both dynamos, substantially as described.

Lubricating Car Wheels.—John V. Hawkey, Greensburg, Pa. No. 614,808. One claim.

WEEK ENDING NOV. 29, 1898

Nut Lock.—William H. Carruthers, Chicago, Ill., assignor to Marguretta E. Carruthers, same place. No. 614,835. Two claims.

Trolley for Electric Cars.—Hosea W. Libbey, Boston, Mass. No. 614,875. One claim.

Claim.—A trolley head having two arms between which the main trolley wheel is mounted and a bracket on each side between which and one of the arms is mounted a small contact wheel or roller substantially as and for the purpose set forth.

Rail Joint.—George F. Owen, Canal Winchester, Ohio. No. 614,885. Two claims.

Railway Rail.—John W. Peterman, Banta, Cal. No. 614,976. One claim.

Underground Conduit for Electrical Conductors.—Charles H. Sewall, Chicago, Ill. No. 614,995. Seven claims.

Claim.—1. The combination with a body of material having a conduit or conduits inclosed therein, of an inclosing layer or sheath of insulating material completely surrounding said body of material on the top, bottom and sides and effectively insulating the same from the earth to prevent the access of extraneous currents to the inclosed body of material, substantially as described.

Railway Switch.—George A. Penrose and Thomas F. Penrose, Meredith, Ark. No. 615,101. Three claims.

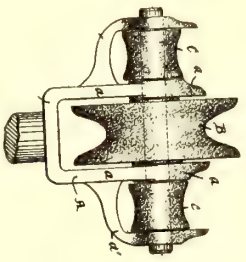
Nut Lock.—Silas Chambers, Sterling City, Tex. No. 615,139. Seven claims.

Electric Railway.—Hermann T. Hillischer, Vienna, Austria-Hungary. No. 615,176. Four claims.

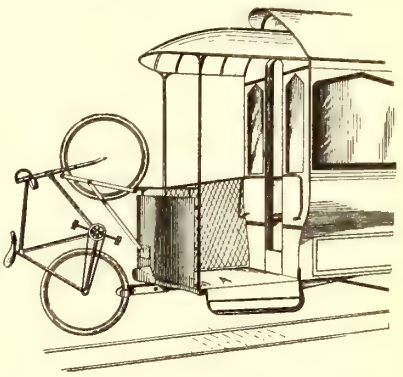
Claim.—4. In an electric railway, the combination of the running rails, an inverted U-rail arranged parallel thereto, an electrical conductor carried in the hollow of said U-rail, but insulated therefrom, a channel or conduit between the said rails, a slot between the said rails leading to said channel or conduit, plates pivoted to the track rail along the conduit, springs acting upon said plates and tending to hold the same across said slot, a trolley running upon said rails, a curved contact arm carried thereby and running in said conduit, and rollers mounted in said trolley frame for depressing said pivoted plates *seriatim* to allow the said contact arm to pass along said slot, substantially as described.

WEEK ENDING DEC. 6, 1898

Bicycle Carrier.—Thomas C. duPont, Johnstown, Pa. No. 615,264. Two claims.



NO. 614,875



NO. 615,264

Claim.—1. The combination of a wheel holding frame, a brace pivotally secured thereto and supporting the same, and a brace block having a vertical slot for the passage, the brace and a cam slot for the end of said brace, said cam slot extending downward from the top of the brace block and curving outwardly at its lower extremity.

Street Car Motor.—Thomas D. Hoskins, New York, N. Y., assignor, by mesne assignments, to Sarah E. Warner. No. 615,274. Twelve claims.

Driving Gear for Motor Vehicles.—Joseph Millot and Benoit Millot, Gray, France. No. 615,360. Six claims.

Headlight Reflector.—Andrew Metternich, Newark, N. J. No. 615,490. One claim.

Claim.—In combination with a car having an interiorly located lamp, of an elongated tubular reflector extending through the wall of the car with its opposite ends flaring outwardly from a point between its ends; the inner flaring end of the reflector being independent of connection with said lamp and supported in a position opposite the latter with a space between the same, and its opposite outer end extending to a desired position to utilize the light from said interior lamp as an exterior headlight.

Truck Lifter.—William J. Donaldson, La Grange, Tex. No. 615,534. One claim.

Electric Locomotive.—Martin E. Thomas, Cassaday, Ky., assignor of three-fourths to W. F. Toops and H. L. Hendrick, Bowling Green, Ky. No. 615,592. Three claims.

Claim.—1. In an electric locomotive, a truck, a body mounted thereon through the medium of interposed springs, wheels mounted upon an axle journaled in the truck, a motor carried by the truck in gear with the axle, a dynamo carried by the body in electrical connection with the motor, an engine, a gear upon the axle, a gear journaled in the floor of the body and normally held in mesh with the gear upon the axle by a spring interposed between the floor of the body and the gear, a gear meshing with the said gear mounted upon a horizontal shaft, pulleys upon the said shaft and a belt connecting the pulleys with the armature of the dynamo, substantially as described.

Electric Locomotive and Truck.—Samuel M. Vauclain, Philadelphia, Pa. No. 615,594. Four claims.

Claim.—4. The combination in an electric motor or truck, of the frame, bearing blocks thereon, a motor, a motor shaft carrying the armature of the motor, said shaft being reduced at each end, a crank adapted to each end of the said shaft and keyed thereto, the ends of the shaft being threaded, nuts thereon confining the cranks to the shaft, the sleeves of said cranks extending through the boxes, wheels mounted on the sleeves, substantially as described.

Brake Handle.—Patrick Flood, Albany, N. Y. No. 615,614. Two claims.

WEEK ENDING DEC. 13, 1898

Wheel and Track Brake for Railway Cars.—Richard Shultz, Davis, W. Va. No. 615,917. Four claims.

Electric Arc Headlight.—William G. Wagenhals, Dayton, Ohio, assignor to the United States Headlight Company, Utica, N. Y. No. 615,927. Twenty-five claims.

Claim.—3. The combination with a vehicle propelled by electricity, of a case and an electric arc lamp contained therein, means

for detachably securing the case to the vehicle, a carbon-feed-operating device attached to the case, but disconnected from the lamp fixture, an upper carbon carrying rod adapted to slide in suitable guides attached to the lamp fixture, spring retracting feeding mechanism adapted to coact with said rod and said carbon feed operating device, means whereby the latter can be manipulated, and suitable connections with the lamp and the case and the vehicle whereby electric current is conveyed from the propelling power of the vehicle to and from the lamp.

Trolley Replacer for Electric Railways.—Lucian A. Cowles, Randolph, Mass. No. 615,966. Five claims.

Claim.—2. A trolley wheel restoring device composed of a forked lever, properly connected with the trolley pole and wheel, and having the ends 5, swinging guides, slotted and adapted to be moved by the ends of the forked lever, a spring hinge in said guides, proper mechanism for connecting and operating said lever and guides in connection with a trolley pole, and a spring normally holding said device out of action, substantially as and for the purposes described.

Hand Strap for Cars.—Edward P. Hendrickson, New York, N. Y. No. 615,986. Two claims.

Claim.—1. A hand strap for cars comprising a main portion and integral straps extending in opposite directions therefrom, a bar and means for uniting the straps together at their ends and to the bar so that loops are formed in the straps to receive the rail of the car and at the main portion for the hand, the straps being held in a diverging condition by the means aforesaid and the hand opening being parallel to the supporting bar, substantially as set forth.

Ball Bearing for Trolley Wheels.—George E. Mittinger, Jr., Cleveland, Ohio, assignor of three-fourths to Frederick J. Schweitzer, same place. No. 616,060. Six claims.

Claim.—1. A wheel having at each side a ball cavity situated at the center of rotation thereof, supporting bearing blocks having registering ball cavities, and a single ball in each pair of cavities, the balls projecting from the wheel cavities into the supporting block cavities and a connection for the supporting blocks passing around the wheel and adapted to permit it to freely revolve, substantially as described.

Trolley Wheel Replacer.—George E. Mittinger, Jr., Cleveland, Ohio., assignor of three-fourths to Frederick J. Schweitzer, same place. No. 616,061. Seven claims.

Claim.—6. A replacing section consisting of sheet metal tapered toward its outer ends and provided with a spiral groove formed by depressing the sheet metal, substantially as described.

Ball Bearing for Electric Motors.—John M. Murphy, Torrington, Conn., assignor of two-thirds to David F. Halsted, New York, N. Y., and William M. Keepers, Newark, N. J. No. 616,063. Four claims.

Week Ending Dec. 20, 1898

Controller for Motor Cars.—Arthur P. Dodge, New York, N. Y. No. 616,089. Six claims.

Claim.—1. In a motor operated by steam or like pressure, a boiler, a controller, comprising a valve, a central shaft, a hand wheel connected therewith, a piston and a cylinder on one side thereof connected with brake mechanism by a hydraulic column, a piston and cylinder on the opposite side similarly connected with a reversing mechanism, the sleeve surrounding the shaft and connected so as to operate the reversing piston and the hand lever with geared connections with the piston of the first named brake cylinder, substantially as described.

Car Fender.—Peter Heesem, Pittsburgh, Pa. No. 616,102. Three claims.

Claim.—1. A car fender comprising the frame provided at its forward portion with rollers mounted on a shaft 19, said shaft 19 being provided with a pinion at one end, in combination with a shaft provided at each end with a pinion, said shaft and pinions being adapted to be brought into engagement with the pinion on the shaft 19 and a gear wheel on the front axle of the car, substantially as set forth.

Nut Lock.—Raymond Hines, Cresson, Pa. No. 616,103. One claim.

Railway Switch.—Edwin S. Leaycraft, Jersey City, N. J. No. 616,120. Eight claims.

Claim.—1. A railway switch, consisting of a switch tongue, an armature operated by a magnetic device carried on a vehicle moving along the railroad track, an arm carrying said armature and oscillating transversely of the railroad track, and a mechanical connection between said switch tongue and armature whereby movements of the latter will be transmitted to the former, substantially as specified.

Combined Rail Joint and Device for Preventing Spreading of Rails.—Henry M. Williams, Fort Wayne, Ind., assignor of one-fourth to Franz Burger, same place. No. 616,171. Five claims.

Claim.—2. The combination with the parallel rails of a railway track, of a rail joint connecting abutting rails at one side of the track, and a tie rod formed at one end with a fork, the branches of which extend through openings of the rail joint and receive nuts at their ends, said rod extending across the track and being provided at its opposite end with a bearing for engaging the rail at the other side of the track, substantially as described.

Car Coupling.—Charles S. Park and George B. Park, Greenfield, Mass. Filed Feb. 8, 1898. No. 616,203. Two claims.

Extension Car Step.—William J. Griffiths, Jr., Mount Vernon, N. Y. No. 616,230.

Rail Bond.—Walter E. Harrington, Camden, N. J. No. 616,232. Six claims.

Claim.—2. In combination with abutting ends of railway rails, a bonding member with smooth contacting surface adapted to contact therewith, a temporarily plastic alloy intermediate said bonding member and the rails and set screws adapted to act upon said bonding member to maintain pressure between it and the rails, substantially as described.

Car Advertising Device.—Arthur H. Hieatzman, Baltimore, Md., assignor of one-half to Napoleon B. Lobe and Ernest M. Manger, same place. No. 616,235. Six claims.

Car Truck Equipment.—Sidney H. Short, Cleveland, Ohio. No. 616,264. Five claims.

Claim.—3. The combination with a truck and its supporting axles, a reservoir carried by said truck, a frame loosely journaled at one end on one of said axles, means for yieldingly suspending the other end of said frame from the truck, an air compressor mounted on said frame, and a pipe delivering from said compressor to said reservoir, as and for the purpose set forth.

Air Brake.—Murray Corrington, New York, N. Y. No. 616,288. Three claims.

Pneumatic Motor for Electric Appliances for Cars.—Clarence A. Evans, Upland, Pa. No. 616,301. One claim.

Valve for Pneumatic Motors.—Frederick W. Hedgeland, Chicago, Ill., assignor to The W. W. Kimball Company, same place. No. 616,323. Five claims.

Sprinkling Vehicle.—Arthur H. Howland, Worcester, Mass., assignor to Frederick C. Austin, Chicago, Ill. No. 616,334. Four claims.

Rail Joint.—William E. Smith, Telluride, Colo., assignor to himself and John Hebbard Adams, same place. No. 616,365. Six claims.

Claim.—6. In a rail joint, the combination of a chair, a pressure plate extending alongside the rail, and a toggle working between the chair and the pressure plate, the toggle having means for holding it in extended position.

Station Indicator.—Jefferson D. Barry, Marlin, Tex., assignor of one-half to A. L. Branson, same place. No. 616,393. Two claims.

Car Coupling and Operating Device Therefor.—Seth Bedford, Charleston, Mo. No. 616,395. Twenty-two claims.

Combined Bearing and Power Transmitting Device.—Carl O. C. Billberg, Lewisburg, and Paul A. N. Winard, Philadelphia, Pa. No. 616,396. Four claims.

System of Electric Traction.—Michelangelo Cattori, Rome, Italy. No. 616,403. Three claims.

Rail Joint.—Orlando Smay, Johnstown, Pa., assignor by mesne assignments, to the Lorain Steel Company, of Ohio. No. 616,440. Two claims.

Claim.—2. In a railway joint, the combination of rails having a portion of their entire web removed, two splice bars, one of which is formed with a projection and perforation, said projection serving in place of the said removed web and sustaining the head of the rails at all points necessitated by the removal of the web, a lug on the other of said splice bars, said lug extending through said perforation, and a key to engage said lug.

Nut Lock or Fastener Bar.—Irvin Y. Baringer, Perkasie, Pa., assignor of one-half to Thomas L. Kneile, Philadelphia, Pa. Term of patent, 14 years. Design 29,834. One claim.

Railway Rail.—George J. Capewell, Hartford, Conn. Filed Nov. 26, 1898. Serial No. 697,565. Term of patent, 14 years. Design 29,833.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. The Street Railway Publishing Company, Havemeyer Buidding, New York.

Financial Notes.

AKRON, OHIO.—The property of the Akron Street Railway & Illuminating Company has been appraised at $932,000, and will be sold to a reorganized company, of which Samuel Thomas is at the head. The new company will be capitalized at $2,000,000. The present outstanding indebtedness of the company is $1,200,000, one-half of which will be done away with. The present bondholders will be given preferred 5 per cent stock to the amount of $600,000, in place of the amount of bonds now held. In addition to this, bonds to the amount of $300,000 will be issued to provide for the entire rebuilding of the lines and the purchase of new rolling stock.

BALTIMORE, MD.—The Baltimore & Northern Electric Railway Company, backed by a syndicate of capitalists headed by Alexander Brown & Sons, of Baltimore, have purchased the Baltimore City Passenger Railway Company. The terms of the sale are $90 per share, cash, involving a total of $12,600,000. The directors of the Baltimore City Passenger Railway Company have ratified the sale, subject to the decision of the stockholders. It is understood that the lines will be rearranged, and that the motive power of the Red & White lines will be changed from cable to electricity.

BALTIMORE, MD.—The capital stock of the Baltimore Consolidated Railway Company is to be increased from $9,172,000 to $9,672,000, to meet the expense incurred by the construction of the extension to Ellicott City. Present stockholders will be allowed to subscribe for the new issue at par in amounts proportionate to their holdings.

BALTIMORE, MD.—The Consolidated Railway Company has decided to issue $500,000 additional stock, which will be offered to the present stockholders in proportion to their holdings at par. The company has outstanding $9,172,000, and its authorized capital is $10,000,000.

BOSTON, MASS.—The West End Street Railway Company has declared a semi-annual dividend of 4 per cent., payable Jan. 2 by the Boston Elevated Railway Company.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company reports earnings as follows:

November.	1897.	1898.
Gross receipts	$417,818	$446,501
Five months ending Nov. 30.		
Gross receipts	2,271,539	2,614,732

BUFFALO, N. Y.—The Buffalo Railway Company has declared a quarterly dividend of 1 per cent, payable Dec. 15.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has filed a consolidated mortgage to secure $625,000 of 5 per cent bonds, with the Maryland Trust Company, of Baltimore, as trustee. The new mortgage takes the place of the $625,000 old bonds now existing, the object being to reduce the interest from 6 to 5 per cent.

CHICAGO, ILL.—Stockholders of the Chicago & St. Louis Electric Railway Company, which was organized several years ago to build an electric railway from Chicago to St. Louis, are, it is said, considering an investigation of the affairs of the company.

CHICAGO, ILL.—The Chicago City Railway Company proposes to increase its stock at the annual meeting to be held in January, from $12,000,000 to $14,000,000, the stockholders to be given the right to subscribe. The company has declared a dividend of 3 per cent, payable Dec. 31.

CHICAGO, ILL.—The West Chicago Street Railroad Company recently declared a quarterly dividend of 1½ per cent.

CLEVELAND, OHIO.—It is reported that an English syndicate is negotiating for the purchase of the property of the Cleveland City Railway Company, the Cleveland Electric Railway Company and suburban roads.

DENVER, COL.—The Denver City Railroad has been sold at auction, by order of the United States Court, under foreclosure of a mortgage for $4,000,000. Frederick P. Olcott, of New York, chairman of the reorganization committee, secured the property for $500,000, the minimum bid allowed. The West End Street Railway was also sold under foreclosure, being purchased by the same party for $40,000.

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GREEN BAY, WIS.—Upon the application of M. Joannes and Thos. W. Spence, receivers of the Fox River Electric Railway Company, Judge Hastings has signed an order for the sale of the property on Jan. 14. The sale will be held at the office of the Sheriff of Brown County, at 9 A. M.

LANCASTER, PA.—The report of William B. Given, receiver of the Pennsylvania Traction Company, for the past year shows an increase in passengers carried of 274,779 over the previous year, and an increase of $15,005.31 over last year in receipts. A decree has been entered, by the United States District Court, for a final adjustment of all accounts. A committee of reorganization has been appointed and a charter applied for.

MERIDEN, CONN.—The Meriden, Southington & Compounce Tramway Company has prepared a petition to the General Assembly for permission to increase its capital stock to $500,000, with rights to build and extend its tracks from Milldale to Mt. Carmel, Waterbury, Meriden and Berlin, by an independent route, to Plainville from Southington, from Dunham's to Compounce Lake, and to build a cable road to West Peak.

NEW YORK, N. Y.—The car barn of the Union Railway Company, situated at Woodruff avenue and Boston Road, was totally destroyed by fire recently, together with a number of cars and supplies. The loss is estimated at $150,000.

OSWEGO, N. Y.—Justice Wright, of the Supreme Court, has granted the motion of the Knickerbocker Trust Company, of New York, to foreclose bonds against the Lake Ontario & Riverside Railway Company for $125,000. The property has been ordered to be sold within two months.

PORT CHESTER, N. Y.—The Highway Commissioners of Harrison have granted the Port Chester Electric Railway Company a franchise through that part of the town lying between Rye and Mamaroneck.

PROVIDENCE, R. I.—The Providence and Taunton Street Railway Company has declared a dividend of 2½ per cent, payable Jan. 2.

QUEBEC, QUE., CAN.—Notice is given that the Quebec, Montmorency & Charlevoix Railway Company will make application, at the next session of the Parliament of Canada, for an act amending the act incorporating the said railway company, viz.: To change the name of the company to the Quebec Railway, Light & Power Company; to ratify and confirm the purchase of the property and franchise of the Quebec District Railway Company; to authorize the company to build a line, or lines, of railway or tramways in Levis, Bellechasse, Dorchester, Beauce and Lotbiniere Counties; to ratify and confirm the purchase of the property, works and capital stock of the Montmorency Electric Power Company; to authorize and empower the company to carry on the business of the Montmorency Electric Power Company; to acquire water powers, and to maintain the construction necessary to improve or utilize the same; to expropriate for the purpose of placing poles and carrying wires; to authorize the purchase of gas and lighting companies.

ST. LOUIS, MO.—Negotiations, which have been in progress for more than three months, have resulted in the sale to a New York syndicate, represented by Brown Brothers, of the Lindell Railway and the Missouri Railroad systems for $8,500,000. The papers completing the sale have been signed and the actual transfer will be made in a few days. The purchase price paid is on the basis of $174 a share for Lindell stock and $192 for Missouri. Nearly every part of the west and southwest portions of St. Louis are reached by the two systems.

ST. CLOUD, MINN.—The car barn of the Benton Power & Traction Company was destroyed by fire recently. Four passenger cars, a snow plow and the building were completed destroyed, entailing a loss of $15,000; partly insured.

SPRINGFIELD, OHIO.—The stockholders of the Dayton, Springfield & Urbana Electric Railway Company have authorized an increase of the capital stock of the company from $10,000 to $750,000.

WASHINGTON, IND.—Ziba F. Graham, formerly general manager of the Washington Street Railway Company, has purchased, at sheriff's sale, the property of said company for $12,500.

ZANESVILLE, OHIO.—A number of Philadelphia capitalists have inspected the lines of the Zanesville Street Railroad, relative to purchasing the same at the receiver's sale, to be held January 3.

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Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, FEBRUARY, 1899. No. 2.

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ELECTRIC RAILROADING IN THE ARGENTINE

Buenos Aires, the largest and most important city in South America and the capital of the Argentine Republic, is situated on the River Plate, which is here about 30 miles wide. The majority of the inhabitants of the city are descendants of the Spaniards who have settled in the country during the last 300 years, but there is also a very large number of foreigners, among whom the Italians are probably the most numerous. The houses are generally of brick, and are usually one story in height. With the rapid immigration which has been setting in the direction of the Argentine and its capital during the past few years, the city has grown and is growing rapidly. The present population is not far from 850,000, and, at the present rate of increase, will probably reach 1,000,000 in three or four years.



OPENING DAY, LA CAPITAL TRAMWAYS, BUENOS AIRES

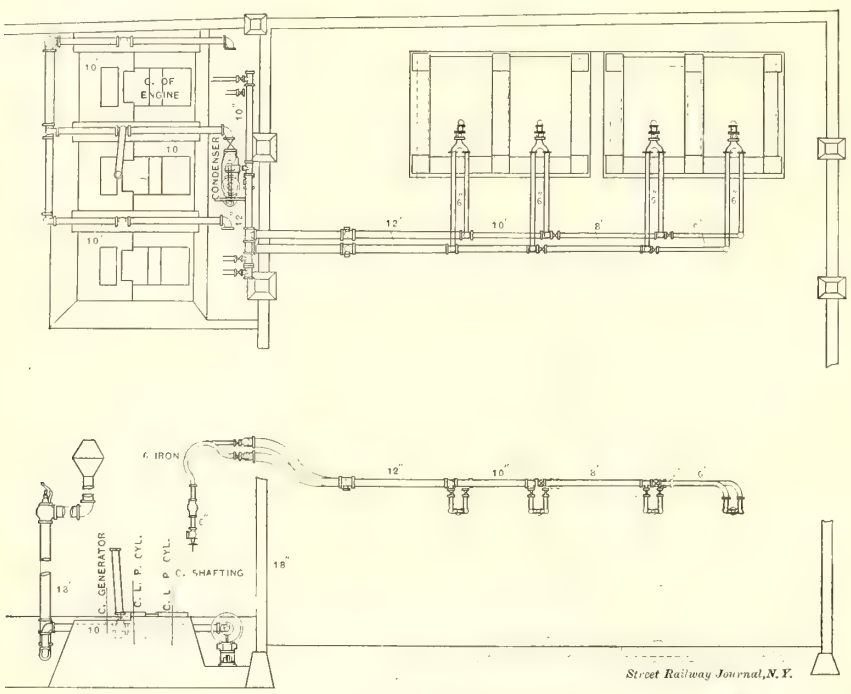
The great extent of the city makes street railway riding a necessity, and as a result the street railway systems have had an extensive development. Every street in the older part of the city, for a territory covering about two square miles, is traversed by a street railway line, with the exception of one short avenue, the shopping street of the city, from which tracks have been rigorously excluded. The streets in this part of the city are, for the most part, narrow, so that only one track is allowed on a street, and the cars of a line run down one street and up another, making most of the mileage single track. The average width of the streets in this section of the city, from curb to curb, is 25 ft., and the tracks are laid on the left-hand side of the roadway, leaving room for only one line of vehicles, which are obliged to run in the same direction as the cars, so that all traffic on every street in this portion of the city is in one direction only. The sidewalks in these narrow streets are usually but 4 ft. in width. In the newer part of the city, where the streets are 50 ft. wide or above, double-track construction is allowed.

A list of the street railway companies in Buenos Aires, with mileage and a general description of the street railway conditions in that city, was published in the STREET RAILWAY JOURNAL for July, 1898. The railway companies have generally a London office, and they are owned in large part by English capital. Horses are used for the most part, and only two systems have yet adopted electricity. Horses and fodder are cheap, an excellent horse bringing only about $25, while coal is expensive. It is nearly all shipped from Wales, and costs from $6.50 gold per ton up. Nevertheless, the railroads which have

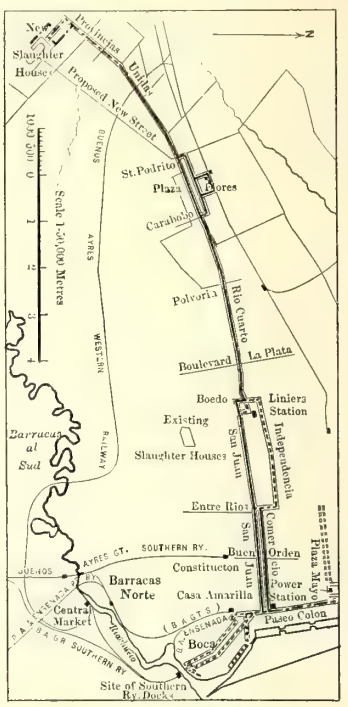
adopted electricity speak favorably of the economical results secured, and electric equipment is being rapidly forwarded.

The companies which have already installed electric power on their lines are the La Capital Tramways Company, the greater part of which, comprising about 8¼ miles of double track, is now in operation by electric power, and the Buenos Aires & Belgrano Railways, or Bright's concession, of which a short section now employs electric traction, but which is being rapidly equipped throughout with the improved power.

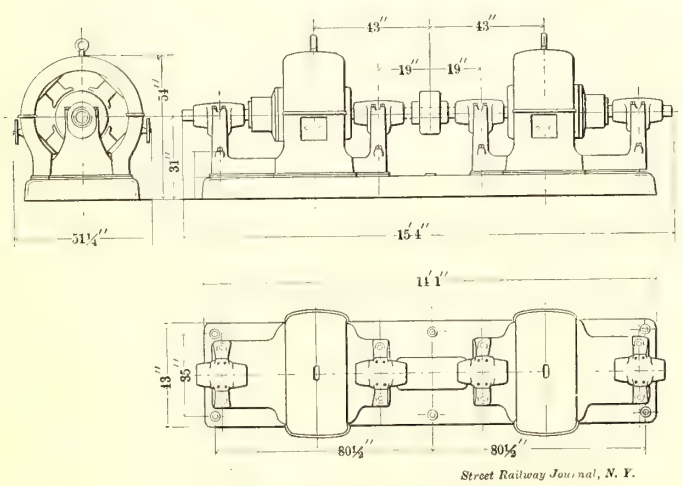
The system of the La Capital Tramways Company, with



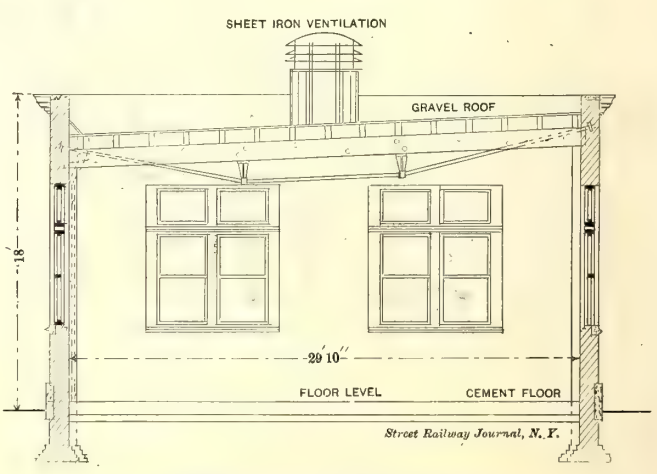
PLAN AND SIDE ELEVATION OF PIPING



MAP OF SYSTEM



BOOSTER FOR BATTERY

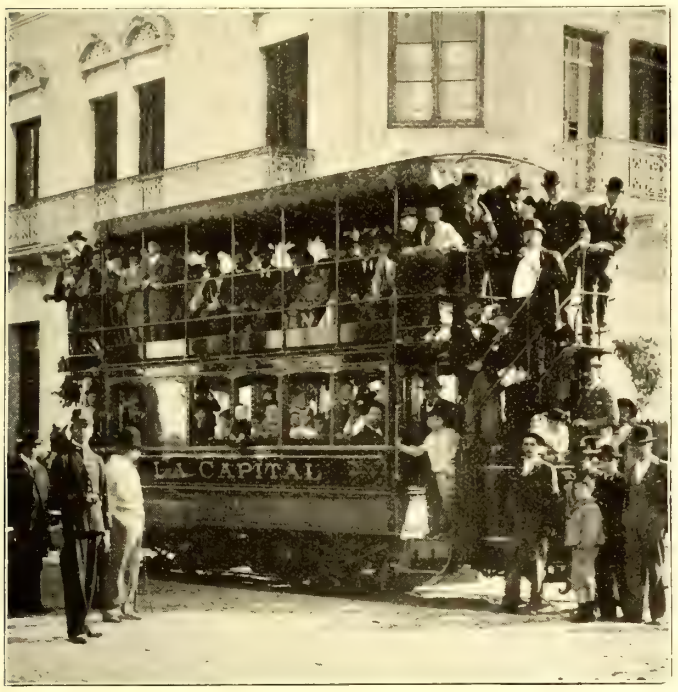


SECTION OF BATTERY HOUSE

which this article directly deals, reaches from the center of the city almost due west to New Chicago, where the government slaughter houses are located, and handles not only a large passenger business but also a large business in the transportation of fresh meat from that point to the city. Some reference has already been made to this traffic in former issues, and as it constitutes a very important branch of the transportation business of the city, and one which might be followed to advantage in other southern cities where the refrigeration of meat is not followed to any considerable extent, some particulars of it may be of interest. The present slaughter houses of Buenos Aires were built by a French company in 1889, at a cost of several million dollars. They have been purchased since by the Government, which rents stalls to the meat purveyors. All the meat consumed in the city comes from these houses, and as there are no refrigerating methods for preserving meat in general use, cattle are killed and the meat distributed to be eaten the same day. The La Capital Company has a contract for transporting all this meat to the city, and about 600 tons are carried on its cars and delivered to about thirty large markets located in different parts of the city. The butchers commence work about 2 o'clock in the morning and all the meat is delivered to the retail markets before 9 o'clock the same day. The special cars for handling this meat were illustrated in the Street Railway Journal for November, 1898, and January, 1899.

The power station of the La Capital Company is located in the old part of the city, near the end of the line and close to the docks. It consists of a framing of steel, supplied by the Berlin Iron Bridge Company, and filled in with brick between the steel columns. The engine room contains three Ball & Wood vertical compound engines of 450 h.p. directly connected to three Walker generators. The piping is in duplicate, and was furnished by Best, Fox

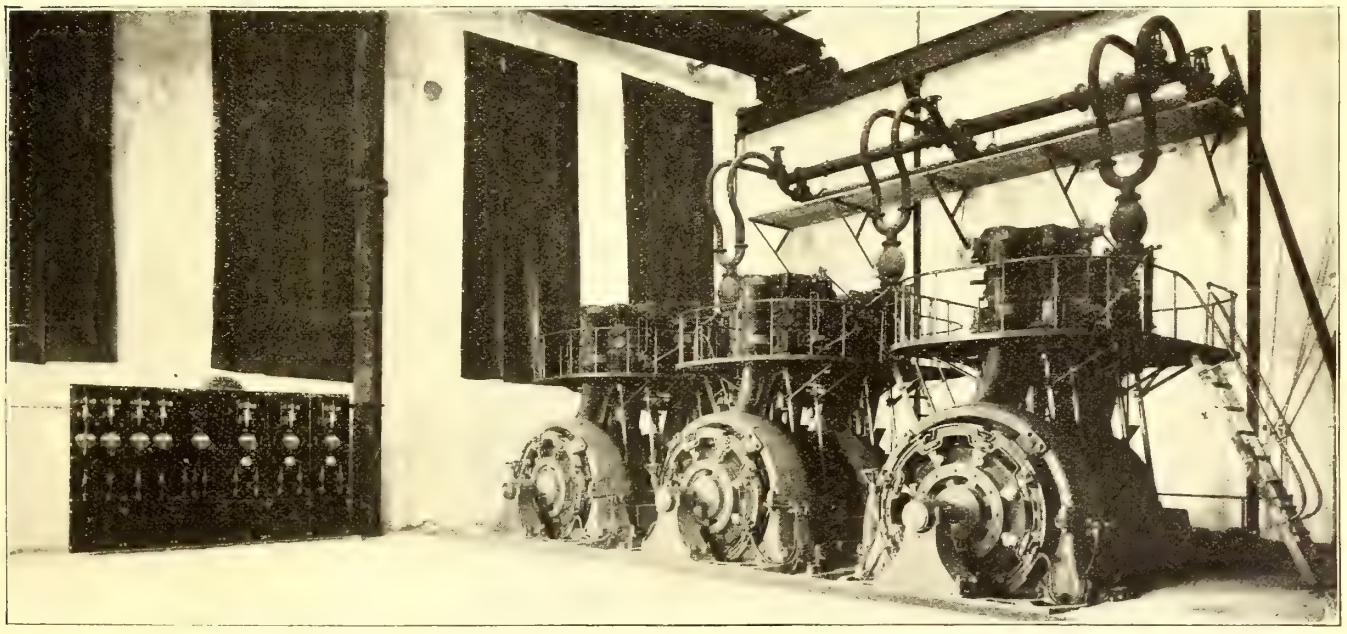
& Company. The arrangement of the piping is shown in the plan view of the station, and under normal conditions of working both sets of duplicate pipes are in continuous use. In case of an accident to one set the other is run at slightly higher pressure until the trouble is remedied. Bent pipe is used instead of elbows. The boilers are of the Stirling type, four in number, and of 350 h.p. each. Green economizers and Worthington compound feed pumps are used, and an induced draft apparatus, supplied by the B. F. Sturtevant Company, is employed. The fans



STANDARD CAR



BOILER ROOM



VIEW OF ENGINE ROOM—LA CAPITAL TRAMWAYS COMPANY

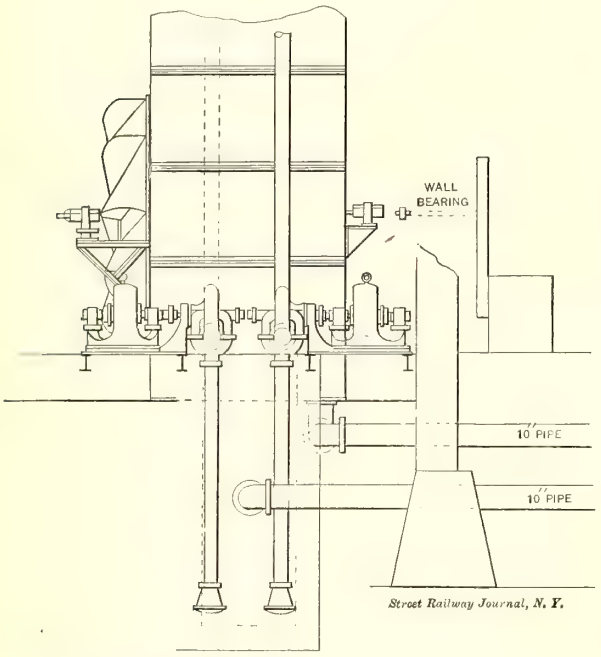
can be run by electric motor or separate steam engine, as desired, but the motor is usually employed. The fans are in duplicate, but arranged with a clutch so that one or both can be driven by either engine or motor. The induced draft apparatus and economizer are both placed over the boilers, as will be seen on the diagram, and by-passes are arranged to cut the economizer out of service if desired. The condensers are of the Conover type, and Barnard cooling towers, supplied by the Wheeler Condenser & Engineering Company, are in use. The management speak in favorable terms of the use of induced draft, which, under the circumstances existing in Buenos Aires, is particularly valuable. In that city heavy showers come up suddenly, and when these occur the people crowd into the cars, throwing a sudden load on the power station. The use of induced draft enables the station engineer to force the boilers up quickly at these times, and thus take care of this sudden load. The ability to force the boilers at will is also valuable in taking care of the evening pleasure load, which, in summer, is often very heavy.

The company has recently installed, close to the station, a chloride accumulator battery of 1000-h.p. hours capacity for station regulation, and also one of about the same size

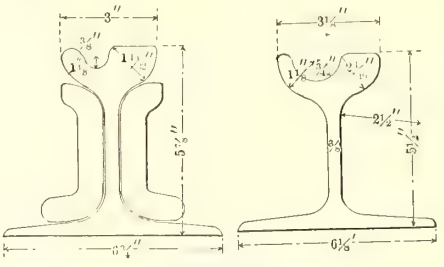
at about half a mile from the further end of the line for maintaining the necessary pressure at that point. Both batteries are fitted with motor-driven boosters; that for the distant battery is a shunt-wound machine of the ordinary type, with current always flowing in the same direction and at about 150 volts. The booster for the station battery is of the differential type. Both boosters were supplied by the Bullock Electric Manufacturing Company.

The track construction, when the electric equipment was first commenced, was that used formerly with horse traffic. The rails were quite soft and of the section shown herewith. An attempt was made to utilize these on part of the line, but it was finally decided advisable to replace them with a modern 9-in. 90-lb. girder rail in the city and a 7-in. 70-lb. rail in the suburbs. The section now employed is that shown above, the grooved rail being compulsory. The 9-in. rails were supplied by the Lorain Steel Company, and the 7-in. rails by the Pennsylvania Steel Company. They are in 30-ft. lengths, as it was found impossible to ship the 60-ft. lengths. They are mounted on 4-in. x 6-in. ties of *colorado quebracho*, which is a native wood, dark red in color, and so hard that spikes cannot be driven into it; holes, therefore, have to be bored for their reception. Ties of this wood practically last forever. They cost about 75 cents apiece, are spaced 2 ft., center to center, and are mounted on 6 ins. of concrete. The joints on the 9-in. rail are all of the twelve-bolt type and most of the track is double bonded with the Brown plastic bond. The special work was supplied by the Lorain Steel Company and the Pennsylvania Steel Company.

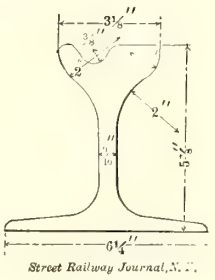
In the original construction tie-rods were used, but it was found that the heavy carts which are in use in this



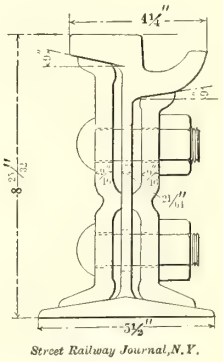
CIRCULATING PUMPS FOR COOLING TOWER



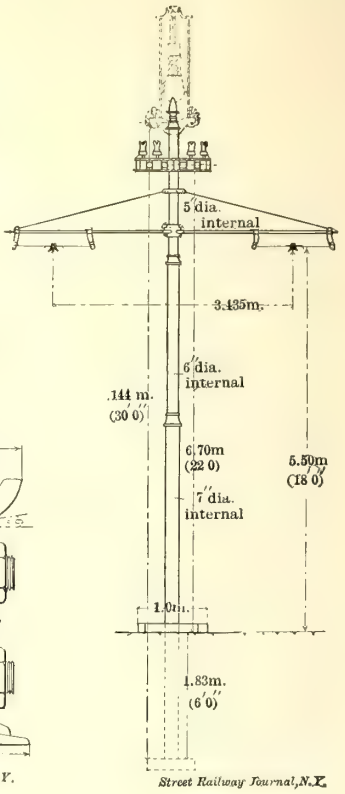
OLD RAILS



OLD RAIL



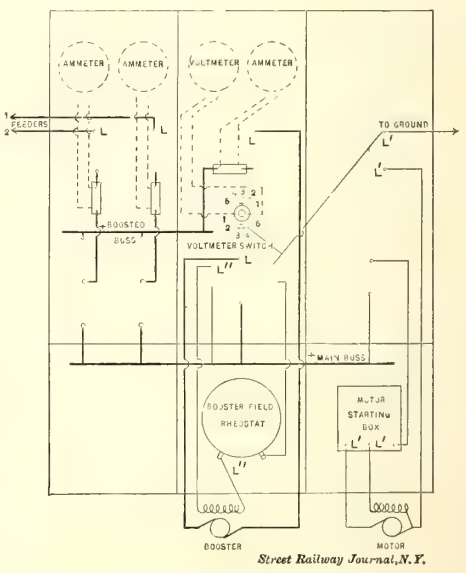
NEW RAIL



POLE



TYPICAL SCENE ALONG ROUTE



CONNECTIONS OF STORAGE BATTERY SWITCHBOARD AT POWER STATION

country broke off the ends of these rods, so that now braced tie-plates are being installed in their place. These native carts weigh from ten to fifteen tons each, and are fitted with wheels about 10 ft. in diameter. They are drawn by bullocks.

All feeders from the power station to Entre Rios, a distance of 1½ miles, are carried underground in creosoted wooden ducts; the rest of the feeders are carried overhead. The line was constructed by the Ansonia Brass Company. A number of poles in the center of the city carry arc lights. All the streets are paved either with stone blocks or native wood, and all paving is done by the company.

The cars are all of the double-deck type, with 18-ft. bodies. They were built by the J. G. Brill Company, and are mounted on Brill 21 E trucks. They are equipped

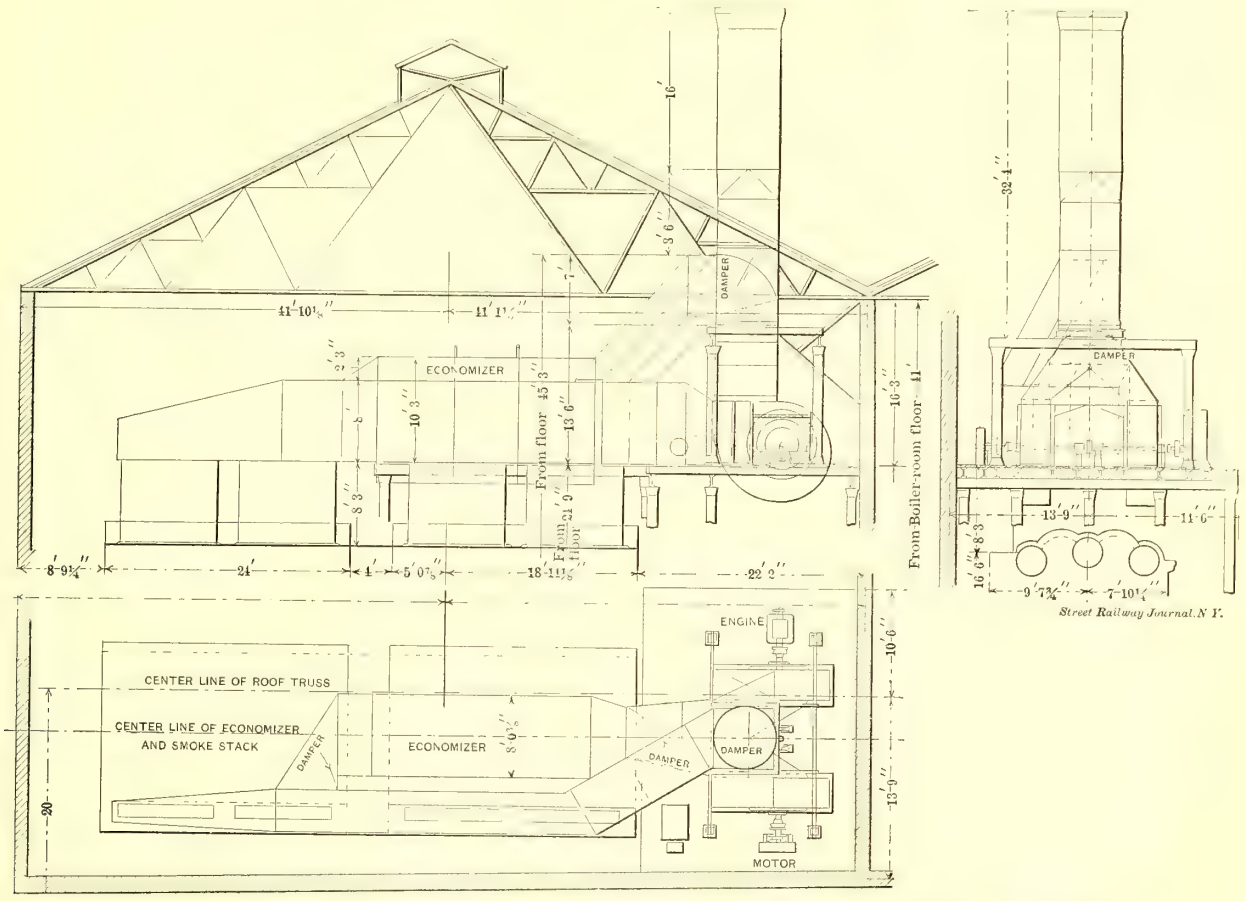
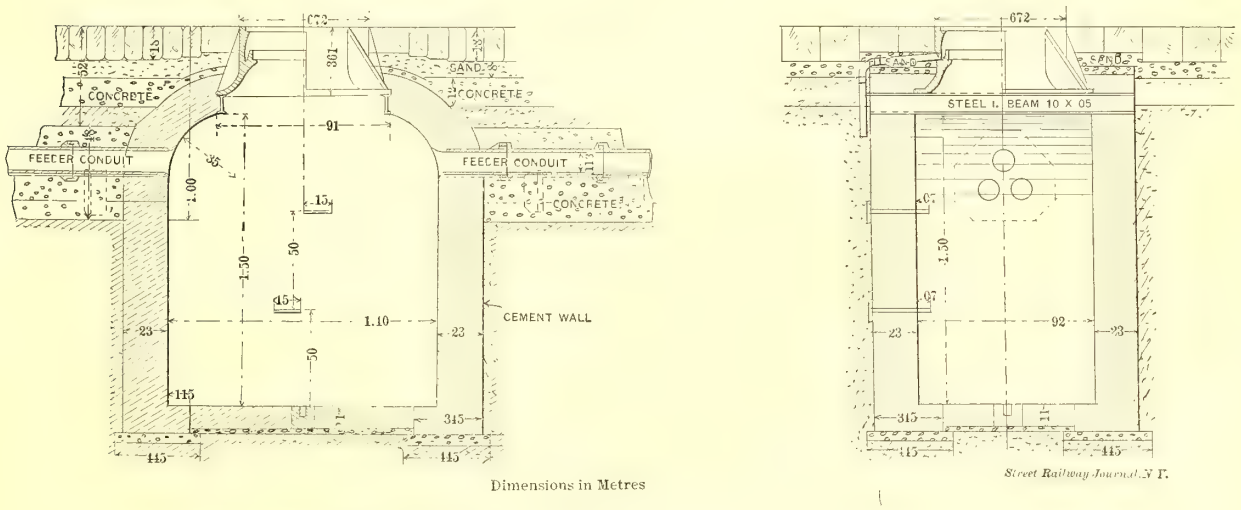


DIAGRAM SHOWING ARRANGEMENT OF ECONOMIZER AND INDUCED DRAFT APPARATUS



LONGITUDINAL AND CROSS SECTIONS OF MAN HOLE

Below Entre Rios iron poles with ornamental brackets are employed; beyond that point wooden poles are in use. The iron poles, which were supplied by Morris & Tasker, are all fitted with what are called refuges; these consist of a raised area at the base of the pole, about 39 ins. square and 6 ins. high, formed by curb stones and paved in the middle. The line appliances were supplied by H. W. Johns Manufacturing Company and A. & J. M. Anderson, and the feeders and the trolley wire by the Ansonia Brass Company. A number of poles in the center of the city carry arc lights. All the streets are paved either with stone blocks or native wood, and all paving is done by the company.

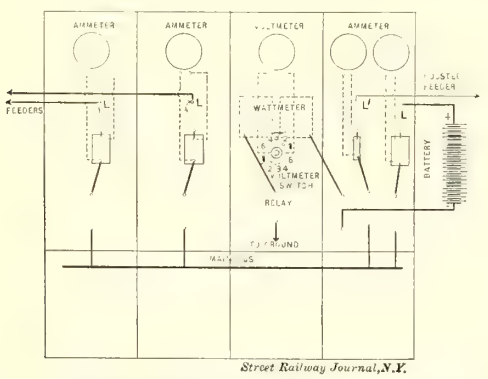
The cars are all of the double-deck type, with 18-ft. bodies. They were built by the J. G. Brill Company, and are mounted on Brill 21 E trucks. They are equipped with short platforms, and are all of short length on account of the narrow streets in the old part of the city, which would prevent the use of a longer car. The double decks are employed on account of the variable climate, which makes some passengers prefer an open car and others a closed car. The management reports that no accidents have followed the use of double-deck cars, and they seem well suited for the conditions existing in Buenos

Aires. The usual European regulations in regard to limiting the number of passengers on the cars are in force, and only four people are allowed to stand on the front platform and six on the rear platform. The climate is about similar to that in Richmond, Va., and no car heaters are required. At present one motorman and two conductors are employed on each car, one conductor for the lower deck and one for the upper deck. Practically all of the motormen and conductors are Italians, as the natives of the country do not seem to take to the work. The wages paid are about $2.25 in paper, which is equivalent to about 80 cents in gold.



LAYING TRACK

The officers of the company are: President, Theo. N. Vail; secretary and treasurer, H. Roberts Parrish; consulting engineer, E. T. Birdsall, M. E.; resident general manager, Charles R. Thursby, C. E.; resident chief engineer, J. W. McCrosky.



Street Railway Journal, N.Y.

STORAGE BATTERY CONNECTIONS AT BOOSTER STATION

Electric Railroading in Milwaukee

Perhaps the heaviest daily car service on any American street railway is that given by the Milwaukee Electric Railway & Light company, of Milwaukee, from Milwaukee to Waukesha. The distance between these two points is 20 miles, and the winter service is given by two cars, which make the distance in about fifty-five minutes, an allowance of five minutes' wait being made at each end. Each car makes nineteen trips a day, or 380 miles in toto. The cars are double truck, and are made by the Barney & Smith Company.

The fare from Milwaukee to Waukesha is 35 cents single trip, and 50 cents round trip, which is considerably lower than the competing railroad fare, and the electric railway has taken nearly all the business away from the steam railroad. The line to Waukesha has been recently rebuilt, and is in magnificent condition. A large portion of it is over private right of way. A short time ago, on the invitation of General Manager Beggs, Henry Villard and other largely interested stockholders of the North American Company, and Edward E. Higgins, editor of the Street Railway Journal, made a trip over this line to Waukesha in fifty minutes, the speed at places being as high as 45 miles per hour.



EXTERIOR OF POWER HOUSE



OX CARTS IN COMMON USE IN BUENOS AIRES

The Milwaukee Company's lines now extend south from Milwaukee also as far as Racine and Kenosha, a distance of about 26 miles from the center of Milwaukee, and it will probably be but a short time before the intervening gap between the end of this line at Kenosha and the Chicago & Evanston Railway, now building northward from the Chicago city limits, will be filled up by a connecting railway, completing a through electric railway between Chicago and Milwaukee.

Electric Railways in Madrid and Barcelona

BY F. C. ARMSTRONG.

In spite of the fact that war was being waged last summer by Spain, the streets of Barcelona and Madrid, the two most important cities of the Iberian peninsula, presented scenes of great activity on account of the introduction of electric tramways in both cities by British capital. It is but just to say here that although the sympathies of Great Britain in the late war were supposed to be with the United States, the engineers who were engaged in the work of tramway installation in Spain were not molested in any way, although most of them were Englishmen and among them were a number of Americans.

Perhaps no nation in Europe is less understood by the English speaking people as a whole than the Spanish. While nearly all the other countries on the Continent are overrun each summer by tourists from England and America, comparatively few venture into Spain. As a result many people have formed their ideas of the Spanish from Cervantes' famous novel, and have the impression that they are a brave, chivalrous, but unpractical nation, romantic and dreamy, with little desire for modern improvement and with no habits of industry. While Spain as a nation has suffered from many causes which it is not the purpose of this article to discuss and which have repressed enterprise, both individual and corporate, the Spanish nature is far from being an idle one, and the average workman bears a striking resemblance to the French peasant in his qualities of frugality, temperance and capability for work.

The city of Madrid, the capital of Spain, is very similar in appearance to many other European capitals of the same population, with broad streets and fine buildings, many parks, amusements and manufactures. Barcelona, the largest city in population in Spain, is, on the other hand, a typical seaport town. Most of the houses are of brick, and many of them particularly in the new part of the city, are of hewn stone and of imposing appearance. It is the seat of various manufactures, a number of which are silks, woolens, cottons, calicoes, etc.

The Tranvia de Madrid is owned by an English company, the Tramways Union Company, Winchester House, Old Broad Street, London, which is also the owner and operator of several other continental tramways. The company's lines in Madrid cover the principal streets of the city, and are approximately 17 miles in length. The Barcelona Tramways Company, Limited, is also an English corporation, with offices at the same address in London, and the routes of the two systems are shown in the accompanying maps. When the electric equipment of both lines was decided upon, Alfred Dickinson & Co., the well known English electrical engineers, were appointed engineers to supervise the installation and tenders were requested from thirty firms for the electrical equipment of both lines. In October, 1897, the contract was finally awarded to Dick, Kerr & Co., Limited, of London, for the complete equipment required for the conversion of both systems. The equipment is similar in many respects, as will be seen from the following description:



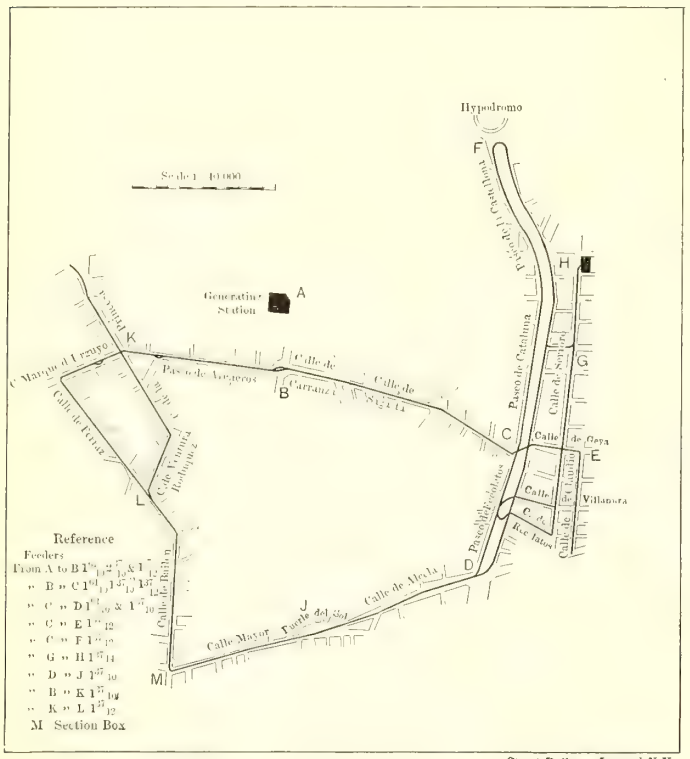
VIEW OF NEW ELECTRIC LINE AT MADRID

POWER STATIONS.

The power station at Madrid is equipped with two water tube boilers, each having 3654 sq. ft. heating surface, and

working at a pressure of 8 atmospheres. The engines are of the Corliss type, cross-compound, having cylinders 20 ins. and 40 ins.x42 ins. stroke. They are coupled direct to compound wound multipolar generators of 425 kw. capacity. Each power unit is provided with an independent Admiralty type surface condenser, operating in conjunction with a cooling tower. This tower has a capacity of dealing with 50,000 lbs. of steam per hour. It is provided with fans for creating an artificial draft, but so far the load has never been sufficiently heavy to necessitate these being put in operation. Indeed, when the full power tests were being made, 800 h.p. was dealt with for twelve consecutive hours, and, strange to say, the water in the reservoir was found to be 3 deg. cooler at the end of the run than at the start. Piping is arranged on the loop system, and consists of mild steel with flanges shrunk on and brazed; all elbows, T-pieces and special fittings are also of mild forged steel and the valves are of specially heavy design.

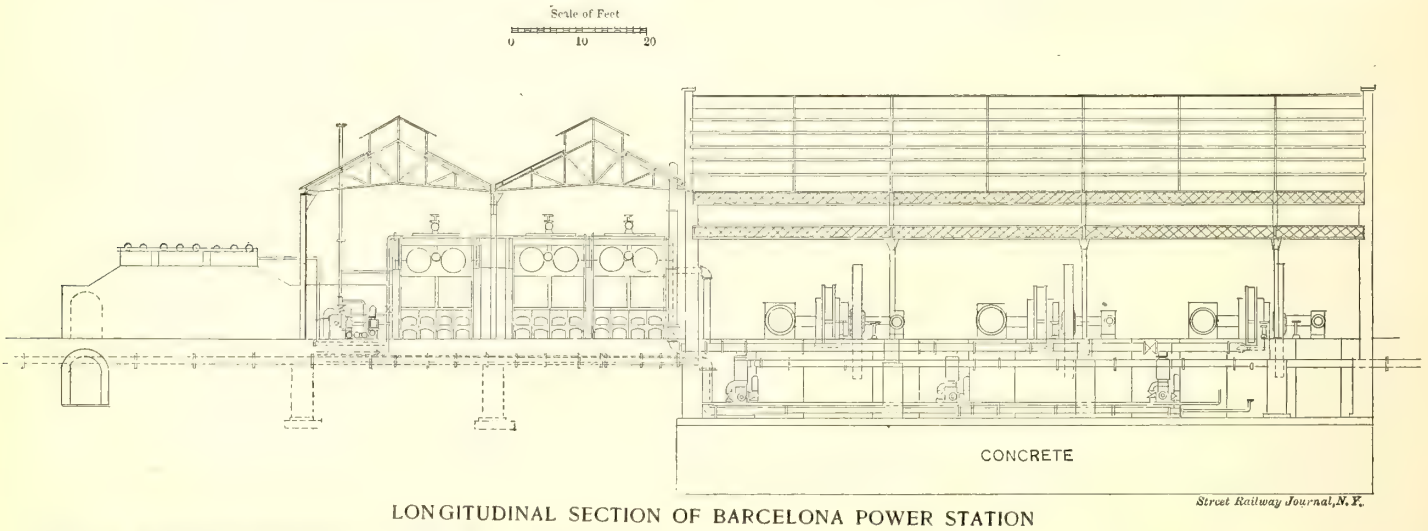
From the generators the current is conducted to the



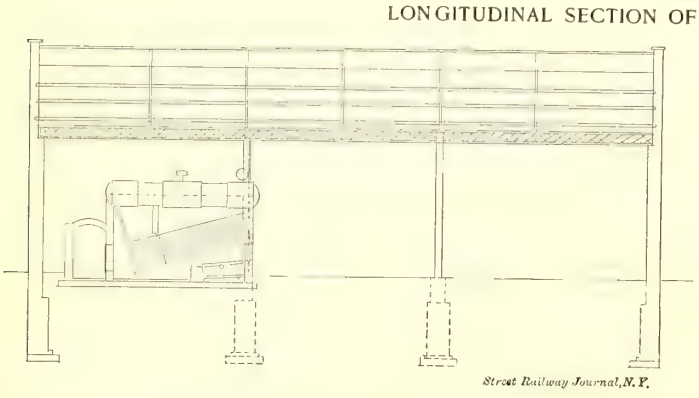
MAP OF MADRID TRAMWAYS



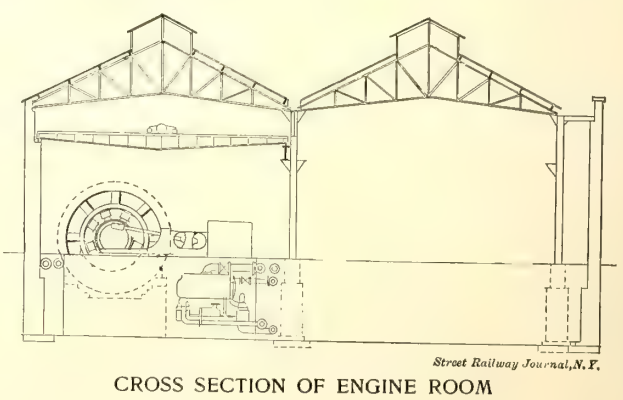
MAP OF BARCELONA TRAMWAYS



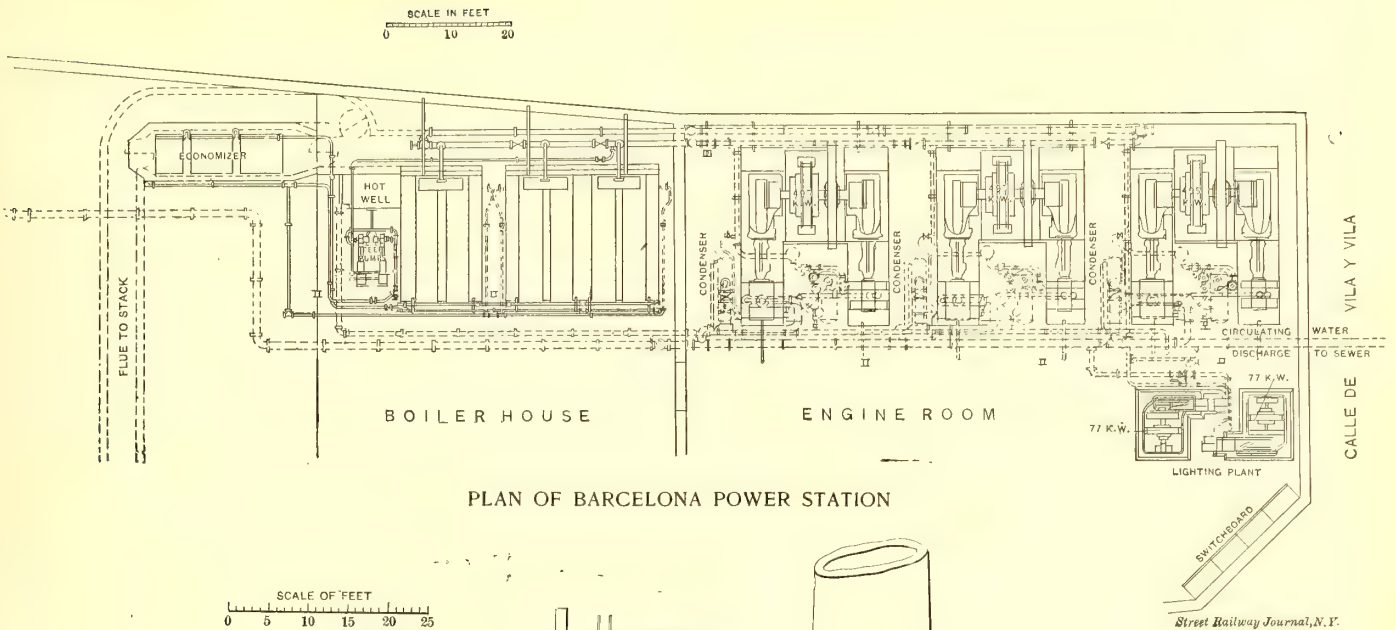
LONGITUDINAL SECTION OF BARCELONA POWER STATION



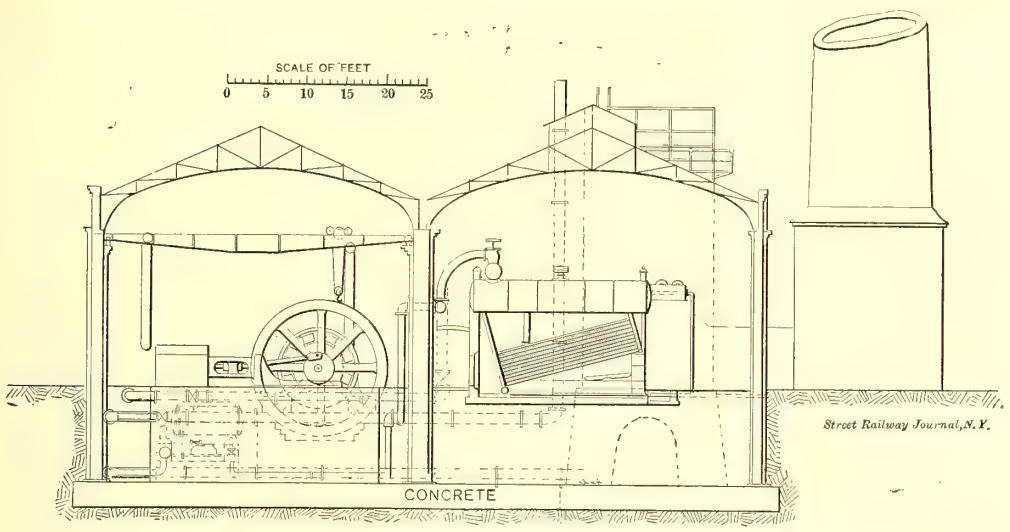
CROSS SECTION OF BOILER ROOM



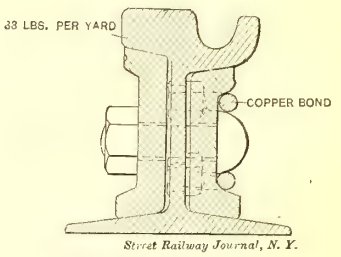
CROSS SECTION OF ENGINE ROOM



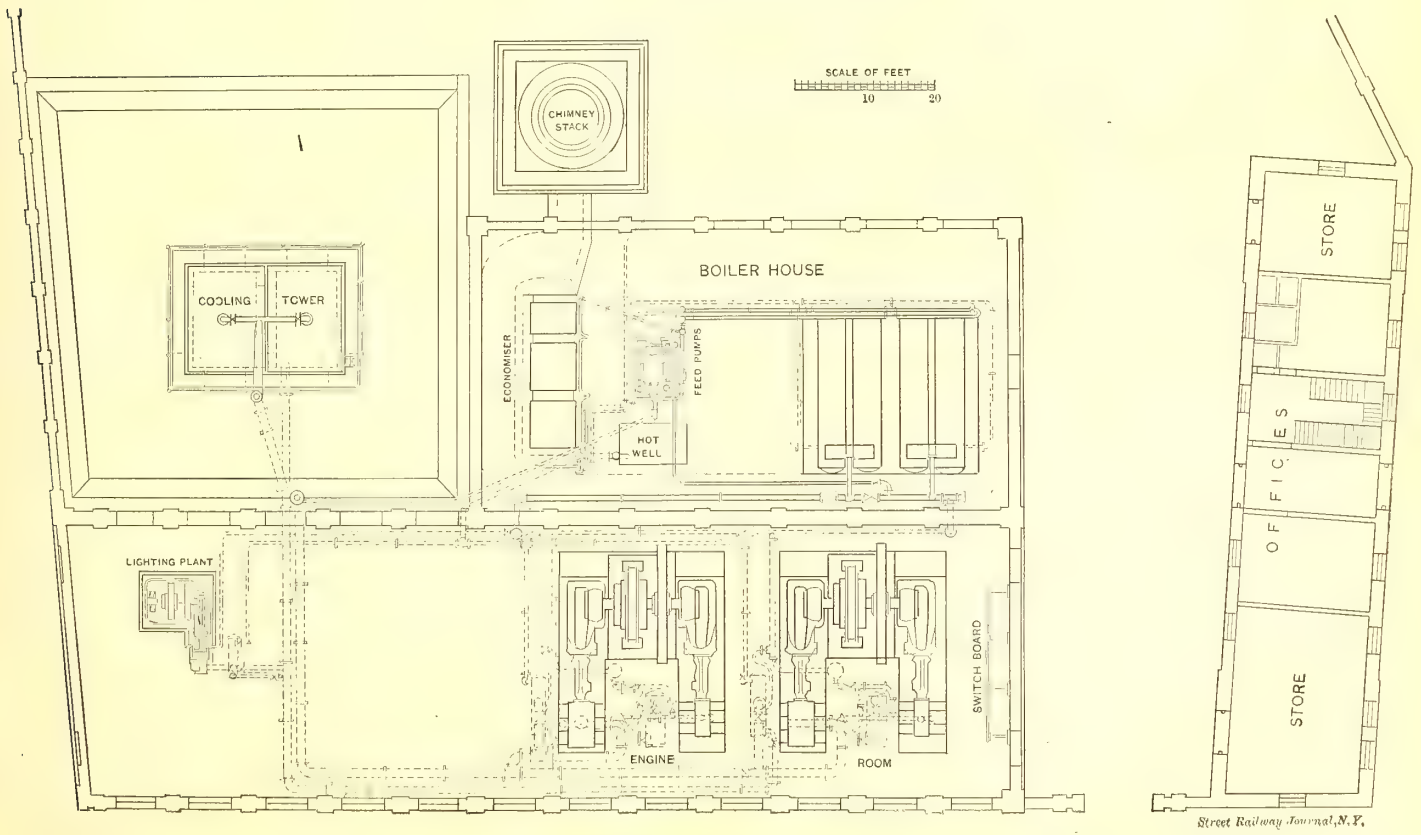
PLAN OF BARCELONA POWER STATION



SECTION OF MADRID POWER STATION



STANDARD RAIL



PLAN OF MADRID POWER STATION

switchboard by lead covered cables. The switchboard is arranged on the usual panel system, there being three generator panels, a main output panel and seven feeder panels. In addition to these there is a Board of Trade panel, as the system has been laid with the view to complying with the Board of Trade regulations as to drop and rail return. There is also a special lighting panel which is arranged so that current can be taken either from the supplementary unit or from the main bus bars and distributed to the several lighting circuits.

The power station of the Barcelona tramways is located near the shore close to the southern end of the system, as will be seen from the map, this selection being dictated by the high price of coal in Barcelona and the necessity of operating, condensing and of reducing the transportation charges on fuel. Owing to the treacherous nature of the soil at this point, the foundations were made extremely broad, that for the chimney, which was to be 200 ft. high, being especially elaborate. After considerable investigation, it was finally decided to make the base of the foundation 54 ft. sq. Concrete was first laid to a depth of 4 ft. 1 in. Upon this was placed a layer of 6-in. railroad rails, laid close together, and above these rails was a layer of concrete 2 ft. 5 in. deep; another layer of rails was then laid in a reverse direction and another layer of concrete 2 ft. 1 in. was placed upon these rails; above this was placed a third layer of rails, then 2 ft. of concrete, and finally, 11 ft. 6 ins. of brick work. By this arrangement of raft foundation, the total weight of the chimney on the foundations was reduced to less than 2 tons per superficial foot.



BULL FIGHT AT MADRID



STREET SCENE, MADRID

The boilers are of the water-tube type, and have the same heating surface as those in Madrid, and are equipped with feed pumps, hot well and economizers. The engines are of the Corliss type with similar cylinder dimensions to those in Madrid, and are each directly coupled to a 425-kw. generator. The piping in this station is on the same general plan as that in Madrid, as shown in the plan of both stations, and in each station there is a small supplementary steam dynamo equipment for use in operating all-night cars and car-house lighting. There are two of these at Barcelona and one at Madrid, each consisting of a horizontal tandem compound engine coupled to a 75-kw. multipolar compound wound dynamo. If necessary, these units are also to be used as boosters for the long-distance transmission.



STANDARD CAR, MADRID



POWER STATION, MADRID



VIEWS OF TRAMWAY AND TRAMWAY CONSTRUCTION IN BARCELONA

SUPPLY SYSTEM

The overhead construction in both cities is generally of the center pole type, though span wire construction is also employed to a considerable extent. The poles are steel tube, with a length of 26 ft. 6 ins., and taper from 7 ins., at a point 6 ft. above the ground, to $3\frac{1}{2}$ ins. at the top, the butt end of the pole being parallel. The poles are bedded in concrete to a depth of 6 ft., and some of them, especially those in the principal street, are most ornate. The whole of the cast iron work for this was done in Spain, and the manner in which it was executed shows that the Spanish art of manipulating iron has not been lost. The brackets of the center pole construction, as will be noticed, are extremely short, and in most instances are not more than 15 ins. in length, and give a remarkably pleasing and unobtrusive appearance to the over-head work. This result is made possible by the use of the lateral or Dickinson type of trolley, which is employed throughout. A section of the base of this trolley, with the arrangement of springs, is shown in one of the engravings on page 81.

All feeders are laid underground, and the distribution from the generating station is arranged as shown in the accompanying plan. The bitumen solid system has been used throughout, the cables being laid in cast iron troughs, supported on suitable bridges, and the whole then filled in solid with bitumen. Distribution is made in Madrid from under-ground boxes at feeding and section points. This was necessary because the authorities would not allow the ordinary type of feeder pillar to be erected. The engravings show the general arrangement of these boxes, the number of connections varying according to the location.



STANDARD CAR, BARCELONA

In Barcelona railway pillar boxes as shown in the cut are used.

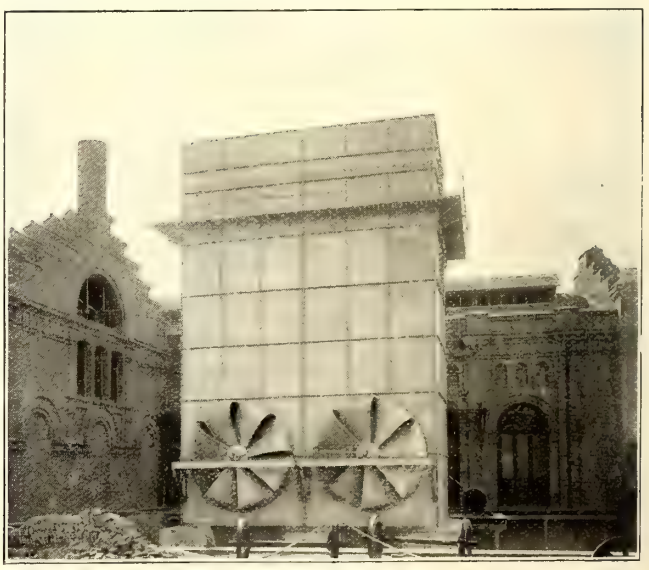
The overhead system is divided into half-mile sections by means of the section insulators, on the same conditions as laid down by the British Board of Trade. The feeder boxes, through which the current is taken from the cables to the line, are supplied with the usual switches and fuses, and, in addition, a pilot wire for testing purposes. This latter wire is also to be used for communicating with the generator station by means of a portable telephone. Where return feeders are employed, and their use is quite general, especially in Barcelona, they are laid in cast iron troughs and bitumen, similar to the outgoing feeders.



VIEW ON THE CALLE ALCALA, MADRID

TRACK CONSTRUCTION

With the electrical equipment of the line the track has been entirely rebuilt and the gage adopted is 4 ft. $8\frac{1}{2}$ ins. The rail is of the grooved type, weighing 82 lbs. per yard, and rests on a stringer 6 ins. deep, and 1 ft. 6 ins. wide, made of concrete in the proportion of one part of cement to five parts of broken stone, gravel and sand. The rails are double bonded at each joint.



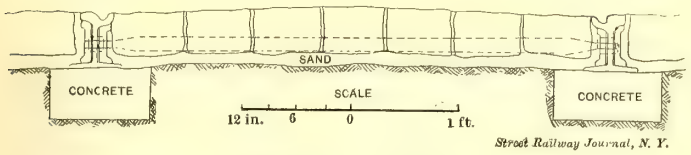
COOLING TOWER, MADRID

ROLLING STOCK.

The cars in use were built to specifications at Saragossa, and are very similar in general appearance to those used in America; in fact they were modeled on American lines, except that extra large platforms are in use. The cars measure over all 25 ft. 2 ins., with body length, inside, of

15 ft. 9 ins. and width of car 6 ft. 11 ins. They carry forty-four passengers, twenty-two seated and twenty-two standing. Eighty-five cars are in use at Barcelona and fifty-five at Madrid.

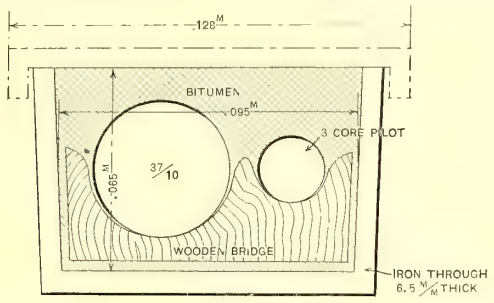
The cars are mounted on trucks of the Brill 21 E type,



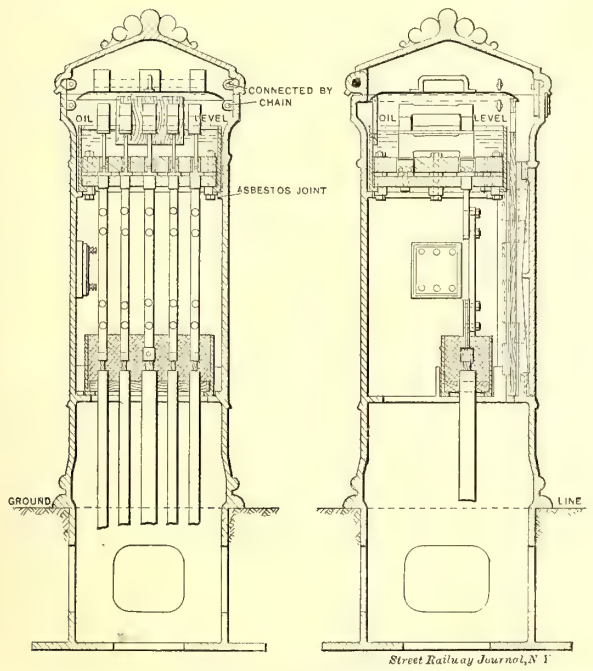
SECTION OF TRACK

with 30-in. steel wheels with cast centers and rolled steel tires, and are equipped with two motors with series parallel controllers. The trolley is of the Dickinson type, as described elsewhere.

Both plants possess peculiar interest from a tramway standpoint, as they are practically the first examples of the electrical equipment of large continental tramway systems upon strictly American lines, viz., the use of slow-speed,



CONDUIT FOR ONE FEEDER



FEEDER PILLAR SWITCH

direct-connected engines with water tube boilers, economizers, single-deck cars, etc. The only important feature in which a departure has been made from standard American practice has been in the use of the Dickinson trolley.

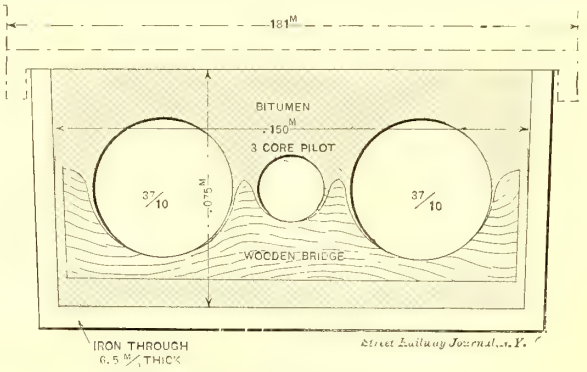
Taking into consideration the extent of these two installations and the circumstances under which they have been made, their successful completion within practically one year from the date of signing of the contract must be regarded as exceedingly creditable both to the consulting engineers, Messrs. Alfred Dickinson & Co., who were responsible for the plans and who supervised the entire installation, and to the contractors, Messrs. Dick, Kerr & Co., Limited, by whose staff the work was carried out without a hitch from beginning to end.

Method of Splicing Cars in Philadelphia

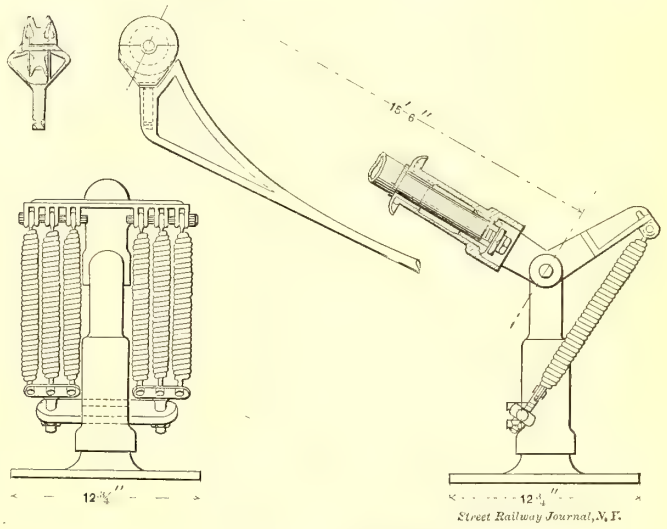
The Union Traction Company of Philadelphia is splicing at its car repair shops quite a number of its old 18-ft. cars, making a new body 25 ft. in length, which is mounted on eight-wheel trucks. In the operation of splicing, the cars are cut in two and the sills are united by a corresponding section inserted with a ship splice, when the whole is reinforced by a steel angle plate 6 ins. x 4 ins. and ⅝ in. in thickness. This is placed on the outside of the sill with the 4-in. limb on the under side. The car is also reinforced by truss rods. The sides and roof are then completed to correspond with the original structure of the car.

An Important Appointment

The Boston Elevated Railway Company has engaged John Lundie, the well-known expert in railroad transportation, as its consulting engineer, for the construction of the new elevated railway in Boston, and Mr. Lundie will shortly begin his preliminary work in laying out and determining the factors in the elevated railway composition as presented by Boston's peculiar conditions. Mr. Lundie's valuable work in analyzing the traffic conditions of the Illinois Central's Chicago suburban lines has given him a high place among railroad experts, and his exceptionally careful study of the Brooklyn elevated railway problems during the past few months has brought him even wider experience. Mr. Lundie's unique methods of attacking railroad transportation questions are the admiration of those who have been privileged to follow them, and his grasp of all the elements entering into any particular case is remarkable.



CONDUIT FOR TWO FEEDERS



DETAILS OF TROLLEY

The Cincinnati & Hamilton Electric Street Railway

In Southeastern Ohio there is now completed a system of connecting interurban electric roads reaching from Cincinnati to Eaton via Hamilton and Dayton, a distance of nearly 100 miles. The lines extending from Eaton to Dayton, and from Dayton to Hamilton, were completed a year ago, while the Cincinnati & Hamilton has just been placed in operation. The road is 15 miles long from Hamilton to the point where it connects with the lines of the Cincinnati Street Railway Company.

The company owns its right of way, which lies alongside a highway owned by a corporation, from whom the railway company purchased the right of way strip. The road throughout its entire length has been chosen so as to lie upon the highest ground, and in this way the high water so frequent in the Miami bottoms will be avoided. The route is very rough, there being but few level stretches in it; the maximum grade is 5 per cent and 1,000 ft. long. There are many sharp curves, but they have been laid out with such extreme care that they can be rounded at a high rate of speed.

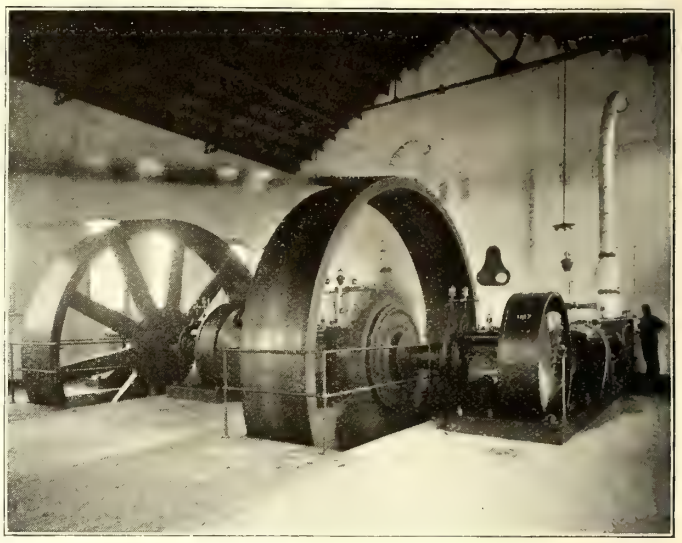
The brick power house is located at Symns Corner, some 5 miles from the Hamilton end. It is 143 x 49 ft., covered with a slate roof supported on steel trusses and has cement floors. There are installed two Hamilton-Corliss engines of 600 h.p. each and running at 90 r.p.h. The cylinders are 24 x 28 ins., the fly-wheels 20 ft. in diameter and weigh 27 tons each. The engines are belted to 400 kw. Westinghouse generators.

Four Stirling water tube boilers of 250 h.p. each form the boiler equipment. These boilers are the Stirling Company's standard street railway type, provided with large drums affording liberal steam reserve space and disengaging surface, sudden demands for steam are thereby provided for without the usual attendant danger of entrainment or sudden dashes of water into the cylinders of the engines.

Berryman heaters, Austin separators, Hoppes purifiers and Laidlaw-Dunn-Gordon pumps make up the remainder of the power house equipment.

The furnaces are fitted with two sheet iron stacks 100 ft. high by 5 ft. diameter; these are set on the boiler walls and held in position by two sets of guys. The storage cistern holds 3,000 bbls. and is supplied from two wells 70 ft. deep reaching into the river gravel.

Near the power house is the car barn 152 x 96 ft., with a wing 69 x 41 ft. It is also of brick with a gravel roof.



ENGINES

There is room for twelve cars and the repair department is also under this roof.

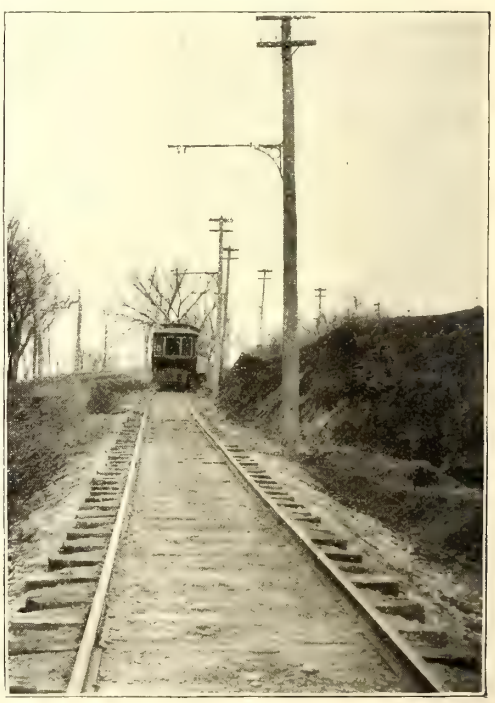
Five fire plugs connected with a fire pump in the power house are located in and around the buildings.

Two No. 0000 trolley wires are used. These are hung from brackets on 7 in., 35 ft. cedar poles, except in the towns of Mt. Healthy and College Hill, where iron poles were demanded by the residents. Three cables of 300,000 c.m. feed the southern part of the road, and two of the same size are required for the northern end. All overhead material was furnished by the Ohio Brass Company. The track is double bonded with No. 0000 Washburn and Moen bonds.

The rails are 70 lb. T section laid on oak ties 6 ins. x



VIEW IN BOILER ROOM



BRACKET WORK

8 ins. x 8 ft. At the joints are 6-bolt angle bars. All special work was made by the Lorain Steel Company. A good heavy layer of ballast, consisting of either gravel or broken stone, is used everywhere. The company bought gravel beds near the line and used two steam engines for hauling its gravel trains.

Eight Kuhlman cars constitute the rolling stock; these are 43 ft. long over all and weigh 25 tons. They are



TERMINAL STATION AT COLLEGE HILL

painted maroon and yellow and are substantial, comfortable and elegant, and are mounted on double trucks of the Peckham Truck Company. They have smoking compartments, are heated with the Consolidated Car Heating Company's electric heaters, and fitted with New Haven registers. The motors, controllers, gears, and pinions and the electric brake are all of General Electric design.

The despatching is by the well-known Garl Telephone system; a portable instrument is carried on each car and plug-in stations are located along the line at intervals of 1000 ft. The road was projected and built by Christy Bros., Akron, O. The officers are Will Christy, president; F. J. J. Sloat, general manager. F. H. Conner was in charge of the erection of the plant.

Roadway Department of the Union Traction Company, Philadelphia

The extent of the system of the Union Traction Company, of Philadelphia, the company owning a greater number of miles of track than any other in this country, has permitted the company to introduce certain methods and appliances into its various departments, which, in many cases, could be adopted to advantage by smaller companies. It is the purpose of this article to describe the practice of one department only, that covering the important subject of roadway. The work of this department embraces not only the care of the track and roadbed, but also the care of the conduits for underground cables, the paving of the entire streets on which the tracks are laid, the care of all the bridges on the system, of which they are seventy, all building repairs, including those on the car houses, power houses and the stables for the draft horses, and the feed and care of the horses. The work is carried on under the supervision of H. B. Nichols, with the designated title of engineer of way.

The forces employed are divided into regular and emergency gangs. All orders and assignments for work are issued from the engineer's office to the foremen of the divisions, of which there are three. The regular gangs have a monthly assignment as to the streets to be covered, and detailed orders to them are issued daily. It is the practice to go over the entire trackage once a year for surfacing, examining and tightening joints, as well as for reversing or renewing angle plates, except where the cast-welded joints are employed.

All paving is also inspected once a year by the regular gangs, while the special forces repair any dangerous holes and attend to complaints, replacing any stones that have been forced from their bed, and repairing the asphalt surface where necessary. The different classes of paving are all numbered, and consist of about an equal amount of granite blocks and asphalt, with some brick. Included in the work of the special gangs is the shoring and protection of all excavations for sewer or pipe connections, whether the excavation is made by the company, by the city or by private parties. The expense for shoring, if for the city or for private individuals, is charged up to the persons or body for whom the work is done.

All jobs for repairs, either to track or paving, or for other purposes, are numbered, and all labor and material are charged to such a number. The labor account for each job number is shown on the daily time sheets, which are forwarded every night, by the time keeper of that division, to the general office. In the issuing of material from the stock room, the amount is first temporarily charged to the foreman of each job, and he is also given credit for any scrap or material returned. The amount of material actually used is given on the material slip, which is forwarded to the general office by the store-keeper. When the job is finished, the amount is charged to the number, and the account of the foreman balanced, but he is held responsible for all work and material.

The care of the special work includes the cleaning of switches, sanding the tracks on the hills and oiling the curves. For this purpose, especially designed carts or wagons, to the number of fifteen, are provided and supplied with pails for oil and sand. On the rear of the cart is a step for the driver, so that mounting and dismounting are rendered easy. Each driver is assigned to a certain district, in which he is expected to keep the switches and curves cleaned and oiled, and the hills sanded. The cost of removing snow and ice is not charged up to each street, as in the paving repair, but goes in as a lump sum. The removal of ice from the track in cold weather is quite an item, as in many parts of the city surface drainage is employed, and water from the alleys runs over the rails and freezes in cold weather.

The engineer of way makes a monthly statement to the president and general manager of all work done during the month, under classified headings. At the beginning of each month also he hands in an estimate of the cost of material and labor required for the current month, and also reports the different classes and amount of track supplies on hand. The material in stock is checked up twice a year, and with the careful records kept, the resources and amount of material on hand can always readily be ascertained.

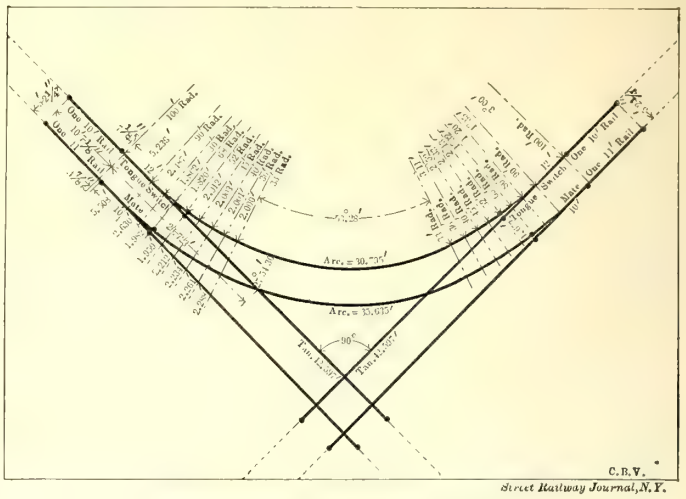
In the consolidation of the various companies into the Union Traction Company the new company inherited a great variety of rail sections, so that the work of keeping the track in repair is very considerable. The cast-welded joint is employed to a large extent on the old rail sections, and about 10,000 such joints are now in service. The standard rail, as required by the city authorities, is a 9-in. girder, but with various head modification. The standard joint plate is 36 ins. long, with twelve bolts. The mileage

also includes about 27 miles of T rail construction on rock ballast. This is the easiest track to keep in repair, and is generally laid on the side of macadam roadway. The company is required to keep in order 35 miles of macadam paving, and for this work a regular force is employed, equipped with steam rollers and other road machines.

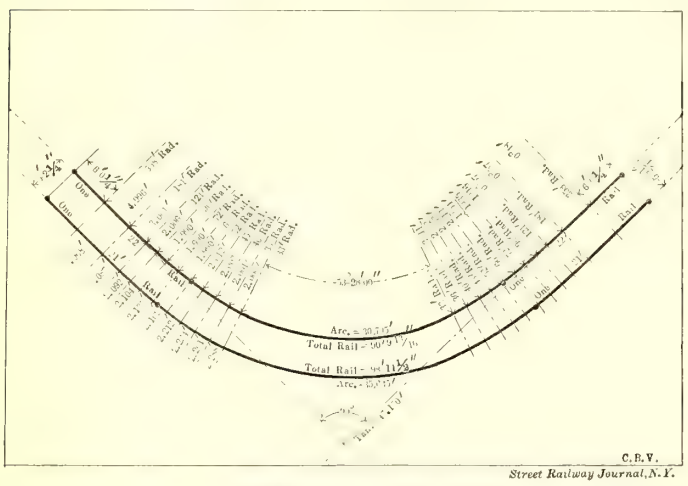
All designs for special work are made in the draughting room, under the direction of the engineer. Each piece of special work is numbered and a record is kept of all repairs required on it. A record is also kept on file of the life of each piece.

SPECIAL TRACK

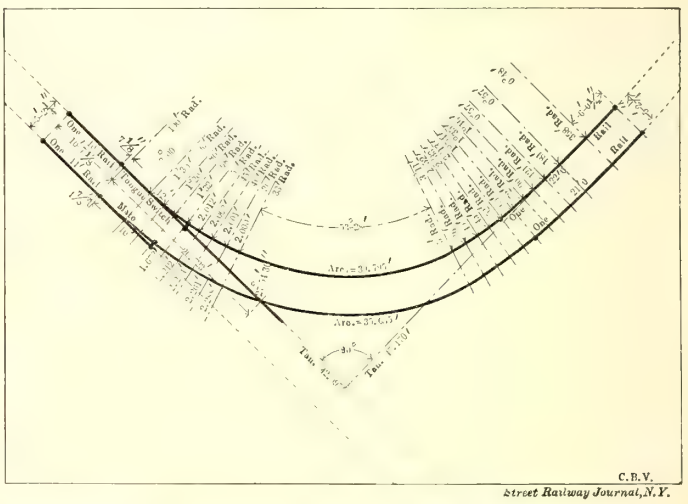
Two standard types of spiral transition switches are employed for all the turnouts on the entire system, one or the other of which installed is depending upon the radius of curve. The accompanying diagrams show the design of these two standards and the cross section at different points, and the table of curves illustrates the method of laying out the spirals. The wearing surface for the switches, frogs and mates is all of manganese steel. In the construction, a very large bolt is employed at the heel of the tongue, and the latter, it will be noted, is reinforced at the base, the sides of the track being under-cut. There are several other special features, including two grooves in the mates, for the wheel flanges, so that with four-wheel trucks the flanges of the front and rear wheel can run in separate grooves. The system requires about 3000



STANDARD CONNECTING CURVE



STANDARD PLAIN CURVE



STANDARD BRANCH OFF CURVE

U. T. CO. ELEMENTS OF NEW 90° CURVE.

	R.	Deflec.	Total Deflec.	Curve. Abs.	Curve. Ord.	Centers. Abs.	Centers. Ord.	Length of Arc. Inside.	Length of Arc. Outside	Tan.	Ex. Sec.
PLAIN.	358	0°-48′	0-48	4.998	.035	0.000	358.000	4.996	5.068	Middle R in 1st col. For Switch R < 60 + Sub. 4.573	Same for Switch if R < 60 +
	181	0 -57	1-45	7.999	.101	2.471	181.017	3.001	3.087	95.844	37 391
	121	0 -57	2-42	10.003	.179	4.304	121.045	2.006	2.092	79.132	29 997
	90	1 -16	3-58	11.990	.295	5.764	90.080	1.990	2.104	68.349	25.106
	72	1 -35	5-33	13.972	.460	7.009	72.123	1.990	2.133	61.453	21.888
	60	1 -54	7-27	15.949	.685	8.170	60.179	1.990	2.162	55.728	19.129
	52	2 -13	9-40	17.938	.985	9.207	52.246	2.012	2.212	51.899	17.218
	45	2 -33	12-13	19.905	1.365	10.382	45.346	2.003	2.234	49.078	15.756
	40	2 -52	15-05	21.849	1.837	11.440	40.459	2.001	2.261	47.170	14.727
	36	3 -11	18-16	23.765	2.411	12.481	36.597	2.000	2.288		
	33	53 -28	71-44	44.759	23.404	13.422	33.748	30.795	35 635		
SWITCH.	100	3 -00	3-00	5.234	.137	0.000	100.000	5.236	5.508	Frog. Angle.	Frog. Lead.
	90	1 -35	4-35	7.715	.301	0.523	90 014	2 487	2.630	20°-00′-33″	30.471
	80	1 -20	5-55	9.569	.472	1.322	80.046	1.862	1.982	21 -28 -07	29.346
	68	1 -32	7-27	11.376	.684	2.559	68.110	1.820	1 959	23 -59 -49	27.892
	52	2 -13	9-40	13.366	.983	4.634	52.245	2.012	2.212	25 -22 -45	27.320
	45	2 -33	12-13	15.332	1.363	5.809	45.344	2.003	2 234	26 -27 -01	26.995
	40	2 -52	15-05	17.276	1.835	6.867	40.457	2.001	2.261	27 -18 -52	26 808
	36	3 -11	18-16	19.192	2.409	7.908	36.595	2 000	2.288	27 -54 -30	26.723
	33	53 -28	71-44	40.186	23.403	8.849	33.746	30.795	25.635		

For any curve.

$\text{Tan}_1 = x_1 \, y_2 \text{ cosec } \Delta - y_1 \text{ cotan } \Delta$. $\text{Tan}_2 = x_2 + y_1 \text{ cosec } \Delta - y_2 \text{ cotan } \Delta$.

$\text{Tan}_1 = R_1 \sin a_1 + R_2 [\sin (a_1 + a_2) - \sin a_1] + R_3 [\sin (a_1 + a_2 + a_3) - \sin (a_1 + a_2)]$ &c. $- \text{Tan}_2 \cos \Delta$.

$\text{Tan}_3 = \{ R_1 \text{ vs } a_1 + R_2 [\text{vs } (a_1 + a_2) - \text{vs } a_1] + R_3 [\text{vs } (a_1 + a_2 + a_3) - \text{vs } (a_1 + a_2)]$ &c. $\} \text{ cosec } \Delta$.

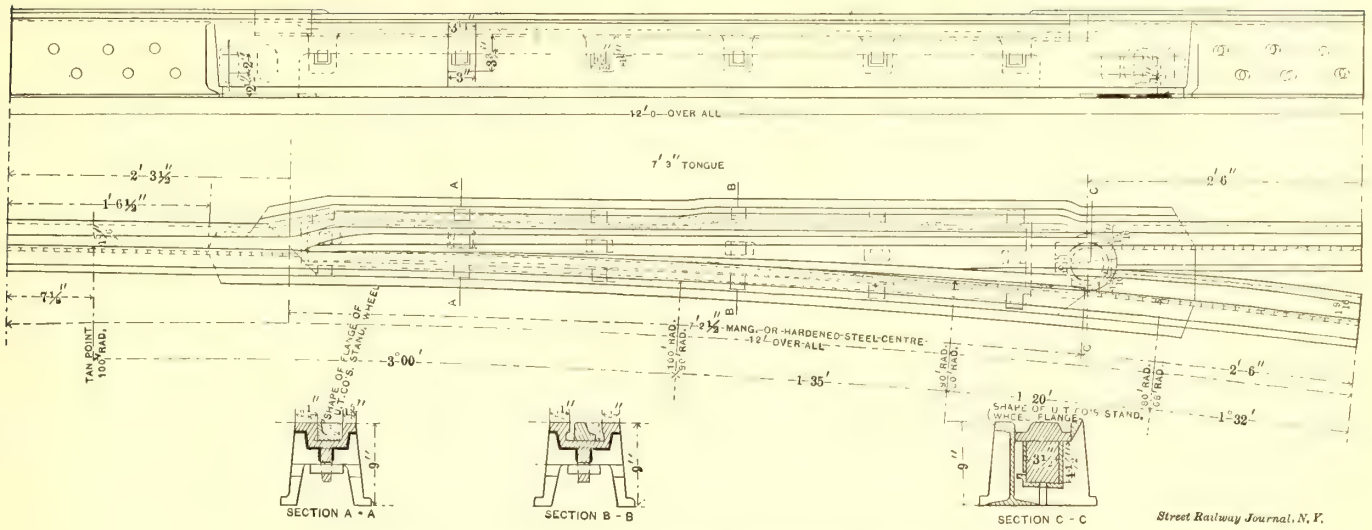
R	From	To	Tangent 90°.	Abs. of Middle Center.	Ord. of Middle Center.
PLAIN.	33	36	.63617 R + 26.176	.31344 (36—R) + 12.481	36.597—.94961 (36—R)
	36	40	.70532 R + 23.686	.26022 (40—R) + 11.440	40.459—.96555 (40—R)
	40	45	.76574 R + 21.270	.21161 (45—R) + 10.382	45.346—.97735 (45—R)
	45	52	.81788 R + 18.923	.16792 (52—R) + 9.207	52 246—.98580 (52—R)
	52	60	.86190 R + 16.635	.12966 (60—R) + 8.170	60.179—.99156 (60—R)
Sw.	52	68	.86190 R + 12.060	.12966 (68—R) + 2.559	68.110—.99156 (68—R)
	68	80	.89159 R + 10.041	.10308 (80—R) + 1.322	80.046—.99467 (80—R)

Formulæ.

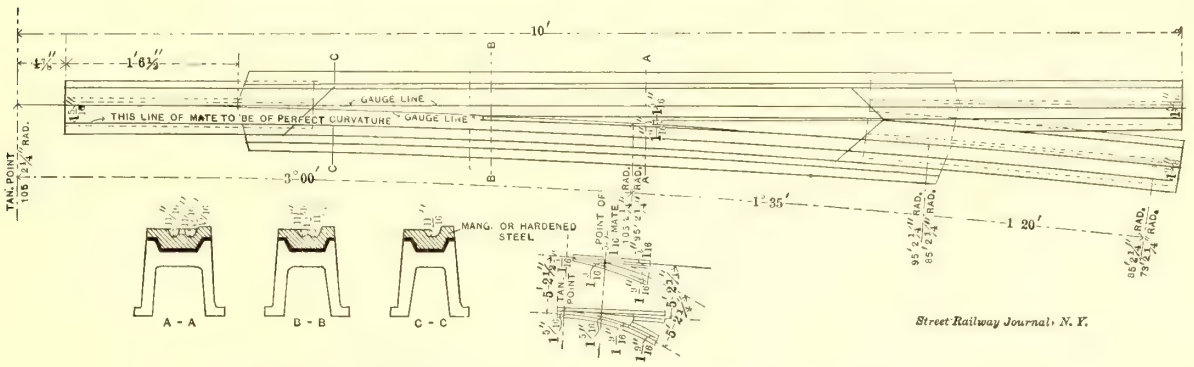
For symmetrical 90° curve;
Tan = R (cos s —sin s) + Abs. S + Ord. S
For symmetrical curve, any angle ;
Tan = Ct. Abs. + Ord. × tan ½ Δ
Ex. Sec. = Ct. Ord. × sec. ½ Δ — R

$$= \frac{\text{Ct. Ord.}}{\cos \frac{1}{2} \Delta} - R$$

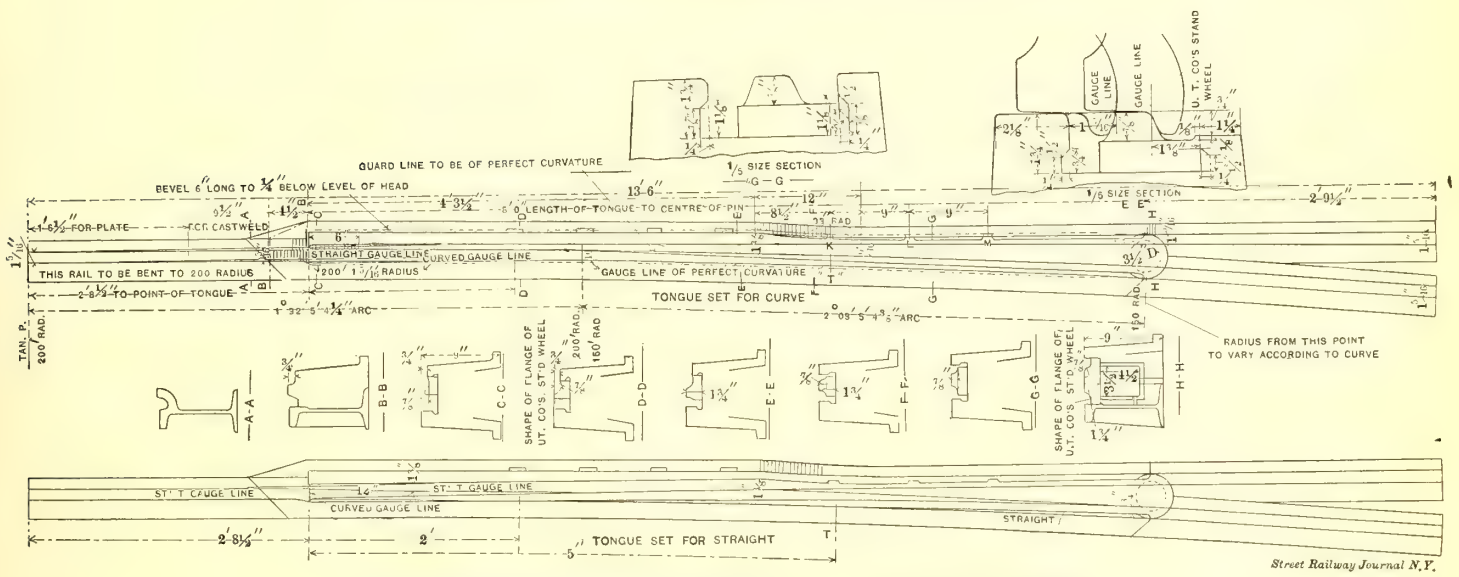
S = end of spiral approach. s = Δ at S.



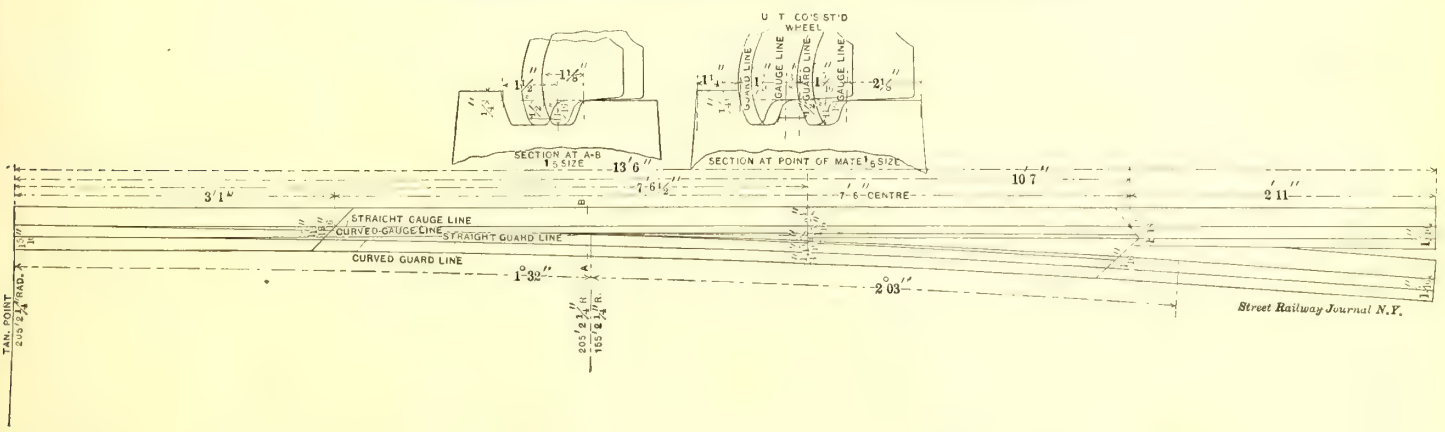
STANDARD TRANSITION SWITCH FOR CURVES UP TO 80 FT. RADIUS



STANDARD TRANSITION MATE FOR CURVES UP TO 80 FT. RADIUS



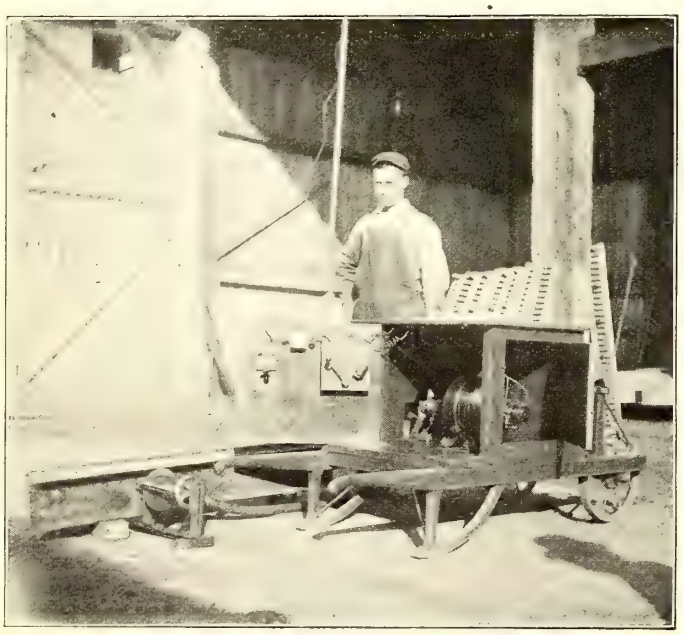
STANDARD SWITCH FOR CURVES FROM 80 FT. TO 150 FT. RADIUS



STANDARD MATE FOR CURVES FROM 80 FT. TO 150 FT. RADIUS

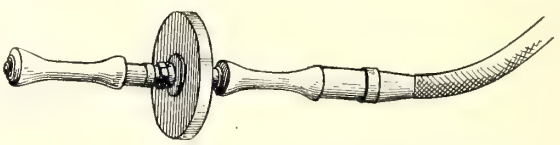
pieces of special work, including steam crossings, of which there are about 135, and the crossings embrace from two to twenty tracks, making about 700 track crossings.

The company manufactures a large portion of its special work, the balance being purchased from the Lorain Steel Company and William Wharton, Jr., & Company. A special shop has been fitted up for track work, and a very complete assortment of tools and appliances have been installed. The track shop occupies a two-story brick building, having a large floor space, and the upper floor, which is served by an elevator, is utilized for setting up and fitting the work; it is the practice to set up complete all curves, crossings and special work, before sending them out. The tool equipment embraces a circular cold saw, operated by an electric motor, heavy punches and shears, a cupola and foundry equipment, two portable hydraulic bending machines, one of 75 tons and the other of 125 tons, both of the Watson & Stillman make. Among these special appliances worthy of note are the beds on which the special work is cast welded. In the preparation of these beds a foundation of concrete, 3½ ft. in depth, is first laid. On the surface of this are steel plates having slots similar to those in the bed plate of the planer, and into these slots are placed the heads of bolts, which serve to anchor the parts



PORTABLE ELECTRIC DRILL

firmly into position. The sand molds are then made around the junction, and into them the molten metal is poured. There is also a second bed with 4-in. T rails, between and beneath the heads of which the anchor bolts are slid. On the opposite side of the shop is a surfacing bed, consisting of a perfectly level wooden floor, reinforced by strips of steel plate ¼ in. in thickness and 3 ins. wide, spaced about 18 ins. apart. By placing rails or special work on this bed, any unevenness in the surface is readily detected. For cast welding simple joints, or where it is necessary to connect rails of different patterns, a mould, consisting of adjustable pieces called chills, is employed, and so designed as to be readily clamped into place. For this class of casting a specially prepared bed is employed. It is in the yard adjoining the shops, and is protected by a temporary cover. In addition to the joint castings and special work the foundry department supplies drain grates and almost all kinds of castings required in this department. The cupola blast is generated by a rotary blower driven by an electric motor. The cold saw mentioned above is also driven by an electric motor, which is started by an ordinary type K controller, but with a water rheostat in place of the ordinary resistance coils. This rheostat is home-made, and consists of a large cask located on the floor above. It is filled with water, in which are two large plates of iron, to which the conductor terminals are attached. To one of these plates is fixed a wooden bar which works in a guide, and is designed to lift the top plate up or to let it down. This bar is operated by means of a rope and windlass from the floor below adjoining the saw. In this way the speed of the saw is readily changed by the windlass rather than the controller. The rails are fed to the saw by a peculiarly designed trolley hoist. The track for the hoist consists of an I beam, about 30 ft. in length, with one end pivoted above and just to one side of the line of the saw bed. The other end of this beam is fitted with wheels which are operated with a hand



PORTABLE EMERY WHEEL

chain, so that it can be swung around on a circular track. This provides a wide range for the hoist, so that pieces of rail may be lifted and readily conveyed to the saw, and in case of a crooked rail, the outer end of the rail can be supported in any position.

For drilling rails, either in the shop or on the line, the company uses a portable electric drill, illustrated on this page. This drill consists of a box or case having two wheels and handles like those of a wheel barrow, on which is placed a 2-h.p. electric motor; the latter is provided with a Stow flexible shaft through which power is transmitted to the drill, which is clamped to the rail in the usual manner. By this arrangement, holes for tie rods, or for other purposes, can be readily drilled. For delivering the current to the motor a pole with a hook to which an insulated conductor is attached, is used. The end of this pole can be hooked over the trolley wire anywhere on the line, while the return circuit is provided by the rail. Another motor similarly mounted and provided with a flexible shaft is employed to operate an emery wheel used for grinding the surface of the rails where the cast-welded joint is employed. The emery wheel is mounted on a short shaft with insulated handles on each side, consisting of thimbles surrounding the shaft. The operator holds the wheel in position by means of the handles, and it is readily adjusted to any surface. A portable motor is also employed for operating a hack saw, so that the rails may be cut at any place on the line. This saw is connected to the rails by means of a frame and clamp, and is capable of sawing a 9-in. rail in nineteen minutes. In connection with the track work there is an auxiliary shop furnished with a number of small iron working tools on which machine repairs are made, and where, also, such small tools and dies as may be required are manufactured.

The track shop is in charge of H. H. Nichols, who has held the position of foreman about two years.

W. D. Young, electrical engineer of the Baltimore & Ohio Railroad Company, writes that that company has not decided to instal the third rail system in the Belt Line tunnel, but has simply been looking into the advisability of its adoption in place of the present overhead structure.

Wrinkles in the Hartford Street Railway Company's System

The thought expended on the little labor-saving devices around a street railway is the best evidence of success, for the successful railway management is a problem of details satisfactorily solved. The Hartford Street Railway Company has introduced many wrinkles, and the following have been selected as being general useful pointers to any system. Mr. Crawford, the general manager, and Mr. Caum, the chief engineer, are responsible for them.

A method of always obtaining dry sand without the cost of drying is an attractive proposition. In Hartford the problem has been solved in this way: Over the boiler room a sealed loft has been built that is used to heat the barn and repair shops. Fig. 1 shows the side elevation of the loft and boiler room. It will be seen that the iron stack from the boiler down stairs passes through this room, and around it is a wrought-iron funnel with a circular opening about 2 ins. wide around the stack at the bottom, and with a flare about 2 ft. wide at the top. The wet sand is introduced into this hopper by a conveyor from the sand pile. This conveyor is run by a motor. The sand when dried by the heat of the stack spreads over the flue of the sand bin, and is perfectly dry by the time it reaches the spout,

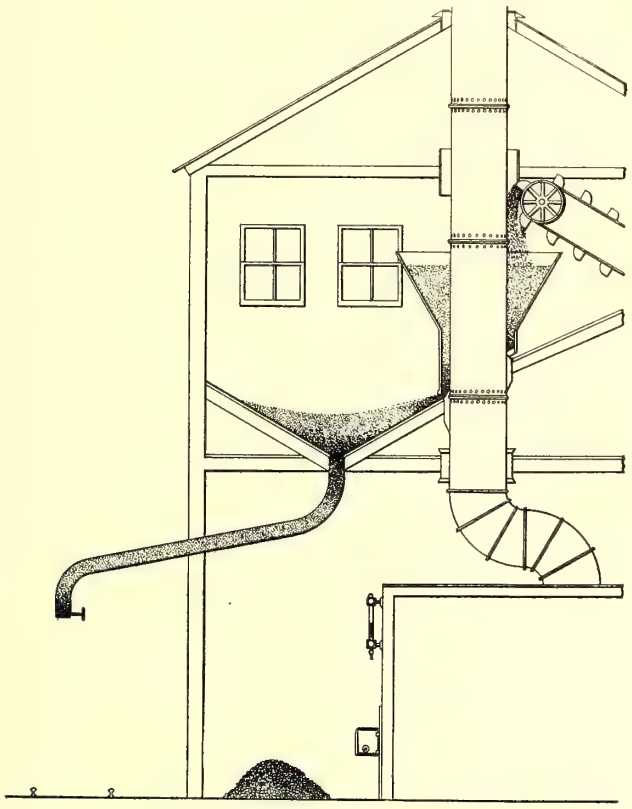


FIG. 1.—METHOD OF DRYING SAND

whence it is delivered into the sand car. In this way the sand is dried practically automatically, and by a heat that would otherwise be wasted.

Eventually Mr. Caum proposes to fill his car sand boxes with sand by a rather novel method. It is not generally known that sand, under air pressure, will flow through a pipe for several hundred feet like a viscous fluid. The pipe itself, however, should curve to changes of direction, and sharp corners with the regular pipe fittings should be avoided. A flexible hose can be used with a valve at the end. This hose can be carried into the car and the sand box filled without the dust and spilling of sand which usually accompanies the replenishing of sand boxes.

The use of the car rheostatic controller, which operates by moving the handle to the right to go forward, and to the left to reverse, leads to accidents. Where a motorman is required at times to operate also a series parallel controller, with a separate reverse, he is liable to move the handle of the controller past the neutral point and reverse the motors in the rheostatic controllers, as this action is just like that of the series parallel controller in passing from multiple to series. Several accidents being attributed to this cause, the Hartford people filed a square hole in the cover of the controller, and into this fitted a metallic block, which projects through far enough to strike the handle when in open position. In this way the motors are protected from being reversed by mistake. A view of the controller with this device is shown in Fig. 2.

Car houses are hard places to keep warm, largely on account of the warping and poor fitting of the doors to their jams. In Hartford a special device is used to draw the door tight, and it is made by the company's blacksmith. The door is swung on the outside, and a long strap-iron U is fastened to the top of the door, as shown at *A*, Fig. 3. The

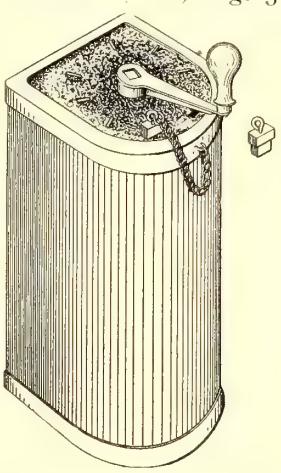


FIG. 2.—CONTROLLER CATCH

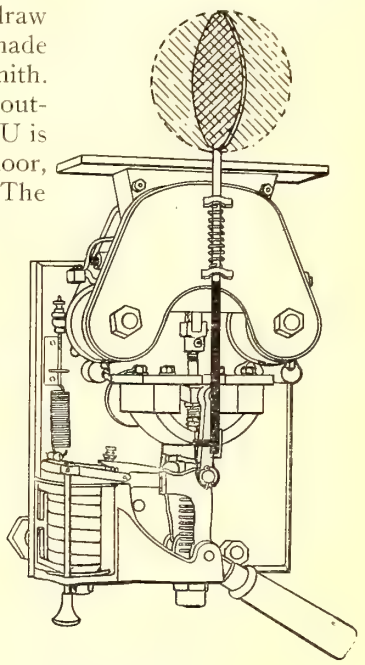


FIG. 4.—CIRCUIT BREAKER SEMAPHORE

wedge-shaped latch is operated by two levers from the barn floor, and is forced into this U, drawing the door tight up to the jam. The result is that the car house can be easily warmed.

Where there are a number of circuit breakers in a row on the switchboard it is difficult at a distance to see which one is open. The Hartford Company has a long narrow power house, and the station engineers have devised a semaphore system to clearly indicate what circuit breakers are thrown. The arrangement is as follows: The toggle joint in opening up the switch jaws strikes a pin, which gives a quarter turn to the semaphore on the circuit breaker and displays a red disc. This is invisible from the engine room floor when the circuit breaker is closed, for it is then edgewise. Each generator circuit breaker is also provided with a semaphore, so that the engineer at a glance can see which units are operating on the system. Fig. 4 shows the general arrangement.

The oiling of a bearing by the oil-can method entails both a waste of oil and manual labor. The conduction of oil to the bearing by a piping system and its withdrawal again after it has worked through the bearing surface the lubrication can be made automatic in its action and does not require the handling of the oil. Mr. Caum has developed for the Hartford Street Railway power station a very complete system.

Each engine has an independent piping system, which can be shut down with the engine; all piping systems are controlled from one point, and a sight feed is introduced into each pipe line. The oil is fed from supplementary tanks in the engine room to the engine bearings by gravity. A tripe valve is used, so that air can be blown through the pipe to clean it out. Five-eighths-in. brass tubing and brass fittings are used throughout. The oiling system can be fed from two independent sources of supply.

The oil house is located at a distance in the rear of the station, and is divided into three fire-proof compartments, which are lighted externally by lamps placed outside the windows. One compartment is for the handling and storage of cylinder oil; another contains the filters, and a third cooling and storage tanks. The oil from the bearings

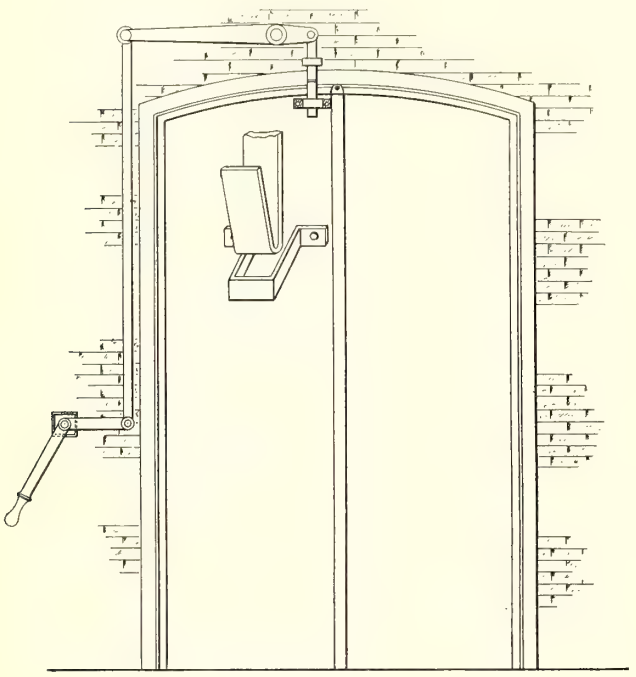


FIG. 3.—CAR HOUSE DOOR CATCH

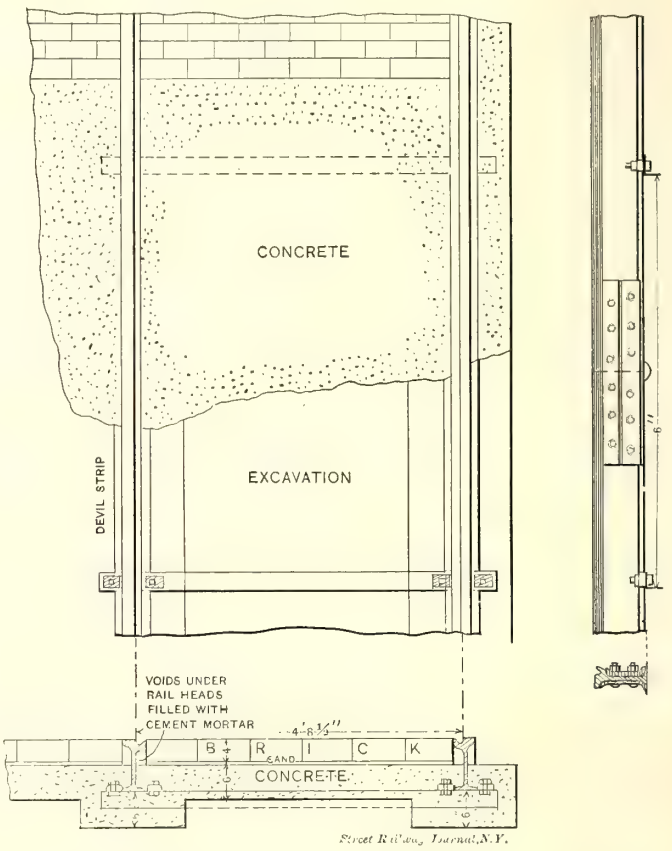
collects in a receiving tank and is forced from this by compressed air to the filtering room, where it is heated and run through filters. From the latter it is forced to the cooling and storage rooms.

There is a duplicate system both in the oil house and up to the air compressor. By turning a two-way valve either supply can be drawn on. The rate of flow of oil through the bearing is about a gallon in two minutes. It is found that the oil does not get worn out as fast when circulated rapidly, and the volume has a cooling effect on a bearing which tends to heat.

The method used for supplying a bearing with oil and drawing it away is accomplished without the slightest external appearance of oil. The engines supplied are horizontal, and the wipers on the crank-pin and the crosshead pin have been dispensed with. The crankhead is lubricated by means of holes drilled at an angle through the cranks from the circumference of the main bearings to the crank-pins. Holes are drilled from the top of the crosshead to the crosshead pin and through the latter to the bearing. This receives oil furnished to the top guides. There is no indication of oil on the white floors and the amount of oil required to supply the waste is extremely low. Even the self-oiling bearings of the dynamos are piped up and supplied with oil by this circulating method, to furnish fresh cold oil during extremely hot weather.

Track Construction on Concrete in Detroit

The Detroit railways were among the earliest in this country to employ concrete for sub-construction in street railway track. The original construction employed by the Detroit Citizens' Railway was a 9-in., 100-lb. grooved rail carried on steel ties spaced 5 ft. centers. The ties were channels 7 in. wide x 7 ft. long and $\frac{3}{8}$ in. thick, with a flange of $1\frac{1}{8}$ ins. deep. They weighed 21 lbs. each. The concrete was laid 6 ins. below the base of the rail and tamped under the ties. It was also laid on top of the ties and carried up



PRESENT STANDARD TRACK CONSTRUCTION IN DETROIT

to within $1\frac{1}{2}$ ins. of the base of the paving. When Belgian paving was used, the latter was then laid on $1\frac{1}{2}$ ins. of sand. The same construction was used with asphalt.

The Detroit Railway, which was built about the same time, used in part wooden ties and in part concrete stringers. The wooden ties were laid on a 6-in. concrete base, between which and the tie was a 1-in. layer of sand. Concrete was also carried up above the ties, and where 5-in. paving was used with a 7-in. rail, the concrete extended to a height of $1\frac{1}{2}$ ins. above the ties. There was then a layer of $\frac{1}{2}$ in. of sand, on which the paving blocks rested. Where concrete stringers were used a trench was first cut 15 ins. deep and 1 ft. wide, a layer of concrete composed of one part of Portland cement, four parts of Louisville cement, eight parts sand and sixteen parts of broken stone, was laid in the bottom of the trench to a depth of 6 ins. The rail, which was 7 ins. high, was then placed in the trench and the 2-in. space between the top of the concrete and the bottom of the rail, with the space on each side, was filled up to the bottom of the pavement with grouting, composed of one part Portland cement, one part sand and three parts of clean fine gravel. The rails were bound together with tie rods placed 10 ft. apart.

The two railways are now under the same management, and the experience of the last three years with both types of track construction have

led to some slight modifications. The stringer construction of the Detroit Railway was found to have gone in spots, and it was thought that this was due in part to the method of holding the rail, which, being with tie rods, did not hold the rail vertical. On the other hand, the heavy ties employed on the Citizens' Railway were not found necessary. The accompanying engraving shows the standard type of track construction now employed by both companies. The present tie is a 3-in. angle bar, and its use is more for keeping the track to gage and the rails vertical, for which purpose it answers better than a tie rod, than it is to support the rails. The concrete is carried down 6 ins. below the base of the rail and covers the ties to a height within half an inch of the base of the paving, which in the engraving is 4 ins. thick. If, however, there should be any soft spots encountered in laying the track the concrete is carried to a greater depth, 2 ft. if necessary, to give a perfectly substantial base for the rail. The management consider the construction illustrated perfectly satisfactory with the clay sub-soil, but with a sand sub-soil would not recommend any type of concrete construction.

After the concrete is laid it is necessary to let it set for five days without running any cars over it if the weather is dry; in the fall when the road is moist it sometimes must be allowed to rest a week. Over 98 miles of track have been constructed in this way during the last three years. The rails are bonded with a U-shaped riveted bond in the base of the rail. The rails are not cross connected, as the axles are depended upon for this purpose, but the inside rails of the double-track are cross connected for 500 ft. by Chicago rail bonds.

As is well known, the Detroit Railway Company installed a considerable amount of electrically welded rail on its Jefferson Avenue line. This rail is still in good condition, and is satisfactory, although the company is not electrically welding any more of its track rails. One chief advantage found with the electrical weld was the good electrical return which it afforded, and the section welded is that upon which the power station is located, so that these rails afford an excellent return to this point, in fact so good that no ground return is employed. In all, about 2 per cent of the welds have broken during the past two years. Where this has occurred the rails have been well bonded.

Changes in Brooklyn

Official announcement has been made that the controlling interest in the capital stock of the Nassau Electric Railroad Company has been purchased by the Brooklyn Rapid Transit Company, owner of the Brooklyn Heights railroad and the two roads will hereafter be operated in complete harmony. The Nassau Company has $6,000,000 capital stock outstanding, and $4,849,000 bonds, and was formed for the purpose of operating the Atlantic Avenue railroad and the Brooklyn, Bath & West End Railroad.

It is stated that very few changes will be made at present in the actual operation of either of the companies with the exception that one or two of the Nassau lines will be given a through service to New York via the bridge over Brooklyn Rapid Transit lines. A number of changes in the personnel of the Nassau Company has been made, however, and the present officers and directors are as follows: President, John E. Borne; vice-president, Hugh J. Grant; treasurer, C. D. Meneely; secretary, W. F. Ham. The stockholders of the Brooklyn Rapid Transit Company will shortly vote on the proposition to increase the capital stock of that company to $45,000,000.

LETTERS AND HINTS FROM PRACTICAL MEN

Notes on the Standard Rules and Regulations as reported by the A. S. R. A. Committee

SCHENECTADY RAILWAY COMPANY.

SCHENECTADY, Jan. 14, 1899.

EDITORS STREET RAILWAY JOURNAL:

The report of the committee appointed by the American Street Railway Association has now been publicly printed in your columns, December, 1898, and it is, therefore, open to discussion and criticism.

The intrinsic value of a comprehensive, consistent and equitable set of standard rules would be immeasurable. The accepted usages of a road, of similar roads or groups of roads are the "constitution" of discipline, the rules and regulations are its "by-laws." With good rules intelligently enforced, the employees will be bound into a homogeneous and interdependent body, but with rules that are incomplete, inconsistent or inequitable their enforcement will be a subversion instead of a conservation of discipline.

Beyond their application to the employees there is at present a further use of good rules, and that is their effect on the courts, the municipal and other authorities and the general public. In these days of conventions with open doors, unlimited discussions and publications, of yellow journalism which probes and exploits the inmost recesses of everything, of suits at law during which matters pertinent and unpertinent are "expert-ed" and spread broad among the people, in these days, the rules of a company and the measure and quality of their enforcement are very often matters in which the courts, the authorities and the people at large take a keen interest, an interest the results of which are often felt in unexpected ways. There is, therefore, all the more reason that the rules themselves should be as perfect as experience, observation, knowledge—and a desire for perfection—can make them. The enforcing of them is an important, but secondary matter; good rules will partly enforce themselves, but the task of enforcing rules that are unreasonable, unjust, inconsistent or otherwise imperfect, is an impossible one, and if persisted in may become a two-edged sword to be used against the enforcer.

The task given the committee was a difficult and thankless one, difficult, because in a territory so large as that covered by the national association, conditions of every kind vary so greatly that a rule that would be perfectly just, proper and appropriate in one section of the country, *might*, in another section, be considered very undesirable. Also at present, the varying laws, regulations, ordinances, recommendations, etc., etc., of the legislatures, courts, municipalities and railway commissioners of the several States and Territories would militate against the formation of a general set of rules; that is to say, of a set of rules which—without change of form or meaning—should be applicable to all railways in the United States.

The task was a thankless one, because, if there is one thing that the average superintendent or general manager believes to be perfect and immaculate it is his rules and regulations, and he usually does not take kindly to, and is not grateful for any rules which have not emanated from him directly or in the formation of which he has not had a hand, especially if he sees that in many respects they are not actually a betterment. In this he is somewhat right, as his rules are generally the outcome of local experiences and necesities, and while they are often crude and strongly tinged with local color and personal idiosyncracies, they have been, as a whole, more just, wise, safe and reasonable

than those forced—or sought to be forced—on him by local legislators and muncipalities or by the aspiring, but inexperienced directors of his own company.

Moreover, given that the committee had reported an absolutely perfect and complete set of general rules, the Association has no authority to enforce their use, nor has it the means to obtain or compel such authority. It would have to depend on the willingness of each railway that was a member of the A. S. R. A., and of the many who are not, and would have been met at once with the inertia of conservatism and the literary jealousy of every-superintendent-his-own-author.

It seems, therefore, that the A. S. R. A. has given the gentlemen of the committee a doubly difficult and thankless task, as it is well nigh a useless one, and it will not be exaggeration to say that not one company will change its rules to conform to those of the committee at the present time, nor would one in a hundred do so were the Association to ratify and recommend them. This, the Association should have thought of at the time of appointment of the committee, as they have placed the gentlemen of the committee in a very difficult position, and have led the street railways of the country to expect something that cannot be realized. The name itself is misleading even were the thing itself possible, as a set of rules for voluntary use by any and all railroads in the country might be called "Uniform," or "Universal," or "General," but could hardly be called "Standard" unless their use was in some way obligatory.

If the A. S. R. A. had been less ambitious or more thoughtful and had contented itself with asking its committee to prepare a *uniform* set of *general* rules for submission to the several State associations for action, the task of the committee would not have been so out of proportion to its report—and its thanks.

As a matter of fact, the State associations are, at present, the only bodies that should attempt to standardize rules. They represent at once the largest and smallest division or group of street railways that have mutual and uniform interest as regards legislation, and they are the only bodies that possess—even indirectly—mandatory powers, as they can, if their majority wills it, influence and cooperate with their several State Railroad Commissions in the formation and enforcement of a standard set of rules.

Such a standard set of rules would, at present, be of very great value within a State. Ratified by the State association, recommended by the State Railroad Commissioners and enforced by the State legislature, they would have the effect of laws, would greatly simplify lawsuits arising from their enforcement or their neglect, and in cases where they were strictly adhered to would greatly minimize the damages. They would make a more efficient body of the railway employees affected by them, as these employees would be more "standard" as regards general rules and would not have—as now—to change all their ideas and methods because they changed their location and employer. They would greatly lessen difficulties, arguments and misunderstandings with the general public, as the rules would soon become as well understood as the "five-cent fare" and, having the authority of the State at their back, would be much less liable to infraction on the part of the public.

As the State associations and State railroad commissioners multiply, these rules—amplified and amended to meet larger and more general conditions—could be made uniform between State and State until they become uniform and standard all over the country. This is not a millenial forecast, nor a utopian dream, but a matter that is right upon us and needs recognition. With interurban street railways stretching out until they become inter-State, with companies operating roads that run across State-lines, and, perhaps, across States, it is ridiculous to think that the running across an imaginary line on the ground should change the whole character of an employee's actions.

Going back to the committee's report and taking into consideration all the difficulties in their way, it *was* possible for them to have given the Association a general set of rules that could have been offered to the State associations. Underlying all street railway transportation business, from Maine to Texas, from California to New Jersey, are certain fundamental principles which must be followed by *all* if the public is to be served with safety, convenience, comfort, regularity and punctuality, if employees are to serve with the greatest efficiency and with the least danger, deprivation, exposure and labor, if the employer is to obtain a fair profit on his investment and without needless risk. To expound and explain these principles, to apply them to specific cases, to show their capabilities and their limitations, to embody the whole thing in a clear, concise and consistent form—that is the province of a "general" set of rules and regulations.

Such rules *must*

1. Be *rules*, not suggestions nor advice; such—if pertinent—may be prefixed as an introduction or deduced as corollaries, but must not be masqueraded as rules.

2. Be "general" in the sense that they are applicable without change of intent or principle to all street railways or surface railways within the territory they are intended to cover.

3. Be "general" in the sense that they must contain nothing local or individual, either as regards locality or personality, use or manufacture.

4. Be comprehensive, covering every point in regard to all employees whose duties are in any way in connection with the public—either directly or through their fellow employees.

5. Be perfectly clear and lucid in language, admitting of no double meaning nor obscurity of meaning.

6. Be perfectly free from contradictions either within themselves or with one another.

7. Be in acordance with general usage, experience and observation.

8. Be reasonable.

9. Be just and equitable.

Such rules *should*

10. Be couched in plain, simple, terse language so as to be easily understood, and—if necessary—memorized. Slovenly composition, ungrammatical language, false syntax, obscure expression, involved, complicated and inverted sentences are to be as much avoided as "elegant phraseology."

11. Be arranged in some connected, definite and consecutive manner, and divided into groups having specific relation to certain persons, duties, acts or things. Under each group the rules themselves should be arranged as much as possible in a natural sequence or order, all cognate matters should be brought under one rule if possible, and each rule should be preceded by its subject as a heading. On the other hand, no rule should treat of more than one subject.

12. Be free from repetitions either within themselves or of one another. Repetitions *in* rules and *of* rules do not emphasize; they only weaken. Emphasis should be used only in proportion to the importance of the subject and should be manifested by other means.

13. Be free from unnecessary, irrelevant or axiomatic remarks and directions. Employees for whom these rules

are made must be considered as having ordinary common and moral sense; a street railway is neither a kindergarten nor a Sunday-school.

They should *not*

14. Be unnecessarily peremptory in tone; "must" and "shall" used too frequently lose their force. It is much better on ordinary occasions to say "will" and "should." The imperatives should be reserved for imperative cases.

15. Be addressed to the second person—"you." It sounds—and is—better to address the rules to employees in the abstract, i. e., impersonally, and for this the "third person"—"he" or "they" is necessary. This is somewhat a matter of opinion, however, but there can be only one opinion on the question of sticking to one kind of address in the rules, either "you" or "he" and "they" may be used, but they should not be mixed. In an *introduction* to the rules the less formal style is an advantage, as each individual employee is there being addressed, while in the *rules* the employees as a class or group are being instructed.

16. Threaten. Penalties should form no part of a rule, although they may be an adjunct of the rules. Dismissal for certain specific and proven grave offences, such as drunkenness on duty, lying, dishonesty and wilful disobedience of safety rules, should be made a *rule*, but beyond that, all penalties, punishments and threats had better be kept out of the rules and the "punishment made to fit the crime"—when the crime occurs. Prompt and just punishment in actual practice is all that is necessary, and a few cases of such will do more good than a rule-book full of "bogy-man" threats, very few of which can be carried out in practice.

The above qualifications and conditions contain nothing but what is reasonable and necessary in a matter so important, and it will do the report of the committee no injustice to test it by them and see how near it comes to fulfilling them. This will be done in a future article.

H. S. Cooper.

Methods of Accounting

Binghamton Railway Company,
Binghamton, N. Y., January, 10, 1899.

Editors Street Railway Journal:

I notice your editorial in the January issue, wherein you ask for views upon Mr. Kittredge's article entitled, "An Ideal System of Street Railway Accounts," and would say that the system of dividing and sub-dividing of the accounts as outlined are almost identical with those followed in this company, and the ideas expressed by Mr. Kittredge as to intelligent and perpetual comparisons have been carried on by us for several years, for the constant information of the general manager of the company.

In addition to our ledger showings we have a comparative table (special) book, in which we show a constant comparison of the receipts from each passenger division of the road, from various other resources, the operating expenses in detail, as well as increase and decrease in supplies on hand, floating debt, etc., and a daily comparison of each division's receipts. From this statement the management is enabled to watch the earning capacity of each division of the road, and to decide as to what service such division is entitled, also to determine at a glance whether any leakage occurs in operating expenses and to correct such intelligently. The many other details of information conveyed by this table furnishes to the office at all times the exact standing of the road. I mention this book as giving the same information constantly as by Mr. Kittredge's system without what seems to me a complication of bookkeeping.

More as a matter of asking information than criticism, I wish to express the following: The appearance of the Maintenance and Emergencies (sub-divided) accounts in the Reserves, as Liabilities in the Balance Sheet, as I understand it from the article, act as sinking funds for the pro rating and equalizing of all expense accounts.

If this interpretation be a true one, I am at a loss to understand how these accounts could be intelligently pro rated unless an estimate be based in each case upon the year preceding, and even then the variation of a year might be so great that the following year would be unjustly pro rated. While the distribution of expense in the various accounts through different months or shorter periods, might seem just when one thinks of a large expense of replacement falling on one month the expense of which has really been accrued during preceding months, the question arises, how can the pro rating be properly adjusted, and why is not the actual condition of the expense account of more instant and valuable information to the manager than the study of the balance sheet. For instance, would the showing of the same operating expense for the summer months with increased car service for pleasure rides, etc., be correct as against the winter months, or could the removal of snow and ice be pro rated throughout the summer intelligently, and, in that line, would not an open winter, without storms, or a winter with frequent and heavy storms, make an unjust showing of one year with another? Again, how can a company depend upon the life of a generator and, as they run year after year without repair or replacement, have you not created a false asset which must also appear in the balance sheet, or, without indemnity insurance, how can one intelligently pro rate against accidents?

Perhaps I may be speaking from ignorance or a too limited knowledge of Mr. Kittredge's ideas in this respect, but it would almost seem that the receipts could be even more accurately pro rated, thus enabling the accountant to forecast correctly any report, for any time, the other necessary and valuable information being available only to those who have access to the balance sheets.

From a personal point of view, gathered from the information desired by, and on hand for, our General Manager, it would seem that the supply store system with its *daily* charges and vouchers, together with comparative tables, made up constantly from the ledger, properly divided, gives the actual and satisfactory status of the road at all times, which cannot be furnished more acceptably to management, bond and stock-holders, the public, and the State.

John B. Rogers, Treasurer.

Fitchburg & Leominster Street Railway Company,
Fitchburg, Mass., Jan. 9, 1899.

Editors Street Railway Journal:

I have carefully read Mr. Kittredge's paper on "An Ideal System of Street Railway Accounts," and, in general, can commend it very highly.

It must be remembered that small roads cannot go into the detail of classification or of accounting as deeply as can the larger, and there are a great many small roads. There is a danger line beyond which the expenses of accounting are entirely out of proportion with the income and needs of the corporation. For example, with a road of $75,000 yearly operating expenses, a weekly inventory would be an absurd proposition. The expense of it would be en-

tirely incommensurate with the cost of supplies not going into immediate consumption. Yet it is as necessary for these small roads to have a sound accounting system as the largest. So any "ideal" system of accounts must be sufficiently elastic to be of use to all without too great expense to any. This, it seems to me, is a virtue of the system which Mr. Kittredge suggests.

I think Mr. Kittredge's reasoning in omitting accounts *N* and *O* entirely wrong. If the items of these accounts may be classified as assets, as parts of other accounts, why are they not assets "in themselves?" They are more tangible and more properly classified as assets than goodwill, which is almost illusory, and they are as properly separate as accounts *A* and *B*. These latter accounts could be as easily pro-rated among the others as *N* and *O*. The object of accounting must be accuracy, and pro-rating these accounts is far from that, as actual experience shows.

One thing which Mr. Kittredge neglects is tickets. These little pieces of paper do a big business on many roads, thousands of dollars worth of them sometimes outstanding. They are essentially a liability and must be accounted as such. The practice of carrying receipts for tickets sold directly to revenue is wrong. The minute they are sold they become a liability against the corporation and so remain until used.

Further, it seems to me that the classification of dividends declared and unpaid as a floating liability and taxes and interest as reserve accounts is wrong. These are all *accrued* liabilities, and, as such, should have separate classification. Reserve accounts for sinking, maintenance or emergency funds are in no sense accrued liabilties nor are accrued liabilties, by nature, exactly similar to funds for the payment of outstanding liabilities like bonds or future extraordinary expenditures for maintenance and emergencies.

Why are not express and advertising (in cars) receipts from operation as much as freight or mail?

Robert N. Wallis, Treasurer.

Bergen County Traction Company, N. J.,
Fort Lee, N. J., January 14, 1899.

Editors Street Railway Journal:

The form you give in your January issue (chart of Analysis and Classification of Street Railway Accounts) is practically the same we use for balance sheet.

William N. Barrows, Secretary.

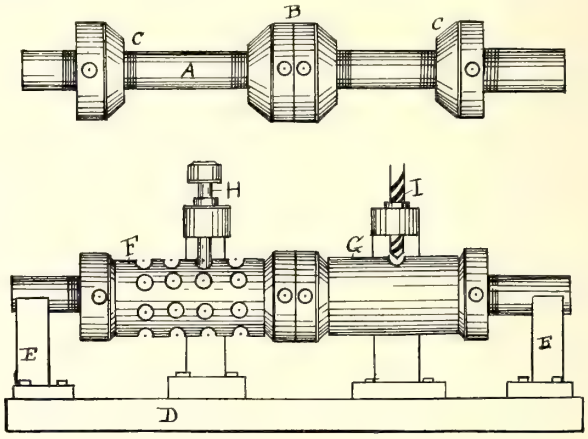
Method of Drilling Armature Bushings

Boston, January 12, 1898.

Editors Street Railway Journal:

They have a way at the West End railway shops here for drilling street railway car axle bushings that is both simple and effective. The rig is especially designed for drilling plug holes in the bushings. A double-end arbor is used, with a drilled bushing on one end and a bushing to be drilled on the other end, as shown in the annexed sketch of the tool.

The arbor (A) is cut with a thread and movable nuts (B) and (C) put on. These nuts are cone-shaped on the sides facing in, and are screwed up on the bushings, as shown in the next view, which represents the bushing (G) in process of being drilled to correspond to the master bushing (F). The arbor rests in the bearings (E) (E), and can be turned easily by the hand. The guide pin (H) rides in the shoulder piece, and the latter is set-screwed to the base piece (D). The drill (I) operates in a leader, which is set-screwed to the base. The nuts for sustaining the bushings in place can be square and tightened with a wrench, or they can be round and provided with holes in which to insert a shaft for turning. As the nuts hold the bushings very firmly in place the machinist can be sure of getting uniformly drilled work. Bolt holes, etc., may be drilled at regular intervals in other lines of work on this device, and at any desired distance from the axis and from



TOOL FOR DRILLING ARMATURE BUSHINGS

each other, regardless of the diameter of the pieces or the length. The jig can be provided with an index plate that can be set for any number of equal divisions and clamped firmly in position. The drill is held in the usual manner, and by means of a variety of sleeves this jig is ready to drill equal spaced holes at the proper distance from centers.

B. F. F.

Amusing Letters

Nearly every railway manager has received letters more or less amusing, asking for a position, damages for a supposed injury to property or feelings, or protesting against some "outrageous" invasion of the author's rights. Below will be found a copy of a letter recently received by F. J. J. Sloat, of the Cincinnati & Hamilton Railway Company.

Hamilton, Ohio, Dec. 19, 1898.

Mr. Sloat and Will. Christie:

Dear Sirs.—The 13 of this Month the No. ten Car Cut My valuabel Dog In Two you have no Pitty for Me I Am Lonesome For My Dog yet I was ofered A Big Prise For My Pet Dog I Would not Take it I would rather have My Dog now What will I do and What will you do My dear Dog is gone.

Yours Most Respectfully,

Mrs. ——— ———.

P. S.—Mr. Sloat Swope has fine dogs get him to give me one In Return For Mine Mr. Sloat you know I Deserve A good Dog.

Mrs. ——— ———.

Great as the loss of her dog must have been to this lady, it was insignificant as compared to the damage recently inflicted upon a gentleman in Brisbane, Australia. His pathetic letter to J. S. Badger, manager of the Brisbane Tramways Company, describing the catastrophe is given below, and should act as a warning to all those who persist in sitting on the hand railing on the top of a double-deck car while escorting ladies home from the theater.

To the Manager of the Brisbane Tramways Company, Ltd.:

Dear Sir.— I regret to have to inform you that on returning from the theater on Wednesday evening last I boarded the first theater car to W'Gabba, and owing to the car becoming overloaded I had to sit on the hand railing on top of the car, with the result that I had my trousers destroyed by being caught on the stone pillar at the north end of the bridge.

As I suffered sufficiently by having to escort a lady home with my pants minus the seat I am sure you will deem it only just that you should suffer the inconvenience of the loss of their value, viz.: £1 1s.

If you have any reason to doubt my assertion you may refer to Mr. ———, who was also a passenger.

I will send you the damaged pants if you wish it.

Trusting you will see the justice of my demand and forward cheque for amount at your earliest convenience,

I am, sir, yours faithfully,

———— ————.

Fighting Snow in Newport, R. I.

A snow storm is unwelcome to most railway managers, no matter how well one may be prepared to keep the track clear, and during a heavy storm continuous and arduous work is usually required from every member of the operating force, from the switchman to the superintendent, to keep the tracks open. Many of the New England roads suffered severely from the blizzard the latter part of November. A good idea of the amount of snow which fell at that time in localities where the fall is comparatively light at most times, is shown in the accompanying engraving, which was taken on the Newport Street Railway, at Newport, R. I. The means employed by this company for combating this snow storm are the snow plow, with its long nose set at an acute angle, a snow shovel brigade, and, coupled with these, vigilance and prompt action.



LARGE DRIFT IN NEWPORT

Combined Street Railway and Lighting Station

The Hagerstown Railway Company has recently completed a new station, from which power will be supplied for operating the street railway system and the electric lights for city and other service, both industries being controlled by the same company. The new building is of brick, tasteful in design, with a ground dimension of 80 ft. x 116 ft., and wing for boiler room 45 ft. x 50 ft. The generators are to be driven from a jack shaft, which extends the whole length of the building down the middle of the floor, and is provided with Hill clutches for coupling the different sections. The power is generated by three tandem compound condensing engines of the Standard type, manufactured by the Harrisburg Foundry & Machine Works. They are of the single piston-valve type, and so far are operating to the entire satisfaction of the management. Two of the engines, which are each of 400 h.p., are located at the ends of the shaft, on the opposite side from the generators, and transmit their power by belts to the shaft. A third engine, a 300-h.p. machine, is belted to the middle of the shaft.

The street railway generator equipment consists of two 325-kw. machines of the General Electric make, which are belted from the extremities of the shaft. An 80-kw. generator provides the power for stationary motor service. The lighting generators consist of one 3000-light alternating machine, one 1500-light alternator, one 125-light Brush arc machine, and four 50-light Schuyler generators, all driven by belts from the shaft. The belts are all of Chas. A. Schieren manufacture.

The boiler equipment consists of three boilers of the Berry type, aggregating 550 h.p., and were manufactured by Robert Wetherell & Company, of Chester, Pa.

Among the auxiliary steam equipment are the condensers and steam piping, which were furnished by Best, Fox & Company, and a Spencer damper regulator, which controls all the dampers of the three stacks.

The switchboard is of black and blue marble, the blue portion being occupied by the lighting instruments. This, with its equipment, was furnished by the General Electric Company. The equipment seems to be well designed for the purposes required. As it was necessary to operate both the lighting and railway generators from the same engine, it was found better to install the shaft with clutches and belting, so that either engine, or all combined, can be coupled to each or all of the generators. For these reasons direct coupled units were not installed. The plant has been erected and the machinery installed under the direct supervision of C. W. Lynch, president of the company, the designs having all been made by W. C. Happerley, superintendent.

Business During 1898

In spite of the fact that the United States was engaged in a war during the past year, the electric railway business has been more prosperous than ever before, and probably a greater amount of contracts for new equipment have been awarded than in any previous year. It is certainly true that most manufacturers have not complained of lack of orders during this period.

From data collected recently by the STREET RAILWAY JOURNAL on the output of certain manufacturers of rolling stock, it is estimated that from all the shops in this country manufacturing street cars, between 5500 and 6000 cars were turned out during 1898. During the same period it is estimated that the output of electric car trucks in the United States was from 8500 to 9500, and of car wheels for street railways from 125,000 to 150,000. A certain proportion of the two former and a small percentage of the latter were undoubtedly for export, but it is impossible to say just what proportion was sent abroad.

The secret of success in handling damage cases lies, no doubt, in their being properly looked after from the very start, *i. e.*, from the time they are first reported. How to do this varies as do the different cases, but no case should ever be handled by any one but an honest, careful and experienced claim agent. For such work, men must be naturally qualified; they should ever have the interests of their road at heart, and yet not blinded by too great a prejudice in its favor; they should have sound, shrewd judgment, and be painstaking and careful of detail to the highest degree. Like the true physician, they should be of a happy, calm temperament; and also, like him, should ever be ready to answer a call. The successful claim agent should have the faculty of handling all sorts of people without friction. His keen perception should reveal to him the nature of each case, but he should never betray anxiety for settlement.—From address delivered at the Niagara Falls Convention, 1897.

STREET RAILWAY JOURNAL

FEBRUARY, 1899.

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, HAVEMEYER BUILDING, 26 CORTLANDT STREET.

BRANCH OFFICES:

CHICAGO.....Monadnock Block.
PHILADELPHIA.....931 Chestnut Street.
LONDON.....39 Victoria Street, Westminster.
PARIS.....50 Boulevard Haussman.
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MOSCOW: Alexander L. Lineff, 9 Gt. Tchernishevsky Pereulok.

Long Distance Telephone, "New York, 2664 Cortlandt,"
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / 25/ / 31 fr

Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

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The Street Railway Publishing Co.,
Havemeyer Building, 26 Cortlandt St., New York.

Apropos of the revival of active interest in increased rapid transit facilities in New York city and the more favorable attitude of the municipal authorities on the question of building an underground electric railroad, we take occasion to again point out the impossibility of avoiding or long postponing the building of such an underground road, or of looking forward with equanimity to the future congestion of traffic on Manhattan Island if greatly increased facilities be not provided. The new electric surface lines are proving so immediately and unexpectedly popular that almost as soon as they start into operation the traffic on all the longitudinal lines is dangerously near the topmost limit of capacity. We know now quite closely the ultimate capacity of the elevated lines, except for possible "double decking," and we know also that there is an enormous number of new apartment houses and private dwellings going up in the northern portion of the Island. These buildings must have tenants and the tenants must have transit accommodations for their every day marketing, as well as for business purposes, and better rapid transit facilities are even to-day a crying necessity. What wonder is it, then, that the political powers behind the throne in New York city should execute a *demivolte* and consent to the further consideration of rapid transit plans on broad gage lines—what wonder also that those at present in charge of, and responsible for the transportation of the people of the city of New York should give most serious consideration to financial and engineering problems incident to the construction of such lines, and should resolve to build them as a supplement to the present almost overburdened facilities.

About ten years ago, just before the beginning of the "boom" in electric railroading, there were well-defined rumors that a European syndicate was forming to introduce compressed air as a motive power for street railways on an extensive scale. The immediate success of electricity prevented the syndicate's plans from being carried to fruition, and compressed air has not since figured as a competitor of importance in the street railway field. Within the past five years, however, further experiments in compressed air have been carried on in this country on a somewhat extensive scale, and the results have been such that ample and powerful financial support has lately been secured for compressed air as a motive power. The first large effort of one of the new syndicates will be directed toward the building of "auto-trucks" for handling the trucking business of large cities, now done by horses, and the parent company purposes licensing local companies for this purpose. It is expected, too, that cabs and possibly even omnibuses will next be taken up. Considerable experimental work has also been done in the street railway field, as has been duly chronicled in the STREET RAILWAY JOURNAL from time to time, and within a few months, a twenty-car, five-mile crosstown line is expected to be in operation in New York City by compressed air. It will need a year or more of full operation of this line before even a preliminary idea of the operating expenses of compressed air can be obtained, although reasonably close estimates of everything except depreciation and "contingencies" is now, perhaps, possible. What has been so far demonstrated in New York is, first, that compressed air motor cars will run, and with fair satisfaction to the public; second, that an amount of air, compressed to 2,500 pounds pressure, can be stored out of sight in an ordinary street car, sufficient to run a car from twelve to fifteen miles, under ordinary conditions of track and service, and somewhat more under favorable conditions; and, third, that air at this high pressure can be compressed and "bottled" with reasonable safety, and the pressure reduced by simple means to a point where it can be used in the motors. What is not demonstrated is whether under all working conditions which street cars and trucks have to meet, including collisions, etc., absolute safety to the public can be always assured; whether heavy grade work such as is frequently found in city streets can be done by compressed air motors or any form of self-propelled car employing reciprocating

motion; and whether the costs of motive power and of maintenance will be comparable with electricity. All these demonstrations will come in time, and what is now certain is that experiments on a larger scale than ever before made in this country are already instituted, and will be vigorously prosecuted to a definite conclusion.

The cost of copper has been constantly rising for the last year and more, and, according to all indications, will continue to increase, especially if the consolidation of the copper mining companies of the Northwest, which has been proposed in Boston, the financial headquarters of the American copper interests, is consummated. The use of the metal is, of course, also constantly increasing, and the extent of its employment in the electric railway industry makes the question of its market price an extremely important one to street railway companies. Efforts to find a substitute for copper as an electrical conductor have been numerous. As is well known, the rails are being employed for carrying the return current to the power station much more extensively than formerly, and underground supplementaries are going out of use. Some companies have even gone so far as to lay mains of buried rails, well bonded together, for connecting the tracks with the power station. The chief reason for this, of course, is to save the expense of the copper, but measures of this kind are, on the whole, poor substitutes, so that the announcement of the aluminum manufacturers that they can compete in price with copper, comparing the two metals in their current-carrying capacity, is interesting. Aluminum is practically three and one-half times lighter than copper, and the pure metal has a conductivity of about 63 per cent that of pure copper. Upon these figures as a basis, it is estimated that for electrical conductors of equal conductivity aluminum at twenty-nine cents a pound is cheaper than copper at fourteen cents. The tensile strength of pure aluminum may be greatly increased, without much loss in its conductivity, by properly alloying it, and it is then well fitted for aerial wires, owing also to its lightness. The chief drawback to its use as an electrical conductor at present seems to be the difficulty of soldering or brazing it, but it is said that this objection is being overcome. The material has been employed as an electrical conductor to a limited extent on some of the long-distance lines in the country, chiefly for telegraph and telephone work, and any advances made in the method of adapting it to electrical uses will be watched with interest.

It is the impression in some quarters that under the Light Railways Act, it will be possible to duplicate in England and other parts of Great Britain, to some extent at least, the interurban electric railways now being so extensively introduced in America, but present indications seem to be that while there may be some construction of this kind, it will be in no way commensurate with that of America or with the development of the electric tramway industry. The Light Railways Act was passed principally with the intention of encouraging the construction of lightly built and inexpensive steam trams for the cheap carriage of agricultural products and goods to the nearest trunk line terminal, in cases where the amount of the traffic would not warrant the construction of a regular railway. The control of such light railways is vested in a body called the Light Railways Commission to whom the applications for the construction of such lines must be made. The restrictions on the construction of these roads are made less severe than those which govern tramways proper, and the procuring of the necessary powers is much less protracted and expensive than is necessary for tramways. The intention is thus to encourage the building of these roads for the benefit of the agricultural class who could thus ship their products at a much less expense than that required for cartage. In spite of the fact that the provisions are in many ways liberal, as described, the development of light railways in England has been exceedingly slow. Although those at present are operated by steam, there seems to be no legal objection to their use of electricity as a motive power, but there are a number of reasons which will serve to prevent the rapid development of these lines, even with electrical equipment. One of the difficulties will be that the city tramways are generally controlled by the municipalities with whom it is necessary to make arrangements for running rights and the use of current. Another, and seemingly a more serious objection to those who have studied the development of similar roads in America, is the limitation of speed. This limitation depends upon circumstances, but the usual maximum is twelve miles an hour. The first objection may be overcome, because the right of municipalities to build roads beyond their own limits is not fully determined and they surely ought to be willing to make any reasonable arrangements for terminal facilities with the light railroad companies, because they must recognize the value of the suburban and interurban feeders to their own systems. The limitation of speed, however, is a very great drawback and seems, under the present conditions of public sentiment, almost insurmountable, owing to the opposition of the vested interests of the steam railroad lines. The latter are extremely powerful in England and represent an enormous amount of capital with securities widely distributed. Any attempt to interfere with the earning powers of any of these roads by the construction of high speed electric railways built along the highways *as competing lines* is naturally almost doomed to defeat, although the conditions for their construction be otherwise favorable. On the other hand, the tramway development in England will, of course, be very large, as practically all the corporations which own tramways, or will soon acquire them, are requesting powers to equip with electricity. Public sentiment in England is favorable to the control of the tramways by the municipal corporations, who have undertaken the management of quasi-public enterprises to a much greater extent than in America, Outside of the tramway field there will undoubtedly be a large development in the electrical equipment of suburban and feeder branches of the steam railroads proper and even—in the not far distant future—of the main trunk lines themselves. There is probably no other country in the world that offers the opportunity for high speed electric service as that furnished by the English trunk lines, with their private rights of way, two and four tracks, no grade crossings, and their frequent train service. The population density in the cities and country is very great and these roads can afford to give their patrons far better service than at present.

A New General Formula for Train Resistance

The alchemists of old sought diligently for the philosopher's stone, the inventors of a later age for perpetual motion, and engineers of the nineteenth century have been almost as eager to obtain a general formula which shall reconcile all existing data and experiments upon train resistance. The first two objects of effort are now known to be unattainable, and the third has until now baffled the best minds in the railroad profession. Only a month ago "Locomotive Engineering," which for years past has devoted special attention to this subject, said editorially: "We do not believe that it is possible to devise a formula that will show an approximation of the resistance due to different kinds of trains at different speeds when train tons are the basis of calculation."

A general formula which appears to be applicable to *passenger* trains of all weights, running at all speeds up to the highest limits so far reached, has been lately worked out, however, by John Lundie as a result of a long series of tests of trains in actual service, and is here given to the engineering public for the first time. His methods of obtaining data are decidedly different from, and much more satisfactory than those commonly employed hitherto, where indicator cards of engines drawing trains at constant (?) speed on level (?) track have been made the basis (with an arbitrary allowance for engine friction) of estimates of resistance per ton moved. In order to be of any value such tests must be made in long distance runs, and it is almost impossible to find a hundred miles or more of absolutely level track for the purpose, while it is also difficult to obtain perfectly uniform speed even on a dead level. Mr. Lundie's method of determining train resistance is based on an examination of the speed curves of a train when *coasting* The possibilities of such a method will be instantly evident to an engineer, and it may be said, at once, that the results warrant a decided predisposition in its favor. It is not only possible to obtain the gross resistance due to track and journal friction and air resistance combined, but to differentiate between the air and the friction elements. The frictional resistance of a train being reasonably constant within somewhat wide limits of speed, the speed curve should be a nearly straight descending line from full speed to a point somewhere near a full stop. Now the actual speed curve dips below this straight line, as seen in Fig. 2, clearly showing a decreasing retarding force (due to air resistance), with decreasing speed.

In Fig. 1 are shown in graphic form the results calculated from more than 150 runs made by Mr. Lundie with trains of different weights on the South Side Elevated Railroad, of Chicago. It will be seen that these results, expressed by the location of points on the diagram, cluster around "straight line curves," and that these lines intercept each other, with surprising accuracy, at a single point located at a definite distance above the origin. This indicates, of course, that the first step in obtaining the final formula has been reached, in the establishment of a constant, representing the minimum possible train resistance for all speeds and weights, and it is interesting to note, by the way, that in none of the recorded experiments so far made on passenger or freight trains of all weights has the resistance per ton been less than the figure indicated by this constant—4 pounds.

Mr. Lundie's formula is as follows:

$$R = 4 + S\left(0.2 + \frac{14}{35 + T}\right)$$

where.

T = the weight of the transportation unit in tons (2000 lbs.).

R = resistance in pounds per ton.

S = speed in miles per hour.

It will be seen at once that unlike most previous formulæ, there are here two variables after the constant, namely speed and train weight. Many other investigators have endeavored to accomplish this, but unsuccessfully, and in the formula which has been in most general use in engineering hand-books, that of D. K. Clark, speed only appears as a variable. From a careful study of his

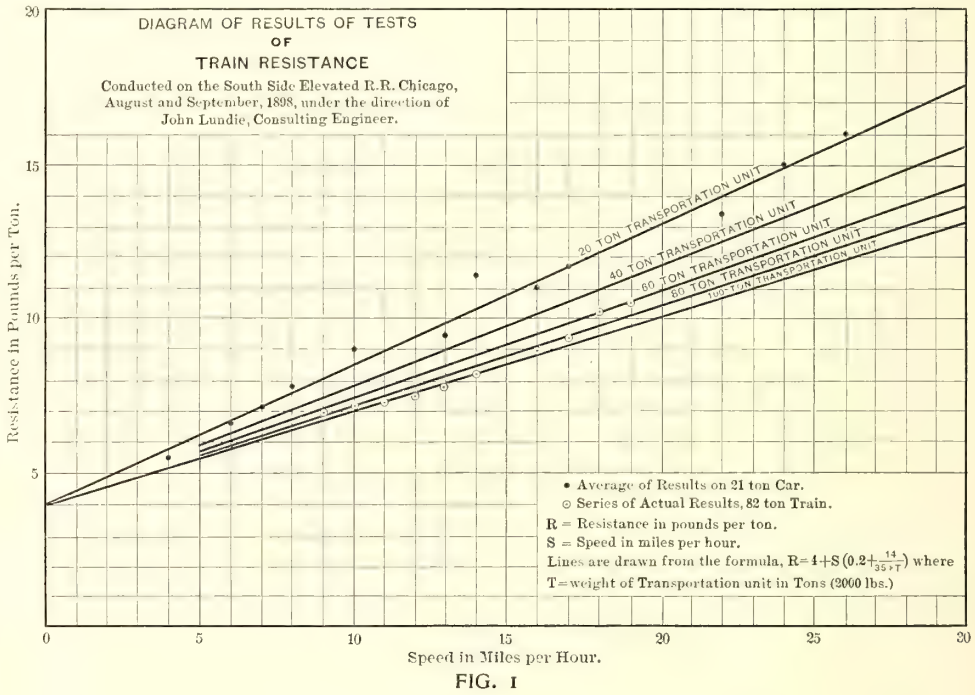


FIG. 1

results, Mr. Lundie developed the formula on the following mathematical basis: the expression by which "S" is multipled is proportional to the tangents of the angles made by the lines developed for different weights, as shown in Fig. 1, and is the characteristic of a rectangular hyperbola which (throughout the range of tests made) co-ordinates quite accurately the relations between train weights and the inclinations of the lines mentioned for corresponding weights. The term 0.2 is an intercept on the axis of y; 14 is the constant product of x and y, with the intersection of the asymptotes as origin; and 35 is an intercept on the axis of x.

The test of any formula lies in its application. Gaged by this test, Mr. Lundie's formula unifies in a remarkably close manner nearly all recently published experiments, together with other formulæ of more limited application, as will be seen by an inspection of the accompanying table. The Stroudley, Sinclair and Dudley tests of train resistance scheduled in this table were brought together by A. M. Wellington in the "Engineering News" in 1892, and referred to as intrinsically worthy of confidence on account of the careful manner in which they were made. To these

we have added further experiments made on the Philadelphia & Reading Railroad in 1889, and on the Central Railroad of New Jersey in 1892, so that a fairly complete range of train weights from 200 to 400 tons, and of train speeds from 40 to 70 miles per hour is given in the table. The Lundie formula checks up all these tests very closely, though in all but one case the results obtained by its use are slightly higher than the observed results. In this connection it may be noted that Mr. Lundie obtained his speed figures by positive methods, having found that speed recorders for variable speeds are not sufficiently accurate owing to the inertia of the moving parts.

These tests are all for heavy railroad passenger trains, upon which Mr. Lundie himself has made no experiments. For trains of from 20 to 100 tons, and for speeds of from five to thirty miles per hour, the Lundie formula is accurate, inasmuch as it is obtained directly from 150 or more observations made by Mr. Lundie in Chicago, as before stated. For lighter units still, the formula agrees with the results of private tests made by several of the great electric companies, and checks very well indeed the Clark formula

$$(R = \frac{S^2}{171} + 7.16),$$

bearing in mind that the latter is generally admitted by engineers to be from one to two pounds too high.

Now it need scarcely be pointed out that when a formula of this general kind, deduced on mathematical principles from a large series of experiments within a comparatively narrow range of action, is found to be equally applicable over a much wider range, a strong presumption in favor of the soundness of its underlying principle is established. It seems practically certain, therefore, that the Lundie formula is thus applicable to the whole range of passenger train traction on straight, level, exposed track in a calm atmosphere. It cannot, however, be said to be applicable to street cars running on gritty or dirty rails, and, in fact, it is unfortunately too probable that no formula whatever can be devised for street railway work for which a large factor of safety would not have to be allowed in practice to provide for great differences in condition of track.

An interesting question now arises as to whether the Lundie formula can be made, with some modifications, applicable to all kinds of train transportation, freight as well as passenger. It does not check the most recently obtained data for exceedingly heavy trains. Tests on the Chicago, Burlington & Quincy Railway, made by the old method of engine indicator diagrams, checked by dynamometer car, show that a 940-ton train of loaded freight cars, running at 20 miles an hour, has a resistance on a straight, level track of 5.5 lbs. per ton. By the Lundie formula this would have been 8.3 lbs. per ton. An extremely heavy train of freight cars on the New York Central, weighing 3428 tons, had an average train resistance, at 20 miles per hour, of about 4 lbs. per ton, or the limiting resistance by the Lundie formula as expressed in the first constant. Other tests on fairly heavy freight train work recently made have shown approximately 6 pounds per ton as an average, when track conditions were good, but these results vary greatly with the condition of the track.

Now it being reasonable to suppose that with the heaviest freight train work, the train resistance will approach the minimum, and the New York Central experiment above referred to, indicating that this minimum is Mr. Lundie's first constant of 4, it would seem that the latter's first constant within the parenthesis, namely .2, must be inapplicable to very heavy freight-train work, and should be, in fact, modified by a variable, probably T. It would be interesting, therefore, to bring together and plot in diagrammatic form, reliable results of a large number of freight-train tests taken with different weights and speeds, to see if a modification of the Lundie formula cannot be made for general application to the heavy class of work, as well as light, and we are inclined to believe that were this experimenting once done there might quite possibly be found a common ground of reconciliation between the two grades of service, by which a formula possessing the general characteristics developed by Mr. Lundie could be made applicable to the entire range of railroad transportation.

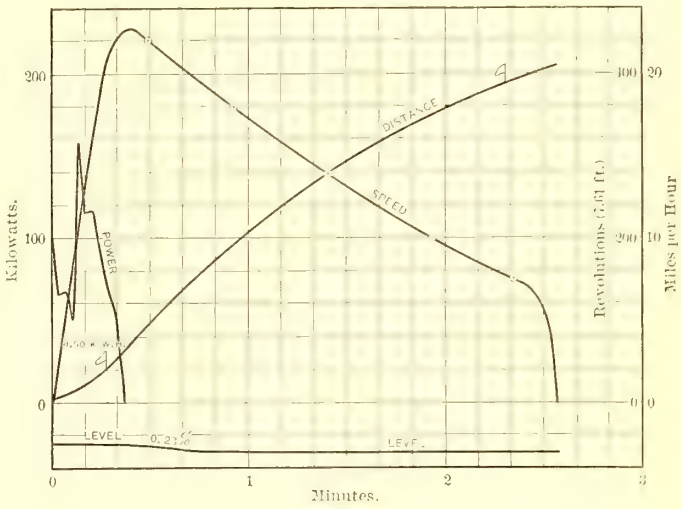


FIG 2.

TABLE SHOWING APPLICATION OF LUNDIE FORMULA TO TRAIN RESISTANCE TESTS.

Test Made By	Year.	On.	Mem.	Average Speed. Miles per hour.	Train Weight. Tons.	Train Resistance. Observed.	Train Resistance. Lundie Formula.
William Stroudley	1885	London, Brighton and South Coast.	Single test	43.3	376	13.2	14.1
Angus Sinclair	1892	New York Central	Mean of six tests	70.	270	19.03	21.1
" "	1892	" "	Single test	69.6	270	19.8	21.2
P. H. Dudley	1882	" "	Single test	51.43	313	16.9	16.35
" "	1889	Philadelphia and Reading	Single test	60.	242.5	18.35	19.0
" "	1889	" "	Single test	63.5	242.5	19.8	19.9
" "	1892	C. R. R., N. J.	Single test	63.2	213	19.0	20.2
Clark formula	....				100	7.74	7.04
" "	....				200	7.74	6.6
" "	....				300	7.74	6.4
" "	....				100	9.5	10.06
" "	....				200	9.5	9.2
" "	....				300	9.5	8.8
" "	....				100	12.42	13.1
" "	....				200	12.42	11.8
" "	....				300	12.42	11.3

The Money Centers and Tramway Opportunities of the World

I.—Europe.

At this time when enormous stores of capital are concentrated in a few great money centers of the world waiting investment in more profitable channels than those immediately in sight, and meanwhile earning little or nothing more than the cost to the bankers of caring for them; at a time, too, when all kinds of "wild cat schemes" are being promoted, and mining and other similar enterprises involving serious risks and possibilities of loss of principal are finding supporters and investors, it is not surprising that more and more attention is being given by the possessors and custodians of capital to the almost limitless field of electric railroading in its various phases—city, suburban and interurban—operating, projected or ready for the projector, in all parts of the world. The flow of money into these channels, however, has hardly more than commenced, if we consider the vast number of opportunities which are offered by the densely populated countries of the old world, so large a percentage of whose population is collected together into cities, towns and villages but short distances apart.

It will be useful, therefore, in the interest of capital seeking investment to take a broad survey of the world and note what may and what may not be done in the different countries, and what are the most promising openings for immediate effort. Such a survey, if thoroughly made, would include a discussion of so many elements of general and special problems of investment as to be entirely beyond the limits of any paper, magazine or even book, but there can here be indicated in brief space the lines on which further work can be done in particular countries or sections.

The four great money markets of the world where capital can be obtained for all kinds of home or foreign enterprises, are London, Paris, Berlin and New York—all charged with the duty of finding an outlet for the surplus profits of great manufacturing countries. It has only lately been possible to place New York in the list of first-class international money lenders, as American capital has been so far absorbed in self development and has even been a borrower in the world's money markets to assist in this process, but now, while self development is by no means completed, our annual surplus investment fund is so enormous, due to growing manufacturing, commercial and agricultural profits, that we can no longer use all our own money to advantage, as is shown not only by the low rates of interest prevailing in America, but by the large sums of American money afloat in the markets of Europe, but subject to call home at any time.

In London there is now little or no difficulty in obtaining money for reasonably promising foreign tramway projects, but there is as yet comparatively little real effort made to find them. In spite of low interest rates and large accumulations of money, the London banker as a rule limits his efforts to passing upon projects which may be brought to him, and leaves to promotors the task of taking the initiative and finding the opportunities. Berlin, on the contrary, is eager, active, outward-looking and anxious to find the money making chances. Hardly a ship leaves a German port without bearing an engineer sent by some financial concern to investigate a proposition or a possible opening in some distant portion of the world. German bankers thoroughly understand the profits in electrical enterprises and are anxious to extend the range of their investments. In fact, the recent serious stringency in the German money market is attributed to the immense amounts of money which have flowed into electric railway and lighting enterprises during the past two or three years, many of which have not yet begun to develop their full earning power. Paris has been somewhat slower than Berlin in understanding tramway profits, but is now making heavy investments at home, in Italy, along the Mediterranean, and to some extent in Russia. Brussels, which has always been the headquarters of several syndicates operating horse tramways in all parts of the world, is increasing its investments in this field, frequently in conjunction with German or French capital, by which Belgian capital has been to some extent overshadowed.

America has poured immense sums of money—probably over $1,000,000,000—into street railway development at home, but has so far made little effort to enter into competition with European money centers in the building or promotion of new enterprises abroad. New York is losing great opportunities, for its capitalists thoroughly understand and appreciate the value of electricity for transportation purposes and need no education. Perhaps a change is coming with the new ideas of "expansion," and this certainly ought to be the case, for no field of international investment offers greater promises of satisfactory return.

It is quite certain that, in spite of occasional exceptions, there will be little interchange of capital for tramway investment between the four great money countries themselves. America has money enough and to spare at low rates of interest for American enterprises, and needs none from Europe. Great Britain owns two or three tramways in Germany and has a little capital in France, but this was placed there before the Germans and French waked up to what was going on. It goes without saying that there is no French capital to speak of in Great Britain, and little or none in Germany. German capital is, however, quietly and unostentatiously at work through international banking houses in Great Britain and France, but still to no great extent, and not to the exclusion of local capital in the same investments.

Both German and French capital is found in Switzerland, in Belgium, and in Russia, German and local capital has almost a monopoly in Austria-Hungary, British and German capital controls South and Central America, while all the capitalist nations of the world are gathering their forces for an onslaught upon Eastern Asia, which is the great virgin money making field of the world to-day.

It is hard for the newer countries of the world to conceive how densely settled are the older ones. Observe the following population densities of continents:

Continent.	Inhabitants per sq. mile.	Continent.	Inhabitants per sq. mile.
North America	12.0	Asia	47.9
South America	5.4	Africa	14.2
Europe	93.0	Australia	1.1

Is it possible that Europe will long be contented with a much smaller steam railroad mileage than America and with higher prices for transportation, when the alternative is presented of profitably operating thousands of miles of electric railways in a territory where the population density is over seven times that of America? No matter who or what is injured in the process, better transportation facilities must and will be given to the people of Europe.

In the accompanying table are shown the number of cities of above 20,000 (usually) inhabitants found in the principal countries of Europe, the population of these cities, and the percentage of this city population to the total population of the country. From such figures a quick idea of the relative importance of each country from the municipal transportation point of view may be obtained.

NAME.	Total Population.	Population per Square Mile.	CITIES ABOVE 20,000 INHABITANTS		
			Number.	Population.	Per Cent to Total Population.
Great Britain	37,731,415	315	382	20,190,568	53.5
Germany	52,279,901	251	161	11,449,000	21.9
Russia (in Europe)	103,703,213	47	87	7,690,159	7.4
Italy	31,102,833	281	62	5,334,000	17.1
France	38,342,948	189	60	7,323,340	19.1
Austria-Hungary	41,358,886	171	41	3,923,558	9.5
Spain	17,565,632	88	22	2,179,256	12.4
Netherlands	4,859,451	384	21	1,632,555	33.6
Belgium	6,410,783	564	17	1,565,809	24.4
Sweden and Norway	6,920,177	17	14	866,158	12.5
Roumania	5,800,000	120	8	533,382	9.2
Switzerland	2,986,848	183	8	449,846	15.1
Bulgaria	3,309,816	83	6	186,055	5.6
Turkey (in Europe)	4,786,545	73	5	316,000	6.6
Greece	2,185,335	87	4	203,225	9.4
Portugal	4,692,113	144	3	460,506	9.8
Denmark	2,185,335	143	3	438,836	20.0
Servia	2,288,259	120	2	80,041	3.5
Luxemburg	217,583	...	1	20,000	9.2

Great Britain.—Existing laws and customs, short time franchises and strict regard for private rights and vested interests are all against the rapid introduction of improved transportation facilities in the British Isles, although much has been done during the past three or four years to overcome prejudice, and considerable headway has been made. Nearly all desirable investments will be taken at home and there will be little or no chance for outside capital, unless working in conjunction with home interests. German and American capital is, however, actually interested to some extent in British tramway development, chiefly through international banking and manufacturing houses. Public sentiment is steadily tending toward municipalization of city enterprises, including that of transportation, and unless this should be checked by poor financial results or admittedly imperfect operation, there will be less and less chance for private capital to engage in such enterprises. There is yet to be built, however, a great network of light railways, to be operated probably by electricity, supplementing the present steam railroad service, and providing for cheap, pleasant and frequent service between cities and towns. Such work will probably be left, for the present at least, to private capital, and if the latter can secure rights of way and terminal privileges within the limits of the cities which they serve, there is quite enough profit in prospect to satisfy the most rapacious of the investing interests. The location and building of such railways will necessarily take time, however, and will be met by vigorous opposition on the part of the existing railroads, unless the latter themselves undertake the work of expanding the transportation facilities of the British Isles, which is quite probable.

Germany.—With nearly half as many cities as Great Britain, and more than half the city population Germany is far more progressive and active in transportation matters, and electric railways are being installed all over the Empire. Here again local capital is dominant and sufficient, and there is little chance for foreign, although in Germany as in Great Britain, immense quantities of American tramway apparatus and material are sold. The home tramway development is controlled to a very large extent by several great syndicates or groups, each composed of banks, promoting companies and manufacturing companies. [See STREET RAILWAY JOURNAL (International Edition) for July, 1898, page 389]. These different groups enter into competition with each other to secure existing and new enterprises, and the amount of capital at their disposal is almost unlimited. Nearly all new enterprises are promoted by some one of these syndicates, for the money influence of the country is very largely concentrated in their numerous banks, and individual outside enterprise will naturally be discouraged. On all good propositions foreign capital can generally be outbid in one way and another, interest rates in Germany being quite low.

Russia.—Russia has been until recently a *terra incognita*—a country jealously shutting itself up and keeping itself aloof from the rest of the world so far as possible. Now, however, foreign enterprise, though hardly welcomed, is not repelled, and in spite of high protective duties, the importations of outside products are very heavy. Among foreign manufacturers none have been more persistent and aggressive than the Germans and Americans, and representatives of manufacturing and business houses of both countries are overrunning the vast Slav Empire and are finding and reporting opportunities for investment. The Russian Government is a borrower in the world's money markets, its borrowings being largely for the purpose of accumulating a sufficient gold reserve to change its monetary system from silver to gold, and as a consequence it has enormous stores of gold already locked up and taken out of circulation. There will doubtless be more or less disturbance of the financial fabric when this change takes place, and provision should be made accordingly, but in general it may be said that with its eighty-seven cities in European Russia and thirty-seven in Asiatic Russia, there should be great chances for money making in the construction and operation of Russian tramways. Individually the Russians are probably well to do, though statistics as to wealth per capita are missing, but the building of the great Siberian railway to the Pacific Ocean and other large projects which the Russian Government has in hand for the development of the immense natural resources of the Empire will doubtless increase individual wealth, but not in proportion to the possibilities for investment.

Italy.—It is somewhat surprising to find that Italy has a larger number of cities above 20,000 inhabitants than France or Austria-Hungary. Italy is not wealthy as a country or in its individual citizens, and there is a great deal of "picturesque poverty" in the peninsula. Nevertheless, it has many tramways already established and more possible locations for others, although to many people it seems a desecration to think of overrunning the land of Cæsar with such twentieth century improvements. German and French capital is quite active in Italy, and frequently comes into competition. The English also own two or three tramway systems, and local capital is, of course, interested to a large extent. The field here is well worth investigation by Americans.

France.—France is self contained and self sufficient so far as money investments are concerned, but is using large quantities of foreign (chiefly American) tramway apparatus and material, purchased by companies formed primarily to control and operate tramway properties. These companies have secured French and, in some cases, Mediterranean rights for handling American apparatus, on advantageous terms, and have not until now found a large enough margin of profit in manufacturing to warrant the building of apparatus in France itself, in view of the larger margins obtainable in purchasing and operating tramways. The principal tramway companies of the country are gradually coming under the control of some one of these promoting corporations, and are thus losing their distinctive character. A number of American engineers and business men are associated

with these French syndicates, and their experience in tramway construction and operation is of great value.

Austria-Hungary.—Extreme Chauviniste or high protectionist ideas prevail in the Austro-Hungarian Empire, and great jealousy of foreign inventors or manufacturers is found as a rule. This can be overcome only by diplomacy, and much of the manufactured products which are supposed to be of home manufacture is, in reality, made in Germany or elsewhere. Germany has a great advantage over other countries in dealing with the dual empire in that so large a portion of the latter's population are German born or of German descent. In fact the difficulties of foreigners doing business at all in a country containing so many different peoples speaking different and troublesome languages are very great, and as a result there is little interference with German and Austro-Hungarian manufacturers in their efforts to keep this business to themselves. The number of cities and the amount of city population is certainly tempting, however, to outsiders, and transportation facilities are by no means perfect though much better in some respects than in other countries of Europe.

Spain and Portugal.—British capital has done much in Spanish tramways during the last two or three years, and those of Madrid, Barcelona, Lisbon, Cartagena, Seville, and others are in their control. France is the great European power most nearly in touch with these two countries, however, and should have decided advantages in obtaining their business. Germany, too, will be favored, while America, in view of recent war complications, would have little chance of success in obtaining valuable concessions. The Spanish people being naturally somewhat indolent in private life, are good patrons of street railways, as is shown in some of the Spanish-American countries as well as in Spain itself.

The Netherlands.—The Netherlands form one of the wealthiest countries of Europe, and have always been lenders rather than borrowers of money, but less in the line of railroad development than of commercial matters. Practically all the Dutch tramways are locally owned, and little is known about them outside. Rates of interest in Holland are so low as to discourage outside enterprise, while it is true, of course, that transportation by the network of canals throughout the Netherlands is so cheap as to make the field for interurban railways probably less promising than in some other countries.

Belgium.—A single great company, the Societe Nationale des Chemin de Fer Vicinaux, controls a large proportion of the tramway and "light railway" mileage of Belgium—no less than 862 miles in all.

As above stated, the Belgians are fully alive to the profits of tramway operation, and have never had to seek outside capital for the development of home propositions. The only way of obtaining a share of tramway development profits in Belgium would be to join forces with local capital, and even this is difficult unless a special and substantial advantage can be shown to the local capital for admitting outsiders.

The Scandinavian Countries.—Norway, Sweden and Denmark are thrifty and prosperous countries, and for ordinary capital requirements do not need to look outside their own borders. Nevertheless, there would probably be no actual repelling of outside capital there to seek investment, but the difficulties of languages would be such as to make it rather hard to form joint syndicates. At present commercial relations with Germany are seriously strained and may quite likely be almost entirely broken off for awhile at least on account of what is considered the high-handed action of Germany in expelling the Danes from Schleswig-Holstein. In trade matters England and the United States would be favored, and there is a very cordial feeling, particularly in Denmark, forAmerica and Americans.

Switzerland.—Switzerland is, in language, part German and part French, and its affiliations are also divided between the two adjacent countries. Nearly all the railways and tramways of the Republic are owned by the cantons, and what private capital is so invested is chiefly French and German. English and American capital would find it difficult to secure a foothold here.

The Balkan Peninsula.—Turkey has for a hundred years been a bone of contention among the European powers, and it can hardly be said that any has permanently obtained great predominance in its councils. At present its cities are being closely examined by a number of European capitalists with a view to tramway possibilities, and it is probable that concessions may be granted in Constantinople and elsewhere. American capital would probably have little chance of success, as it would doubtless be the Sultan's policy to use his franchise conveying powers to further his purposes with some one or other of the European powers.

The other countries of the Balkan Peninsula are more or less subject to European influence, and the conveying of franchises would naturally be matter of some delicacy and would require considerable diplomacy to effect. British capital has so far been successful in several cities of the peninsula.

Frequent and severe punishment for petty offenses should be abolished and a code of rules established worthy of the men and the business they represent. The almost universal practice in punishing minor offenses is to "lay off" the employee from one to ten days, without pay, which is in effect a fine of from two to twenty dollars. The man is soured, his family suffers from the loss of earnings, and if the man happens to be a conductor it is not surprising if he tries to "get even" by nipping fares. The practice is still adhered to by many railway companies, and the offenses which it is supposed to correct still continue. Such a practice would not be countenanced in a manufactory, a store, or in commercial affairs; why should it be on street railways? If the man is valuable enough to be retained in service, why should his family suffer the loss of his wages? If the man were permitted to continue at his work and one-half the amount he would lose by laying-off were assessed as a cash fine, the practice would be condemned in unmeasured terms both by the press and an indignant public. If employees are not amenable to reprimand administered in a proper way, then they have not your welfare at heart, and should be dispensed with altogether.—From paper read at the St. Louis Convention, 1896.

All foremen and sub-foremen should be impressed with the idea that all men under their charge should be treated in a gentlemanly manner, and with the utmost fairness; that there shall be no favoritism in recommending men for promotion, or in shielding them from punishment.—From paper read at the St. Louis Convention, 1896.

Again, as a second suggestion, I wish that we might induce every street railway company in this country to take an active part in this, our association. I sometimes fear that some of the smaller companies, who, as yet, by reason of location or character of travel, have not found it to their advantage to adopt the more recent kinds of motive power, but are still using horses, feel that they have no place in our gatherings.—From address at the Atlanta Convention, 1894.

STREET RAILWAY MILEAGE, CARS AND CAPITALIZATION IN AMERICA

STATES.	No. of Roads.	ELECTRIC RAILWAYS.						CABLE RAILWAYS						HORSE RAILWAYS.				MISCELLANEOUS RAILWAYS.				TOTALS.				CAPITAL STOCK			FUNDED DEBT.			CAPITAL LIABILITIES.			STATES.
		TRACK MILEAGE.		MOTOR CARS.		TRAIL CARS.		TRACK MILEAGE.		GRIP CARS		TRAIL CARS		TRACK MILEAGE.		HORSE CARS.		TRACK MILEAGE		CARS, ENGINES, ETC.		TRACK MILEAGE.		CARS		TOTAL.		INCREASE.	TOTAL		INCREASE	TOTAL		INCREASE.	
	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898		1897	1898		1897	1898		
New England States.																																		**New England States.**
Maine	22	152	230	225	290	87	80		....			..		3	3	4	4	..	..			155	233	316	374	2,427,875	3,351,042	923,167	2,466,000	3,558,000	1,092,000	4,893,875	6,909,042	2,015,167	Maine
New Hampshire	7	63	80	109	137	28	46	..	..	....	..	..	..	4	...	21	..	..	..	..	..	67	80	158	183	750,000	820,000	70,000	668,500	706,000	37,500	1,118,500	1,526,000	107,500	New Hampshire
Vermont	9	35	77	45	72	4	4	..	..	..	..	..	..	...	...	...	...	..	..	..	..	35	77	49	76	499,500	880,800	381,300	401,000	656,000	255,000	500,500	1,536,800	636,300	Vermont
Massachusetts	84	1,325	1,632	4,286	5,156	194	147	....	..	..	..	..	..	33	12	444	361	6	..	3	2	1,364	1,644	4,927	5,666	39,330,900	47,978,250	8,647,350	24,288,900	28,625,900	4,337,000	64,619,800	76,604,150	12,984,350	Massachusetts
Rhode Island	6	158	181	476	511	152	90	..	....	..	..	..	..	..	..	..	..	..	..	..	..	158	181	629	691	8,360,200	8,610,200	250,000	8,644,200	8,844,200	200,000	17,004,400	17,454,400	450,000	Rhode Island
Connecticut	27	372	417	830	918	95	93	..	..	..	..	..	..	...	..	15	..	....	..	..	..	372	417	960	1,011	9,686,740	10,875,740	1,189,000	8,967,100	10,015,800	1,178,700	18,653,840	20,891,540	2,267,700	Connecticut
TOTAL	155	2,105	2,617	5,991	7,084	560	460		.			..		40	15	485	365	6	...	3	2	2,151	2,632	7,039	7,911	61,055,215	72,516,042	11,460,827	45,435,700	52,436,500	7,000,800	106,490,915	124,952,542	18,461,627	TOTAL
Eastern States.																																		**Eastern States.**
New York	102	1,559	1,862	4,921	6,684	814	607	55	54	1,214	1,118	55	200	208	197	2,939	1,753	173	180	2,052	2,044	2,085	2,293	11,995	12,406	193,317,661	217,785,952	24,468,291	177,403,556	200,883,778	23,380,222	370,821,217	418,669,730	47,848,513	New York
New Jersey	34	653	686	1,422	1,581	196	160	2	..	2	..	..	..	21	13	66	38	....	..	..	..	676	699	1,086	1,779	36,123,250	33,612,423	*2,510,827	36,011,000	42,722,785	6,708,785	72,134,250	76,335,208	4,200,958	New Jersey
Pennsylvania	89	1,658	1,679	3,610	5,152	285	346	27	...	156	..	..	..	14	2	143	20	10	12	7	..	1,709	1,693	4,101	5,518	142,048,445	169,429,350	27,381,905	77,078,103	85,021,400	7,943,297	219,116,608	254,451,750	35,335,142	Pennsylvania
Delaware	4	32	35	35	90	..	..	..	..	..	..	..	..	..	..	..	..	..	....	..	..	32	35	85	90	611,284	715,040	103,756	750,000	750,000	..	1,361,284	1,467,040	105,356	Delaware
District of Columbia	12	83	159	245	583	253	373	28	6	142	42	234	..	44	15	211	81	..	..	..	..	155	181	1,085	1,071	14,000,100	15,960,300	1,275,200	4,510,500	8,535,691	3,775,891	19,509,500	24,500,991	4,991,491	District of Columbia
Maryland	9	285	348	761	1,010	136	57	21	21	72	72	36	36	2	..	100	..	2	2	2	2	310	371	1,107	1,117	13,488,150	15,188,030	1,988,850	13,350,000	15,870,000	2,520,000	27,048,150	31,558,030	4,509,880	Maryland
Virginia	18	184	211	291	342	63	71	..	..	..	..	..	..	9	1	25	1	4	4	5	7	197	216	384	421	5,566,250	7,075,665	1,509,415	5,805,000	6,742,000	937,000	11,371,250	13,817,665	2,446,415	Virginia
West Virginia	5	41	45	38	62	4	10	....	..	..	..	..	..	6	1	8	1	9	7	24	25	56	53	74	98	1,510,000	1,478,000	*32,000	760,000	959,000	199,000	2,300,000	2,437,000	137,000	West Virginia
TOTAL	273	4,495	5,025	11,273	15,504	1,751	1,624	133	81	1,586	1,232	325	236	394	229	3,492	1,894	198	205	2,090	2,078	5,220	5,541	20,517	22,568	407,388,140	461,542,330	54,154,190	316,280,519	361,474,654	45,194,135	723,668,659	823,016,984	99,348,325	TOTAL
Central States.																																		**Central States.**
Michigan	33	494	572	1,121	1,174	166	152											3	3	4	4	497	575	1,291	1,330	9,194,846	11,750,200	2,555,354	10,576,700	17,505,450	6,928,750	19,771,546	29,255,650	9,484,104	Michigan
Ohio	68	1,174	1,374	2,347	2,888	960	581	45	20	251	221	108	18	10	2	21	4	3		13	...	1,232	1,396	3,760	3,712	65,487,800	72,088,400	6,602,600	27,406,502	32,879,000	5,472,498	92,894,302	104,967,400	12,073,098	Ohio
Indiana	26	343	395	494	556	230	240							12	10	30	17					355	405	754	813	10,397,550	10,909,750	512,200	9,401,000	10,408,000	957,000	19,898,550	21,317,750	1,419,200	Indiana
Kentucky	11	178	188	331	334	228	216							10	20	125	125	...				218	208	684	675	7,521,900	7,440,900	*75,000	6,663,300	7,020,000	356,700	14,185,200	14,460,900	281,700	Kentucky
Wisconsin	18	282	318	458	562	79	87							4	4	2	2	..	..	..	..	286	322	539	651	9,435,000	9,876,100	441,100	9,414,000	10,049,000	1,065,000	18,179,000	19,925,100	1,746,100	Wisconsin
Illinois	59	1,113	1,365	2,124	2,628	2,702	2,828	82	82	617	585	522	639	28	26	109	60	20	11	229	5	1,243	1,484	6,303	6,645	104,202,525	104,888,185	685,660	79,106,400	74,897,000	*4,209,400	185,308,925	179,785,185	*3,523,740	Illinois
Minnesota	9	292	301	671	742	318	6	7	1	40	50			4	7	6	9	..	..	6	2	303	309	1,041	809	18,809,100	19,334,100	525,000	13,648,000	12,747,000	*901,000	32,457,100	32,081,100	*376,000	Minnesota
Iowa	27	219	290	283	354	154	154	..	..	..	..	..	..	11	9	22	14	2	3	4	5	232	302	463	527	8,083,000	10,113,000	2,330,000	4,293,000	5,029,000	736,000	12,376,000	15,442,000	3,066,000	Iowa
Missouri	29	489	529	982	1,113	696	516	101	94	326	389	490	370	24	27	62	31	..	..	..	..	614	650	2,536	2,419	29,490,500	30,328,000	837,500	32,839,000	31,842,000	*997,000	62,329,500	62,170,000	*159,500	Missouri
TOTAL	280	4,584	5,332	8,811	10,251	5,533	4,780	235	197	1,234	1,245	1,120	1,027	133	105	377	262	28	17	256	16	4,980	5,651	17,331	17,581	262,640,221	277,031,335	14,411,114	193,167,902	202,526,450	9,358,548	455,788,123	479,557,785	23,769,662	TOTAL
Southern States.																																		**Southern States.**
North Carolina	8	39	37	59	66	12	8	..	..	..	....	..	..	2	2	3	3	2	2	..	..	43	41	74	77	611,000	786,000	175,000	710,000	510,000	*200,000	1,321,000	1,296,000	*25,000	North Carolina
South Carolina	5	10	50	12	62	4	19	....	..	..	..	..	..	35	4	93	12	....	....	....	....	45	54	109	93	462,000	1,247,000	785,000	205,000	1,340,000	1,135,000	667,000	2,587,000	1,970,000	South Carolina
Georgia	14	224	225	325	314	42	39	....	..	....	..	..	....	11	11	9	9	9	5	10	6	244	241	386	368	4,548,400	1,018,400	*500,000	4,784,000	5,523,000	739,000	9,332,400	9,671,400	239,000	Georgia
Florida	7	43	44	40	54	10	8	..	....	..	..	..	....	11	11	16	16	..	9	..	14	54	64	66	92	326,500	531,500	205,000	4 600	204,600	200,000	331,100	736,100	405,000	Florida
Alabama	16	88	120	111	131	68	96	..	..	..	..	..	..	14	14	42	14	83	79	107	87	185	213	328	328	5,507,800	5,447,800	*60,000	2,685,000	2,645,000	*20,000	8,172,800	8,092,800	*80,000	Alabama
Mississippi	4	6	6	3	4	8	8	....	....	..	..	..	..	12	6	17	8	2	2	28	28	20	14	56	48	195,000	151,000	*41,000	19,000	68,000	49,000	214,000	222,000	8,000	Mississippi
Tennessee	17	216	237	345	335	91	85	1	1	2	..	..	..	5	5	12	5	10	9	10	15	232	252	460	440	4,937,500	5,057,000	119,500	4,021,000	4,755,000	734,000	8,958,500	9,812,000	853,500	Tennessee
Louisiana	11	172	190	470	488	4	55	....	..	..	..	..	..	13	13	19	29	6	....	58	..	191	203	551	572	11,373,000	11,379,100	26,100	9,163,400	9,567,400	404,000	20,516,400	20,946,500	430,100	Louisiana
Arkansas	7	40	34	59	61	41	35	....	....	..	..	..	....	29	27	57	55	5	5	..	..	74	66	157	151	1,530,375	1,509,375	*30,000	982,000	1,032,000	50,000	2,512,375	2,532,375	20,000	Arkansas
TOTAL	89	838	943	1,424	1,615	280	353	1	1	2	....	....	....	132	93	268	151	117	111	213	150	1,088	1,148	2,187	2,169	29,471,575	30,201,175	729,600	22,554,000	25,645,000	3,091,000	52,025,575	55,846,175	3,820,600	TOTAL
Western States.																																		**Western States.**
South Dakota	4	7	8	3	3	3	3	....	.			..	..	6	15	7	13	....		....	....	13	23	13	19	275,000	375,000	100,000	75,000	. . .	*75,000	350,000	375,000	25,000	South Dakota
Nebraska	10	187	152	210	220	206	152	...	.	.	.	..	....	23	22	24	24	..	.	....	....	210	174	440	396	8,437,500	6,679,250	*1,758,250	4,420,000	2,410,000	*2,010,000	12,857,500	9,089,250	*3,768,250	Nebraska
Kansas	11	107	110	118	96	77	67	..	..	....	....	..	..	22	28	30	31	..	.	.	.	129	138	225	194	2,615,000	2,709,000	90,000	2,085,000	2,368,000	283,000	4,700 000	5,073,000	373,000	Kansas
Texas	25	267	224	337	273	56	63	..	..	..	..	..	..	54	30	129	60	..	..	.	11	321	354	522	407	5,952 500	4,622 500	*1,330,000	5,030,000	6,184,000	1,154,000	10,982,500	10,806,500	*176,000	Texas
Colorado	11	207	215	269	233	213	201	30	30	62	62	80	80	7	7	5	5	22	21	4	32	266	272	633	613	10,355,000	10,355 000	. . .	9,719,000	11,261,000	1,542,000	20,074,000	21,616,000	1,542,000	Col rado
Montana	5	47	65	36	61	16	31	2	...	4	...	1	....	..	....	1	..	....	....	.	....	49	65	58	92	1,700,000	1,620,000	*80,000	1,250,000	1,346,500	96,500	2,950,000	2,966,500	16,500	Montana
Idaho	1	4	4	2	2	....	....	....	....	....	....	....	....	..	....	..	..	..	....	.	....	4	4	2	2	54,000	54,000	. . .	....	....	....	54,000	54,000	....	Idaho
Utah	5	92	92	105	102	17	22	....	....	....	....	....	....	..	....	..	..	8	18	2	7	100	110	124	131	1,756,000	1,756,000	. . . .	1,000,000	1,000,000	.....	2,756,000	2,756,000	....	Utah
Washington	21	210	211	186	178	18	28	18	21	45	55	15	15	4	4	6	6	..	..	..	....	232	236	270	282	8,870,000	8,271,300	*598,700	6,200,457	5,759,228	*441,229	15,070,457	14,030,528	*1,039,929	Washington
Oregon	12	114	117	186	142	28	22	3	3	16	16	.	1	5	7	4	8	21	21	14	29	143	148	248	218	2 516,300	2,520,800	4,500	2,235,000	2,335,000	100,000	4,751,300	4,855,800	104 500	Oregon
California	12	501	537	708	765	119	108	117	127	661	675	48	57	127	99	316	284	67	112	71	77	812	895	1,923	1,966	43,065,240	42,151,230	*914,010	23,626,600	24,673,600	1,047,000	66,691,840	66,824,830	132,990	California
TOTAL	157	1,743	1,755	2,160	2,075	753	697	170	181	788	808	144	153	247	212	522	431	118	172	91	156	2,279	2 320	4,458	4,320	85,596,540	81,110,080	*4,486,460	55,641,057	57,337,328	1,696,271	141,237,597	138,447,408	*2,790,189	TOTAL
United States	954	13,765	15,672	29,659	36,429	8,877	7,014	539	460	3,610	3,285	1,589	1,416	947	654	5,144	3,103	467	505	2,653	2,402	15,718	17,291	51,532	54,549	846,131,691	922,400,962	76,269,271	633,079,178	699,419,932	66,340,754	1,479,210,869	1,621,820,894	142,610,025	**United States**
Canada	37	498	634	836	1,242	376	200	...	....	....	..	.	....	12	9	33	20	.	30	....	49	510	673	1,245	1,711	17,056,600	19,533,100	2,476,500	6,123,000	8,476,452	2,353,452	23,179,600	28,009,552	4,829,952	**Canada**

* Decrease.

STATES.	No. of Roads.	ELECTRIC RAILWAYS.						CABLE RAILWAY				TE
		TRACK MILEAGE.		MOTOR CARS.		TRAIL CARS.		TRACK MILEAGE.		GRIP CARS.		
	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	18
New England States.												
Maine	22	152	230	225	290	87	80	....	....	....	....	·aine
New Hampshire	7	63	80	109	137	28	46	....	....	....	....	·hire
Vermont	9	35	77	45	72	4	4	....	....	....	....	·ont
Massachusetts	84	1,325	1,632	4,286	5,156	194	147	....	....	....	....	·setts
Rhode Island	6	158	181	476	511	152	90	....	....	....	....	·land
Connecticut	27	372	417	850	918	95	93	....	....	....	....	·icut
TOTAL	155	2,105	2,617	5,991	7,084	560	460	....	....	....	....	·AL
Eastern States.												
New York	102	1,559	1,862	4,921	6,684	814	607	55	54	1,214	1,118	York
New Jersey	34	653	686	1,422	1,581	196	160	2	....	2	....	·rsey
Pennsylvania	89	1,658	1,679	3,510	5,152	285	346	27	....	156	....	·ania
Delaware	4	32	35	85	90	....	....	....	....	....	....	·ware
District of Columbia	12	83	159	245	583	253	373	28	6	142	42	nbia
Maryland	9	285	348	761	1,010	136	57	21	21	72	72	land
Virginia	18	184	211	291	342	63	71	....	....	....	....	·ginia
West Virginia	5	41	45	38	62	4	10	....	....	....	....	·ginia
TOTAL	273	4,495	5,025	11,273	15,504	1,751	1,624	133	81	1,586	1,232	3AL
Central States.												
Michigan	33	494	572	1,121	1,174	166	152	....	....	....	....	·igan
Ohio	68	1,174	1,374	2,347	2,888	960	581	45	20	251	221	1Ohio
Indiana	26	343	395	494	556	230	240	....	....	....	....	·iana
Kentucky	11	178	188	331	334	228	216	....	....	....	....	·ucky
Wisconsin	18	282	318	458	562	79	87	....	....	....	....	·nsin
Illinois	59	1,113	1,365	2,124	2,528	2,702	2,828	82	82	617	585	5inois
Minnesota	9	292	301	671	742	318	6	7	1	40	50	·esota
Iowa	27	219	290	283	354	154	154	....	....	....	....	·Iowa
Missouri	29	489	529	982	1,113	696	516	101	94	326	389	4souri
TOTAL	280	4,584	5,332	8,811	10,251	5,533	4,780	235	197	1,234	1,245	1,1AL
Southern States.												
North Carolina	8	39	37	59	66	12	8	....	....	....	....	·olina
South Carolina	5	10	50	12	62	4	19	....	....	....	....	·olina
Georgia	14	224	225	325	314	42	39	....	....	....	....	·orgia
Florida	7	43	44	40	54	10	8	....	....	....	....	·orida
Alabama	16	88	120	111	131	68	96	....	....	...	....	·bama
Mississippi	4	6	6	3	4	8	8	....	....	....	....	·sippi
Tennessee	17	216	237	345	335	91	85	1	1	2	...	·essee
Louisiana	11	172	190	470	488	4	55	....	....	....	....	·siana
Arkansas	7	40	34	59	61	41	35	....	....	....	....	·ansas
TOTAL	89	838	943	1,424	1,515	280	353	1	1	2	....	·TAL
Western States.												
South Dakota	4	7	8	3	3	3	3	....	....	....	....	·akota
Nebraska	10	187	152	210	220	206	152	...	....	....	....	·raska
Kansas	11	107	110	118	96	77	67	....	....	....	....	·ansas
Texas	25	267	224	337	273	56	63	....	....	....	....	·Texas
Colorado	11	207	215	269	233	213	201	30	30	62	62	8rado
Montana	5	47	65	36	61	16	31	2	....	4	....	ntana
Idaho	1	4	4	2	2	....	....	....	....	....	....	·Idaho
Utah	5	92	92	105	102	17	22	....	....	....	....	·Utah
Washington	21	210	211	186	178	18	28	18	21	45	55	hgton
Oregon	12	114	117	186	142	28	22	3	3	16	16	·egon
California	52	501	557	708	765	119	108	117	127	661	675	4ornia
TOTAL	157	1,743	1,755	2,160	2,075	753	697	170	181	788	808	14L
United States	954	13,765	15,672	29,659	36,429	8,877	7,914	539	460	3,610	3,285	1,58s
Canada	37	498	634	836	1,242	376	200	....	....	....	....	·la

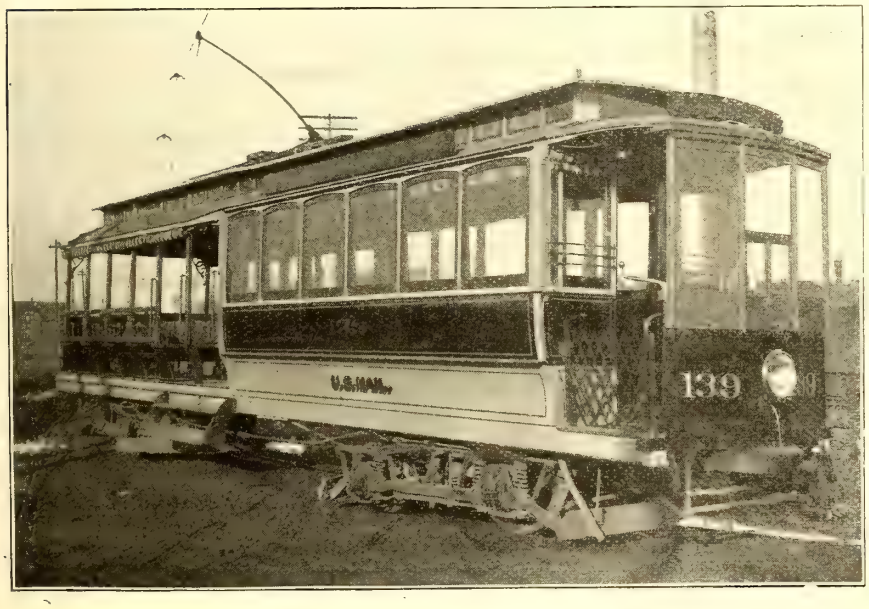
* Decrease.

Improvements in Denver

The Denver Consolidated Tramway Company has recently been equipping some of its cable railways with electric power. In its new track construction the company is using a 72-lb., 6-in., 60-ft. T rail, mounted on 5 in. x 7 in. x 7 ft. creosoted ties, ballasted and thoroughly tampered with gravel.

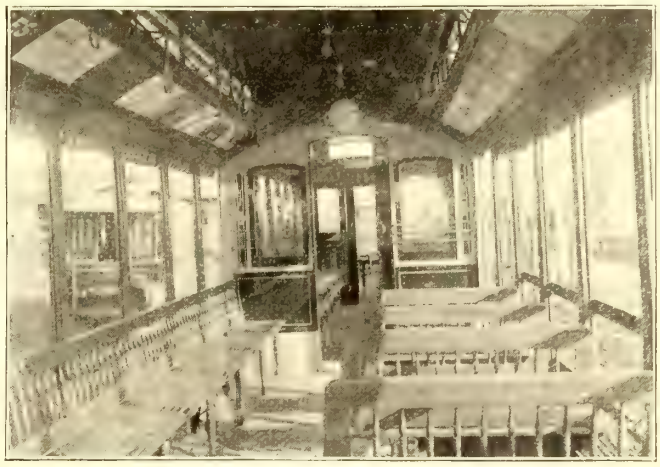
The company has also been experimenting on splicing some of its old 16-ft. cars, each with an ordinary seven-bench trailer to make a 39-ft. combination car, which is a very popular type of car in Colorado. The method of splicing employed is as follows: The cars are mounted on a framing of two 6-in. I-beams extending the entire length of the car, the beams being joined together by stout oak pieces. The running boards are then removed from the trailer and wooden guards put on the sides of the open car, which is fitted with long storm curtains in addition to the ordinary shades. The seating arrangement of the open portion of the car was changed by the removal of the seats on one side and the substitution in their place of longitudinal seats, made up to a certain extent from the seats removed. The object of this arrangement was that, while it afforded nearly the same seating capacity as before, it enabled the conductor to collect the fares more quickly and with perfect safety. The engravings herewith give a good idea of the external appearance of the car and the seating arrangement of the open portion.

The entrance is near the middle of the car at the end of the closed portion of the car, and is of ample width, allowing passengers to get on and off the car at the same time. The company is considering the advisability of protecting this entrance with an ordinary gate or guard for the purpose of minimizing accidents, resulting from people stepping off the car while in motion. It is expected that a large number of cars will be equipped in this way. The closed portion is always at the front end of the car which is always run in the same direction.



EXTERIOR OF COMBINATION CAR

All of the company's cars have recently been fitted with storm fronts, similar to that shown in the engraving of the exterior of the car. A curtain, not shown in the engraving, is put on the motorman's left-hand side for the purpose of protecting him from drafts. All of the cars are now being fitted with the changeable headlight of the Crouse-Hinds Electric Company, of Syracuse, N. Y. The company has also equipped all of its cars with a fender devised by A. L. Lawton, manager of the Colorado Springs Railway. These fenders have picked up a number of persons, as well as dogs, bicycles, and in one instance, a horse. The management reports that it is well pleased with the fender.



INTERIOR OF COMBINATION CAR

Street Railway Mileage and Capitalization in America

In the accompanying inset will be found a most careful compilation of the mileage of electric, cable and horse railways in the United States and Canada; the number and distribution of the cars operated thereon, and the capital stock and funded debt of the operating companies—all arranged by states and sections of the country, and comparison made with corresponding figures for 1897. A similar table appeared in the STREET RAILWAY JOURNAL for October, 1897, in which the 1896 figures were given, and from these two compilations the general growth of the industry in America for the last three years can be understood, as well as the distribution of the increases from year to year.

Contractors for Tramways in Barcelona and Madrid

Elsewhere in this issue F. C. Armstrong describes the new electric railway systems recently installed in the cities of Madrid and Barcelona, Spain. The chief sub-contractors for the railway apparatus used in those plants were as follows:

Generators and motors—British Thomson-Houston Company (Limited).
Engines—E. P. Allis Company.
Boilers—Babcock & Wilcox Company.
Condensers and water tower—Wheeler Condenser & Engineering Company.
Economizers—Green Economizer Company.
Feed wire—Callender's Cable & Construction Company.
Car bodies—Compañia de Ferro-carrilles de Zaragoza.
Car trucks—J. G. Brill Company.
Trolley wire—Felten & Guilleume.
Rail bonds—Neptune, made by Felten & Guilleume.
Rails—Phœnix Actien Gesellschaft

Our experience has been that if the conductors and the passengers will use the transfers as we intended they should use them, we can afford to give them.—From address at the Montreal Convention, 1895.

LEGAL NOTES AND COMMENTS*

Edited by J. Aspinwall Hodge, Jr., and Robert Ernest, of the New York Bar

Heating and Other Accommodations in Street Cars

There was a time—not very far distant—when places of public concourse, such as theaters, lecture halls and churches, had no other means of heating than the foot stoves, which might be carried by some of the more luxurious members of the audience; and long after it was the universal custom to properly heat such places, it was still an unheard-of thing that any public conveyance should be furnished with any other means of heating than the hot brick or the little foot stove.

With the steam railroad there came, first, wood and coal car-heaters, and now, even these are things of the past, and in some States are prohibited by statute, the steam railroad being obliged to furnish steam heat, because of the danger of fire in case of a railroad wreck

It was some years after the street car was introduced before what was then considered a novel luxury was introduced into some of them in the shape of a small coal stove; but now that is almost universal, except where it has been supplanted by the luxurious electric heater supplied from the same current which propels the car and lights it.

As each of the inventions is introduced and becomes established, it ceases, in the public mind, and in fact, to be a luxury, and becomes a necessity; and, in passing from one class to the other, a legal obligation is created, by reason of the general rule, that in the contract between the common carrier and the passenger there is an implied agreement that the latter will be furnished with the ordinary comforts or necessities which are incident to the mode of conveyance furnished. This is the common law, and where there are statutes they have either merely declared it or have imposed additional burdens upon the common carrier by definitions of what are necessities and ordinary comforts.—(Texas & P. R.R. vs. Pierce, 30 S.W., 1122; Boothby vs. R.R., 66 N.H., 342.)

As the electric street railroad is gradually furnishing the same sort of transportation as the steam railroad, and in much the same way, it finds itself assuming new responsibilities, and becoming more and more subject to the same rules which apply to its older rival. Among these undoubtedly is the duty of heating its cars and its waiting rooms, where these are furnished as ancillary to its business at its transfer points. So far as we are aware, there is no adjudicated case of the Appellate courts upon the duty of a street car company to keep its conveyances warm, and upon its liability to passengers for illness caused by the want of proper heat.

That it is the duty of the steam railroad company to heat its cars, and that they are liable where, through negligence, they do not do so, and especially after the attention of the servants of the railroad have been called to the matter, has been more than once adjudicated.—(Ft. Worth & D. C. R.R. vs. Hyatt, 34 S.W., 677; Taylor vs. R.R., 38 S.W., 304; Hastings vs. R.R., 53 Fed., 224.)

This rule, when it shall be applied to the street car, will undoubtedly be applied with due consideration of the difference in the conditions. For the ordinary passenger upon the street car in a city, who steps into the car from the street, warmly dressed, and who leaves it after a ride of only a mile or less, is manifestly not so exposed to the elements as to raise any presumption that a subsequent illness results from such a ride, however inadequately the car was heated; and, on the other hand, upon the question of contributory negligence, a passenger on the street car can, at very small expense and comparatively little inconvenience, leave an unheated car as soon as he becomes aware that its temperature is dangerous to his health, assuming that he is riding through a city street, or is upon a line where the headway between cars is not great, and where he can procure another and better-warmed conveyance.

But when the trolley line reaches out into the country, and becomes intra-urban, the conditions grow more and more like those of the steam railroad, and, as they approximate them, the duty of providing like accommodations and comforts increases. H.

* Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

INDIANA.—Construction of Franchise—Extension Validity—Conflicting Franchise—Unoccupied Streets—Completion of Tracks—Constitutional Law—Control of Streets.

1. Acts 1861, p. 75 (Rev. St. 1894, sec. 5450; Horner's Rev. St. 1897, sec. 4143 et seq.), authorizes the organization of street railway companies, which are declared to be "corporate in perpetuity," and provides that such companies shall first obtain the city's consent to the construction of their roads through the streets of any city, and that the act shall not take from the city the exclusive control of its streets. A city passed an ordinance granting a street railroad company a franchise to operate on its streets for a stated period, and afterward extended such period. Held, that the street railway company had not, without further legislation, the right to continue the operation of its railroad on such streets after expiration of the time fixed by the ordinances.

2. Where a street railroad company incorporated under said provisions accepted an ordinance of a city granting it a franchise to operate its road on the city's streets for a stated period, and thereafter sought and secured an extension of such period, it, by so doing, in conjunction with the city, construed said act as giving it no power to occupy streets beyond the time granted by the city, and was bound by such construction.

3. The fact that a city has given a street railway company permission to construct its road on all the streets of the city, and that thereunder such company occupied a portion of the streets, does not make a franchise granted by the city to another company during the life of the former franchise invalid as to streets not occupied by the former company, since its franchise was exclusive only as to streets on which it had constructed its road, and from the time of such construction.

4. Where a city authorized a street railroad company to construct its road on all the streets of the city, and thereafter, during the life of such franchise, authorized another company to construct a street railroad system on the same streets, the rights of the two companies during the co-existence of the two charters, as to unoccupied streets, were equal, and, where one company thereafter constructed its road on any of such streets, its right as to so much thereof as was necessary for the proper operation of its cars was exclusive.

5. A contract by which a city authorized a street railroad company to construct a system of street railroads on its streets, in consideration of an annual payment to the city by such company, and its agreement to repair and clean that part of the streets occupied by its tracks, the fare being limited, and the undertakings of the company secured by sufficient indemnity, is legal and binding as between the city and the company, even though the contract may not be an advantageous one for the city.

6. After passage of two municipal ordinances, one of which granted a street-railroad franchise for a term and the other of which extended it, the city attorney advised the city that the extension was invalid. The city then granted a franchise to construct a street railroad system in the city's streets, including those occupied under the former franchise to another company, on condition that a certain portion of its system should be constructed within a specified time, the contract providing that delays caused by judicial restraint of the construction should not be counted, and delays caused by injunctions against the construction issued because of prior franchises should extend the time for completion for a stated period. The extension of the original franchise was afterward adjudged valid. Held, that the second franchise was not invalid, as granted under a mistake of law or of fact.

7. Where a street railway franchise required the company to complete its road on certain streets within a stated time, and another company, without authority so to do and without consent of the former company or of the city, forcibly took possession of such streets, and extended its road over them, the latter company could not complain that the former had failed to complete its road over such streets within the required time.

8. Act June 4, 1861, sec. 12 (Rev. St. 1894, sec. 5450; Horner's Rev. St. 1897, sec. 4143), requires street railroad companies to first obtain the city's permission to lay their tracks over said streets, and provides that nothing in the act shall deprive a city of the exclusive control of its streets. A company organized under said act was by a city given permission to construct a street railroad system on all the streets of the city. It constructed a road on a portion of such streets, and left others unoccupied. Held, that it could not thereafter take possession of, and extend its road over, other streets without further permission from the city.

9. A valid contract between a street railroad company and a city, whereby the former is given a franchise to construct a street railroad system on the streets of the latter, cannot be abrogated by an act of the legislature.

10. Acts 1897, p. 154 (Horner's Rev. St. 1897, sec 4154), amending act June 4, 1861, sec. 12, which provides that street railroad companies shall first obtain the city's consent to lay their tracks in streets, and that the act shall not deprive a city of the exclusive control of its streets, by adding that, on expiration of a street railroad franchise, the right to use the streets shall forever cease, does not annul an existing franchise to operate on city streets granted by a city under charter authority.—(City Ry. Co. vs. Citizens' St. Ry. Co. et al., 52 N. E. Rep., 157.)

LOUISIANA.—City Ordinance—Watering Street Car Tracks.

1. An ordinance of the City Council of the city of New Orleans which requires corporations operating street electric cars within the limits of the city, upon tracks laid down in the public streets thereof, to water their tracks so as to effectually lay the dust within their tracks, is a legal exercise of the police power of the city. Such an ordinance tends to promote the comfort and convenience of passengers, and the health and comfort of the inhabitants of the city.

2. It is neither indefinite nor unreasonable.—(State vs. Canal & C. R. Co., 24 So. Rep., 265.)

NEW JERSEY.—Street Railroads—Use of Streets—Notice of Location—Judicial and Legislative Acts—Constitutional Law.

A statute (3 Gen. St., p. 3237, sec. 126) authorized borough councils, upon public notice to all parties interested, to grant or to deny to a street railroad a location of its tracks conformably to its route; such grant, if made, to be upon such lawful restrictions as the interest of the public was deemed to require. Upon notice, consent to a location was given, upon the restriction, among others, "that the limit of this consent shall be twenty-five years from the acceptance of this ordinance." Subsequently, and without notice, a supplement to this ordinance was passed that eliminated the above restriction. Held: 1. The municipal act of the "location" of the tracks of a street railroad operated by the trolley system does not involve any private rights. 2. Such location is a legislative, and not a judicial, act. 3. Apart from express statutory requirement, notice is not requisite. 4. The notice required by the act is satisfied when it has been complied with. 5. Whether the action of council was in bad faith is not a judicial question.—(State —Moore et al., prosecutors—vs. West Jersey Traction Co. et al., 41 Atl. Rep., 946.)

NEW HAMPSHIRE.—Extension of Line—General Law—Public Good.

Laws 1895, c. 27, sec. 3, providing for the organization of street railway corporations by general law, and authorizing the court to determine whether the public good requires the building of a street railroad on a proposed route, has no application to an extension, by a previously and specially chartered corporation, of its road, which it was authorized by its incorporation to build.—In re Nashua Street Ry., 41 Atl. Rep., 858.)

NEW JERSEY.—Statutes—Special and Local Acts—Eminent Domain—Compensation—Street Railroads—Franchise—Certiorari —Rights of Taxpayers.

1. The act of June 13, 1898 (P. L., p. 461), entitled "An act to authorize boards of chosen freeholders to widen, straighten, grade and otherwise improve highways under their control, and to provide for the construction of street railroads thereon," is not rendered special or local by the provision that nothing in the act "shall be construed to authorize the construction of a street railroad on any public highway on which it is not lawful at present to authorize the construction of a street railroad."

2. The direction contained in said act that commissioners appointed on condemnation of lands taken for the purpose of widening, straightening, or changing the location of a highway in making their estimate and assessment of damages, "shall take into account the benefits conferred by the improvement on the remainder of any lot or tract of land partly taken," is not unconstitutional.

3. The fact that a street railroad company, with which a board of chosen freeholders has made a contract, under said act, to construct a street railroad upon a public highway under its control, has no franchise, apart from such contract, to construct or operate a street railroad upon such highway, does not give a taxpayer owning land upon the highway a standing to attack the contract. (State—Randolph et al., prosecutors—vs. Board of Chosen Freeholders of Union County et al., 41 Atl. Rep., 960.)

NEW YORK.—1. Statutes—Subject and Title—Separable Provisions.

Laws 1863, c. 361, entitled "An act to authorize the construction of a railway and tracks in the towns of West Farms and Morrisania," authorizing in the first eight sections the construction of a street railway, and in section 9 the construction of a railway to other towns, is not void in toto, as violative of Const. art. 3, sec. 16, providing that no bill shall embrace more than one subject, which shall be expressed in the title, since section 9 may be disregarded as unconstitutional, without affecting the rest of the act.

2. Same—Amendments.

Laws 1892, c. 340, amending Laws 1863, c. 361, entitled "An act to authorize the construction of a railway and tracks in" certain towns, by providing for the consolidation of companies formed thereunder, does not contain more than one subject, and that subject is sufficiently expressed in the title (Const. art. 3, sec. 16), since the amendment is within the reasonable scope of the subject contained in the title of the original act.

3. Charter—Forfeiture.

The corporate life of a company formed under Laws 1863, c. 361, providing in the first eight sections for the construction of street railways in certain towns and in section 9 for their construction in other towns, is not affected by a failure to comply with such section 9, since no authority was acquired thereunder by reason of its unconstitutionality.

4. Same—Special Privileges—Constitutional Law.

Laws 1892, c. 340, amending Laws 1863, c. 361, by exempting the corporations formed thereunder from the provisions of the general railroad act (Laws 1890, c. 565, secs. 93, 95, 98), relating to the sale of the franchise of street railroads, payment of percentage of gross receipts, and repairs of streets, is not violative of the constitution, as amended January 1, 1875, prohibiting the granting of immunities or privileges, since such provisions were conditions imposed by the Legislature, which it had power to take away.

5. Same—Construction—Consent of Municipal Authorities.

The general railroad law (Laws 1890, c. 565, sec. 91) provides that the consent of municipal authorities having "exclusive" control of any portion of a street on which it is proposed to build a railroad must be obtained before proceeding therewith. The department of public parks in the city of New York was vested with exclusive power to locate and maintain all streets, etc., until Laws 1890, c. 545, invested such power in the commissioner of street improvements in the Twenty-third and Twenty-fourth wards as to all streets therein. Held, that as the department of public parks did not have "exclusive " control of streets within the meaning of the railroad act, the commissioner has none such, and hence his consent for the construction of a railroad in such wards is unnecessary.

6. Same—Extension of Lines.

A company "extending" its lines under Laws 1892, c. 676, is not restricted to a mere prolongation of existing branches, since the term "extended" is given a broader meaning by section 90, which provides that any corporation organized since 1884, for the purpose of building or extending a street railroad or any of its branches on or along any street or avenue in any city, town or village, may do so by compliance with the article in which such section is contained.—(Bohmer vs. Haffen, 54 N. Y. Suppl., 1030.)

LIABILITY FOR NEGLIGENCE

DELAWARE.—Action on the case—Declaration—Certainty—Carriers—Injury to Passengers.

1. A declaration in "case" charged defendant with "so negligently and carelessly omitting and neglecting to use proper care and caution in running one of its cars, wherein the said plaintiff was then and there a passenger for hire, that said car ran from the rail with great force and violence," whereby plaintiff was thrown out and injured. Held, sufficiently certain.

2. A count in "case" is sufficiently definite where it charges defendant with "negligently and carelessly running two cars, upon one of which the said plaintiff was then riding as a passenger for hire, upon a certain track, which was then and there, through the negligence and carelessness of the said defendant, improper and

unsafe," whereby the car was thrown from the track, and plaintiff thereby thrown to the ground and injured.

3. A count in "case," which charges defendant with "so negligently and carelessly running a certain car in which the plaintiff was then and there a passenger for hire, and was then riding, that the said car jumped from the track," thereby causing the plaintiff's injury, is sufficiently certain.

4. A declaration in "case" charged defendant with "so negligently and carelessly operating a certain electric car, which was then and there running for the carriage of persons for hire, that thereby the said plaintiff, who was then and there a passenger on said car, was, through the negligence and carelessness of the said defendant as aforesaid," thrown from the car and injured. Held, insufficient, since the statement of facts admits of almost any proof to sustain it.—(King vs. Wilmington & N. C. Elec. Ry. Co., 41 Atl. Rep., 975.)

MINNESOTA.—Injury to Person on Track—Evidence—Question for Jury.

The plaintiff sued for personal injuries received while on defendant's track in a public street, and, against defendant's objection introduced in evidence a special rule of the defendant street-railway company intended for the guidance of its motorman, which provided that "he must keep a sharp lookout to avoid running into pedestrians and vehicles, especially at cross streets. While the car is in motion, the responsibility for safe running rests with him. * * * He will be held responsible for any damage arising from negligence." Plaintiff did not know of the existence of this rule, nor was there any evidence showing how long it had existed. Held, error; that the rule imposed a higher degree of care on the motoneer than the law required, that the jury might have understood that this rule imposed upon him and the defendant an extraordinary degree of care as to travelers on defendant's track, whereas the law imposes only a reasonable degree of care and vigilance in such cases. Held, also, that there was sufficient evidence to justify the trial court in permitting the question of the defendant's negligence and the plaintiff's contributory negligence to go to the jury.—(Isaacson vs. Duluth St. Ry. Co., 77 N. W. Rep., 433.)

NEW JERSEY.—Expert Evidence—Question for Jury.

1. The opinion of an expert witness as to the cause of an accident is incompetent when it is based upon the existence of certain facts and conditions at the time of the accident, of which he has no personal knowledge, and has not heard all the evidence in the case, unless the opinion is elicited by a question entirely hypothetical in form.

2. The opinion of a witness, that the kind of block signals used on a trolley road are not such as to insure reasonable safety to the employees operating the cars of that road, is incompetent and irrelevant; that conclusion being a question for the jury alone to determine from all the evidence in the case.—(Bergen County Traction Co. vs. Bliss, 41 Atl. Rep., 837.)

NEW YORK.—Personal Injuries—Excessive Damages.

A verdict of $3,750 is not excessive for injuries to a healthy woman, fifty-five years of age, which bruised and sprained her, and confined her to her house for two or three months on her physician's advice, and caused permanent prolapsus uteri and congestion, necessitating the wearing of a pessary.—(Rippe vs. Metropol. St. Ry. Co., 54 N. Y. Suppl., 958.)

NEW YORK.—Injury to Person on Track—Contributory Negligence.

Where plaintiff, on a dark night, was driving along the track of a street railway on which its cars would approach from his rear, and there was no room for him to drive outside of its double tracks, and he was familiar with both the street and the street railway's method of operating its cars thereon, in an action for personal injuries he is bound to show affirmatively that he was exercising that reasonable care which the obvious dangers of his situation demanded, as there is no inference that he was free from contributory negligence, in the absence of evidence that he ever looked back or listened for the approach of the cars.—(Johnson vs. Brooklyn Heights R. Co., 54 N. Y. Suppl., 547.)

In an action for personal injuries, caused by negligence, the trial court has discretionary power to reduce a verdict as being excessive.

2. Same—Appeal.

In an action for personal injuries, the evidence showed that plaintiff was a boy eighteen months old, and that his leg was amputated above the knee. The verdict was $15,941.25. The trial judge, in his opinion, stated that the amputation was below the knee, and that, if he could exercise any discretion, he would reduce the verdict, but erroneously decided that he had no such discretion. Held, that the verdict was not clearly excessive.—(Kalfur vs. Broadway Ferry & M. Ave. R. Co., 54 N. Y. Suppl., 503.)

NEW YORK.—1. Review—Conflicting Evidence—Finding of Jury.

The verdict of a jury on conflicting evidence will not be disturbed.

2. Warning from Approaching Car.

Workmen repairing a street about a street-car track are entitled to more warning of an approaching car than the noise it makes in running.

3. Same—Collision with Street Car—Contributory Negligence—Question for Jury.

Plaintiff was rightfully at work on defendant's street-car track, repairing the street, when he was struck by a car whose bell gave him no warning of its approach, but which he could have seen, if he had looked, at a distance of 1,500 feet. Before stooping down to pour tar on the paving, he looked and saw no car in sight. As the tar had to be poured while very hot, it could not be long delayed, and to do so he had to bend over. He swore he did not know the car was near him until he was struck. Held, that the negligence of plaintiff, in omitting to look after he began to empty his bucket, was for the jury.

4. Instructions—Harmless Error.

A refusal to give a specific charge, where the court had already charged correctly the proposition involved, was harmless error.—(Lewis vs. Binghamton R. Co., 54 N. Y. Suppl., 452.)

NEW YORK.—Negligence of Motorman—Child on Track—Burden of Proof.

In an action against an electric street railway for killing a six-year-old boy, the negligence alleged was the omission of the motorman to stop the car before striking the child. The car was running at a speed not to exceed the prohibited rate of more than 12 miles an hour. Plaintiff's evidence showed that, when the car was 71 feet from where the boy was struck, the boy had passed onto the outside rail, and was running directly across the track, but was struck when he had nearly reached the inside rail. The rails were not quite five feet apart, and, if plaintiff's evidence was true, the car traveled more than 17 times as fast as the boy, which would make its speed at least 34 miles to the hour (assuming the boy was running at the rate of 2 miles an hour), which was incredible, in view of the finding that it was not going faster than 12 miles per hour. The motorman testified that when he first saw the boy he was running diagonally by the car, and, "quick as a shot," ran and fell over the rail, and that he immediately lowered the fender and applied the brakes, but to no avail. There was no evidence that the motorman saw the boy, or heard any warning concerning him, except his own testimony. Held, that a verdict for plaintiff should be reversed, since it was as reasonable to infer the motorman was not negligent, as the contrary, and the burden of proof was on plaintiff.—(White vs. Albany Ry., 54 N. Y. Suppl., 445.)

Decision on Cast Welded Rail Joint Patent

In the case of the Falk Manufacturing Company vs. the Missouri Railroad Company and the American Improved Rail Joint Company, which has been pending since July, 1897, an opinion was filed on Jan. 10 by Judges Adams and Sanborn, of the United States Circuit Court at St. Louis. In this opinion the Court finds that while the Falk company's patent sued upon (No. 545,040) has five claims, yet each of them might be said to be practically based upon the following steps, viz.:

1. Cleaning the abutting rails for a short distance from the ends.
2. Heating such cleaned rail ends.
3. Adjusting a mold around such rail ends, and
4. Pouring molten metal into the molds.

After commenting upon the result obtained, in the way of securing what are known as "continuous rails," the Court says:

"In our opinion, without entering into any detailed analysis of the evidence bearing on the state of the art, consisting generally of publications, technical works, mechanical operations, individual experiences, common knowledge and divers patents—all of which have been carefully considered—the efforts of the patentee, as disclosed by this patent, belong to the domain of mechanical skill and not to the domain of invention."

The Court further holds that the Norris patent of 1851 and the Stephenson patent of 1831 are anticipatory of the Falk patent. The Falk company contends, however, that these patents describe inventions which were never tried in practice, and, therefore, do not hold.

It is understood that the Falk company will appeal this decision at once, carrying the matter to the highest courts if necessary, but it holds that even should the patent be finally defeated, it does not follow that its control of the cast welded joint business would be thereby weakened, since it holds numerous other process or detail patents, without infringing upon which it is claimed that no successful cast welded joint can be made.

Recent Annual Reports

BOSTON ELEVATED RAILWAY COMPANY

In the first annual report of the Boston Elevated Railway Company, the directors review the history of the company from its organization in 1894 to its lease of the West End system and its leased lines, which took effect Sept. 30, 1897. The summary of the business for the complete year, ending Sept. 30, 1898, is as follows:

Gross earnings from operation		$9,179,096.35
Operating expenses		6,566,584.16
Net earnings from operation of leased lines		$2,612,512.19
Subway rental	$106,134.35	
Interest on West End funded debt	498,600.00	
Dividend on West End preferred stock, 8 per cent	512,000.00	
Dividend on West End common stock, 7 per cent	635,950.00	
Dividend on Somerville H. R. Company's stock, 6 per cent	9,180.00	
Taxes on West End property	435,860 44	
Total payments under lease of West End St. Ry. Co.		$2,197,724.79
		$414,787.40
Add interest on special deposits		78,156.59
		$492,943.99
Taxes, Boston Elevated Railway Co.	$86,049.74	
Compensation tax under agreement with Commonwealth, act of 1897	80,317.09	
		166,366.83
Balance		$326,577.16
Interest paid to holders of Boston Elevated Railway Company, receipts, Aug. 15, 1898, 2¼ per cent on amount actually paid in		112,500.00
Surplus for the year		$214,077.16

The report shows that work on the plans of the new elevated line has been vigorously prosecuted, and within a short time a large proportion of the structure will be put under contract. Foundations will be begun in the opening of the spring of 1899. The plans for the terminal stations at Roxbury and Charlestown have been completed, and a large part of the required land has been taken by eminent domain or purchased. George A. Kimball is the company's chief engineer of elevated lines, and since the report was issued John Lundie has been appointed consulting engineer, particularly with a view to decisions of car service and operation.

The company's general balance sheet shows as its large items a capital stock of $5,000,000, and a lease account, West End Street Railway Company, of $1,362,023 in liabilities, and in assets, cash on hand and in bank, $5,532,445, and West End Street Railway Company and Somerville Horse Railroad Company bond, property and open accounts amounting to $1,932,048. The company carried 209,561,175 passengers during the year, of which 28,239,880 were free transfer passengers. The car mileage was 32,379,445, and the receipts per total passenger were 4.279 cents.

THE COLUMBUS STREET RAILWAY COMPANY

The annual report of the Columbus Street Railway Company for the year ending Dec. 31, 1898, shows the following interesting figures:

EARNINGS AND OPERATING EXPENSES IN DETAIL

	1897.	1898.
Gross earnings	$605,921	$680,173
Operating expenses	286,874	327,692
Earnings from operation	$319,047	$352,481
Miscellaneous earnings	5,397	8,860
Total receipts—all sources	$324,444	$361,340
Fixed charges	200,151	205,964
	$124,293	$155,376

EARNINGS AND EXPENSES PER CAR MILE

	1897.	1898.
Earnings	$.168	$.183
Expenses—		
Maintenance of way	.006	.01
Maintenance of equipment	.007	.008
Conducting transportation	.046	.046
Power	.007	.007
General expenses	.013	.016
Total expenses	$.079	$.087
Net earings	.089	.096

The balance sheet shows in liabilities, capital stock, $3,000,000; bonded debt, $3,000,000; Crosstown bonds, guaranteed, $572,000; reconstruction reserve, $28,531; current liabilities, $192,301. In assets are plant, property and franchises, construction and equipment, $6,346,755; Crosstown lease and ownership, $572,000; park construction and equipment, $33,115; current assets, $38,393; prepaid accounts and sinking fund, $43,594. The balance sheet surplus is $231,025.

CHICAGO CITY RAILWAY COMPANY

The annual report for the year ending December 31, 1898, including the following figures of operation, is as follows:

	1897.	1898.
Gross earnings	$4,816,516	$4,832,806
Operating expenses and taxes	2,908,982	2,926,490
Net earnings	$1,907,534	$1,906,316
Interest	207,877	207,877
Dividends	1,440,000	1,440,000
Balance for the year	$259,657	$258,439
Depreciation, etc	50,000	90,000
Per cent operating expenses	60.84	60.97
Passengers carried, cable	41,444,646	38,482,628
Passengers carried, horse	691,051	477,313
Passengers carried, electric	53,485,425	57,032,173
Miles run, cable	12,562,610	11,678,020
Miles run, horse	198,860	143,900
Miles run, electric	11,616,530	12,563,380

At the annual meeting, Joseph Leiter, formerly second vice-president, was made first vice-president, and D. G. Hamilton was made second vice-president; other officers and directors remained unchanged. An increase of $2,000,000 in capital stock was authorized.

NORTH CHICAGO STREET RAILROAD COMPANY

The annual report for the year ending December 31, 1898, includes the following figures:

	1897.	1898.
Passengers carried	56,354,147	58,422,077
Miles run	10,644,270	10,916,737
Receipts from—		
Cable lines	$1,421,848	$1,448,652
Electric lines	1,375,638	1,456,908
Horse lines	20,911	15,865
Total	$2,818,398	$2,921,425
Other income	93,153	93,898
Total income	$2,911,551	$3,015,323
Operating expenses	1,319,926	1,390,681
Net earnings	$1,591,625	$1,624,642
Interest, rentals, taxes, etc	636,462	543,666
Dividend paid, 12 per cent	791,943	870,957
Balance, surplus	$163,220	$210,019

WEST CHICAGO STREET RAILROAD COMPANY

The annual report for the year ending Dec. 31, 1898, includes the following figures:

	1897.	1898.
Passengers carried	78,594,932	80,600,505
Receipts from—		
Cable lines	$1,451,984	$1,427,622
Electric lines	2,382,768	2,539,204
Horse lines	13,859	11,634
Advertising, etc	51,307	53,443
Gross earnings	$3,899,918	$4,031,903
Operating expenses	1,929,664	2,017,946
Net earnings	$1,970,254	$2,013,957
Fixed charges—		
Rental of leased roads	$736,465	.....
Coupon interest	.....	$1,198,000
Other interest and taxes	399,720	.....
Dividends paid	791,340	791,340
Surplus for year	$42,729	$24,617

NORTHWESTERN ELEVATED RAILROAD COMPANY

At the annual meeting of the Columbia Construction Company, which has a general contract for building the Northwestern Elevated Railroad, President George A. Yuille announced that in December an arrangement was completed with Blair & Company, of New York, whereby the Northwestern Elevated Railroad Company had secured a loan of $4,500,000 to pay off the outstanding obligations incurred for labor, material and right of way, and to complete the road and put it in operation. In order to secure this loan, the capital stock of the Northwestern Company had been reduced from $15,000,000 to $10,000,000, of which $5,000,000 was in common stock and $5,000,000 in preferred, and the authorized bond issue was reduced from $15,000,000 to $5,000,000. It was agreed that the parties making the loan would receive as a bonus $1,000,000 of the preferred stock and $1,000,000 of the common stock, leaving for the Columbia Construction Company on the final completion of the road and payment of the loan $4,000,000 of preferred and $4,000,000 of common stock.

LAKE STREET ELEVATED RAILROAD COMPANY

The annual report for the year ending Dec. 31, 1898, includes the following figures:

	1897.	1898.
Passengers carried	11,229,590	12,391,020
Gross earnings	$579,961	$633,403
Operating expenses	329,124	324,947
Net revenue	$250,837	$308,456
Taxes	18,612	13,849
Interest on bonds	227,605	221,677
Miscellaneous interest	29,874	37,667
Loop rental	15,707	61,954
Total	$291,798	$335,147
Extraordinary expenses	31,880	.....
Deficit for year	72,841	26,691

NEW ORLEANS TRACTION COMPANY

The annual report for the year ending Nov. 30, 1898, is as follows:

	1897.	1898.
Gross earnings	$1,239,256	$1,311,365
Operating expenses	847,833	801,971
Net earnings	$391,423	$509,394
Other income		39,150
Total		$548,544
Fixed charges		380,013
Balance		$168,531
Dividends, 5 per cent on preferred stock		125,000
Surplus		$43,531

SOUTH SIDE ELEVATED RAILROAD COMPANY

In view of the equipment of the South Side Elevated Railroad Company, of Chicago, by a novel and hitherto untried electric system, the Sprague multiple unit system, the following abstract of President Carter's report to the stockholders, on January 26, will be of peculiar interest:

The company's road was operated by steam power from Jan. 1 to Apr. 20. In that time the operating expenses ranged from 80.8 to 84.7 per cent of the gross receipts. From Apr. 20 to July 27, the operation was partly by steam and partly by electricity, the change being gradual and necessarily involving the additional expense of maintaining two systems. In these months the operating expenses ranged from 70.2 to 75.7 per cent of the gross receipts. Since July 27, 1898, the operation has been entirely by electrical power, and the percentage of expenses to earnings steadily decreased from 63.7 per cent to 55 per cent in December.

All of the above figures include a loop rental of one-half cent per passenger. Not including the loop rental, but including all other operating expenses, taxes, car licenses, etc., the road was operated in October for 47 per cent, in November for 47.7 per cent, and in December for 45.4 per cent. Expenses have not only been on an increasing ratio, but gross earnings have been steadily increasing.

If the entire year be divided into two periods of six months each, the contrast between steam and electric operation becomes more striking. The number of passengers carried during each period is approximately the same. The net earnings applicable to interest and dividends were for the first half of the year (steam and mixed operation) $98,973, and for the second half with electrical operation (mixed in July) were $196,933, or almost double the earnings of the first six months.

The net earnings applicable to dividends on stock during the last six months were at the rate of 3½ per cent per annum, as against but 1 per cent per annum for 1897.

At the time the change in power was undertaken, the road needed about ninety cars to transact its business, and 120 seemed an ample equipment on the new basis, but with growing patronage it has become necessary to increase the total equipment to 180 cars, of which 120 will be motor cars and sixty trail cars.

The operating expenses of the power plant, based on maximum power required of 8,000 h.p. for about four hours each day in the winter months, is about $8 per h.p. per annum, and adding to the above general expenses 10 per cent depreciation, interest, insurance and taxes, the total cost per maximum h.p. per annum does not exceed $15.

Mr. Carter speaks of the Sprague multiple unit system as follows:

"At the time of the last annual meeting we reported that the test of the train equipped by Mr. Sprague, made on the Metropolitan Elevated road, was satisfactory. We began using electric cars in April, had sixty-seven in operation in May, and gradually increased the number until July, when they finally superseded the steam trains. We had minor difficulties to contend with which were met and solved. None of them resulted in injury to any passenger, and none of them involving the control of the train, which has always been complete. I am assured that the difficulties and annoyances were not so great as they were in installing the excellent steam locomotives which they displaced. We believe that the Sprague multiple-unit system has fulfilled expectations. Exhaustive tests have proved the economy of rapid acceleration and long coasting. A schedule speed of 15 miles per hour is easily maintained, and time lost is easily made up. If needed, in order to meet competition, your company has the ability to increase the speed to 20 miles an hour.

"The reliability of the equipment has been fully tested this winter, when 150 cars, all we had, were in daily operation (Sundays excepted) for many weeks.

"We have not been in electrical operation long enough to definitely determine the cost of maintenance, but we have sufficient data to confidently state that it will be low, as low as any other line doing equivalent service, and lower than many surface lines with 18-ft. single truck cars. The advantage of this flexible system on crowded days, for switching and changing the length of trains, is apparent."

The use of storage batteries is also referred to at some length in President Carter's report, and the statement is made that their use is a success, certainly in the matter of keeping up voltage and enabling the road to operate more cars, to furnish increased facilities to patrons and to prevent damage to power house machines under a sudden demand for increased power, while it is claimed, though not as yet fully demonstrated, that the cost of power production is also cheapened.

Another Consolidation in Baltimore

An agreement has been signed whereby a syndicate, headed by Alexander Brown & Sons, secures the right to purchase the entire capital stock of the Baltimore Consolidated Railway by March 30, payment to be made by April 30, and the price to be $37.50 per $25 share. Stockholders may elect to take cash or the securities of the proposed new company. This syndicate is the same one that purchased the capital stock of the Baltimore City Passenger Railway last month, and the agreement probably means the consolidation of practically the entire street railway system of Baltimore.

Uniforms for Employees

Hackett, Carhart & Company, of New York, one of the oldest and most reliable clothiers in the country, are now making a specialty of supplying uniforms of all kinds for employees and officials, and are paying particular attention to the requirements of employees on street railways and steam roads. This company has not been content with following the old methods of turning out this class of work, but has introduced a new and improved system whereby it is enabled to furnish high grade uniforms at reasonable prices. It cordially requests superintendents and purchasing agents to send for samples and estimates.

Chicago Street Railway Franchises

The following official statement has recently been issued by Charles T. Yerkes, relating to the Chicago street railway properties:

There is considerable misunderstanding regarding the legislative position of Chicago's street railway franchises. The impression which prevails in Wall Street is that it is necessary to secure an extension of franchises, before 1903, or the various roads will pass to the control of the city. It is also claimed that a repeal of the Allen law becomes necessary and a new measure adopted by the General Assembly of the State of Illinois before there can be any renewal of franchises, inasmuch as the City Council of Chicago has practically failed to extend the street railway franchises for fifty years under the present Allen law.

These premises are wrong. The street railways of Chicago are nearly all operated under 99-year franchises; at least all of the important lines, which include the Chicago City Railway Company, operating on the South Side, and the so-called Yerkes properties, operating on the West and North Sides. This disposes of the socialistic talk so recently rampant in Chicago respecting probable municipal ownership.

The franchise position of the street railways is briefly as follows:

Under authority granted by the State, the Chicago City Railway Company was granted a 99-year franchise from Feb. 14, 1859. The Yerkes properties on the North and West Sides hold franchises for 99 years; that on the North Side dating from 1886 and that on the West Side dating from 1863. Under the terms of these 99-year franchises it was provided that the City Council of Chicago should grant ordinances in periods of 20 years, permitting the use of and designating streets under specific terms. The first 20 years was passed without feature, and not until 1883 was there any trouble regarding the extension of time for the use of the streets. At that time the elder Carter H. Harrison, then Mayor of Chicago, saw fit to make political capital out of the street railway and demanded that a compensation be exacted for a renewal of the ordinances granting the use of certain streets already occupied and others which there was a desire to occupy.

In 1883 there was need for improvement in the street railway systems of Chicago, and it was not deemed wise to antagonize investors by precipitating a legal fight over the question of authority to declare occupied streets vacant. It was also important that new streets be acquired. In consequence the street railway companies agreed voluntarily to pay the city $50 per car per year for an extension of ordinances for another 20 years. It is notable that the Mayor, the elder Harrison, publicly stated that he had invariably been advised by eminent counsel that the city had no authority to displace the street railway companies who were in possession of streets and that the 99-year franchises could not be abrogated.

So far as the legal position is concerned there is no change at present. The same reasons exist to-day, however, for a peaceable solution of the franchise quesion that did in 1883. It is not desired to disturb the confidence of investors by what might be an almost endless litigation over the authority of the city to abrogate the use of streets in which cars are now operated. It was with this end in view that the Humphrey's bill was proposed and a compromise reached, which resulted in the Allen bill. If 50-year ordinances could have been obtained from the city under this bill there would have been no danger of a long legal fight.

Since it has been found that there is little hope of securing any results from the existing state of things in the Chicago City Council, recourse is to be had to the State Assembly, which convenes in Springfield, Jan. 4. There is a rabid demand for the repeal of the Allen law, but this is not likely to occur, but, instead, some sort of amendments made whereby a compromise is had. A number of bills have already been prepared, but it is yet much too early to say what the precise nature of the compromise will be.

Change in the General Electric Company

John McGhie has resigned his position as manager of the advertising department of the General Electric Company, in order to undertake important and responsible work with the "American Machinist." His headquarters will hereafter be at Cleveland, Ohio, to which city he will move his family from Montclair, N. J. Mr. McGhie's management of the General Electric Company's advertising business has been able and painstaking to an unusual degree, and the record which he leaves behind him is one with which both his principals and himself have every reason to be satisfied.

W. J. Fransioli, formerly general manager of the Manhattan Railroad Company, of New York, has associated himself with the American Air Power Company.

NEWS OF THE MONTH

The Boston & Albany Railroad is trying an interesting experiment which should also be of interest to street railway managers. This consists of sprinkling its roadbed with non-flamable and practically odorless oil for the purpose of freeing the tracks from dust. In addition to removing the dust the oil sprinkling keeps the rain from washing away the roadbed, destroys vegetation, prevents frost from penetrating and injuring the roadbed, lessens the noise of trains, and by preventing dust greatly reduces the danger of hotboxes. It costs $150 a mile to sprinkle the roadbed, and one sprinkling a year is sufficient.

The Boston Elevated Railway Company has 456 miles of overhead electric feeder lines, 63 miles of underground electric feeder lines, 133 miles of underground conduit duct, 68 miles of underground electric return lines and 2.8 miles of submarine cables. It owns 3370 electric motors, 1274 electric box cars, of which 884 are twenty-five foot bodies, and 1292 electric open cars, of which 724 are nine and ten bench, 11 mail cars, 3370 electric motors and 236 cars and electric snow plows.

The recent stoppage of traffic on the underground electric conduit road on Sixth Avenue, New York, for several hours, was due not to flooding of the conduit, as has been erroneously stated in the press, but to the overloading and consequent burning in two of a main feed wire furnishing current to one of the sections of the line. This line is now being operated in a somewhat temporary way pending the completion of the new 70,000 h.p. station, and the final feed wire system to be installed in connection therewith.

A 15-ft. flywheel in the Birmingham Traction Company's plant at Pittsburgh, Pa., burst about 10 o'clock on the night of Dec. 11, and did considerable damage. A 300-h.p. engine was wrecked and a portion of the building suffered considerable damage. No one was hurt.

The Rochester (N. Y.) Railway Company suffered serious loss on Jan. 1 from fire, which destroyed its State Street barns, and twenty-one cars that could not be saved in time. The cause of the fire is unknown.

The following bills have been introduced in the Senate at Albany, N. Y.: One requiring all street cars to be equipped with "automatic, trip and drop front fenders" (violators are punishable by a fine of $100 for each day a car is run without such fenders; also one providing that whenever any street car is delayed for five or more minutes, passengers shall receive transfer tickets good at any time for a continuous ride on any line of the company. Violation renders companies liable for damages in $250, to be recovered in civil action by passengers to whom transfer is refused.

The street railway company at Marinette, Wis., has decided to place heavy curtains on both ends of its car to protect the motormen.

All the surface and elevated railroad companies in Greater New York were compelled by the city authorities during the recent grippe scare to thoroughly fumigate all their cars, including all mats, matting, rugs, etc., used therein.

President Gaston, of the Boston Elevated Railroad, states that for the year Oct. 1, 1898, to Oct. 1, 1899, the number of transfers issued by the Boston Elevated Railroad shows a larger increase than for any year in the history of transportation in Boston. In the past eight years the number of passengers carried have increased 52 per cent, while free transfers have increased 251 per cent. During the last fiscal year the number of passengers increased 5 per cent, while transfers increased over 19 per cent.

A suit was recently brought against the Rochester Railway Company for five cents, this being the amount the plaintiff claimed was due him as change for ten cents which he handed a conductor on the defendant's road. The conductor swore that the plaintiff gave him five cents instead of ten, and as he was able to bring witnesses to prove this, the suit was decided against the plaintiff, who had to pay the costs.

The Bloomington (Ill.) City Railway Company, on Dec. 17, turned the receipts of its Normal line over to the Normal Library Association, and the cars were in charge of the young ladies of that association as conductors. Nearly $200 was added to the funds of the library as a result of the day's operation. A chaperon rode on each car to assist the young ladies.

It is stated that thirty employees of the Newport News & Old Point Railway & Electric Company, formerly the Newport News, Hampton & Old Point Railway Company, divided $16,000 between them recently, the gift of J. S. Darling, president of the old company, and his son. Individual amounts were based on time of service. One man received a check for $1,000, and several conductors received $750 each.

The Columbus (Ohio) Street Railway Company is considering the advisability of placing the weather forecasts printed on neat cards in all its cars. The local weather station will probably furnish the printed cards daily, and it is believed this departure will add to the popularity of the street railway lines.

Definite plans are said to be under active consideration at present for a reorganization of the Kings County Elevated Railroad Company, with a view to its consolidation with the Brooklyn Elevated Railroad Company. The Kings County reorganization committee has recently held several meetings, and a plan will, it is said, before long be issued to stock and bond holders of the road. It is stated new securities will soon be issued for equipping the road with electricity, etc.

The Rochester (N. Y.) Railway Company has adopted a novel carrier for cigars, and will place a number of them in its cars. The device is made of nickeled tin, and has places for four cigars, the idea being that when a man boards a car with a lighted cigar which he desires to save he can place it in the carrier until he leaves the car.

The combination open and closed cars which have been in operation on the lines of the Nassau Electric Railway of Brooklyn, and which were described in the STREET RAILWAY JOURNAL for November, 1898, have not been very popular with the public. To overcome some of the objections raised, the company has made a number of changes in five of the cars, and if it is found advisable the changes will be made in all of the combination cars on the road. The principal improvement consists of four levers placed on the rear platform, by which the conductor can open any one of the side doors without leaving his place. Both bell ropes have been placed on the outside of the car, so that conductors will not have to open a door to ring up a fare or give the motorman the signal to go ahead or stop. The loud noise caused by the slamming shut of the side doors is also done away with on the improved cars by the insertion of a rubber strip in the door jamb, while a rubber knob prevents a similar noise when the doors are opened. In addition to these improvements a rubber matting about half an inch thick has been placed along the side step of the car to keep the passengers and conductors from slipping in stormy weather, and the upright iron bars used as hand rails have been incased in rubber. A gutter has been added to the side of the car also to keep the rain and water from dripping down upon the conductor as he passes along the step. The gutter runs toward the rear of the car and empties the water over the rear platform.

The lines of the East Liverpool Railway Company, of East Liverpool, Ohio, were tied up for several hours recently on account of a strike of the employees. The trouble was caused by the discharge of a motorman who was a member of the motormen's union, but was finally settled by a compromise, and the men returned to work.

The Syracuse Rapid Transit Railway Company has voluntarily placed in operation a new scale of wages for motormen and conductors. Since 1896 the pay of the men has been 13½ cents per hour for the first twelve months, 15 cents for the next twelve months and 16½ cents after that. From now on the pay for the first three months in service will be 14 cents an hour, for the next three months 14½ cents, for the next six, 15 cents, for the next six, 15½ cents, for the next six, 16 cents, and for the next six and thereafter the men will receive 16½ cents an hour. This new schedule will be particularly advantageous to the new men, as under it the average pay per hour for the first two years will be 15 cents, instead of 14 cents as formerly. Men who have been employed by the company for more than two years will be given the best runs. In addition to the above increase in wages the company has notified all its motormen that they will be furnished fur overcoats at the company's expense. The coats are to be worn only during the hours of duty, and are to be returned to the station foremen at the end of the day's run.

The annual report to the Legislature of the New York Board of Railroad Commissioners was made on Jan. 4, and contained the following general statistics:

Year ending June 30.	1897.	1898.
Capital stock	$126,978,482 50	$132,844,303 33
Funded debt	104,823,698 57	130,179,166 90
Unfunded debt	23,254,380 39	31,806,542 42
Cost of road and equipment	221,665,039 63	233,635,396 51
Gross earnings from operation	29,911,428 02	31,884,384 20
Operating expenses	18,117,799 48	19,153,716 55
Net earnings from operation	11,793,628 54	12,730,667 65
Income from other sources	1,262,358 95	1,457,501 55
Gross income from all sources	13,055,987 49	14,188,169 20
Taxes and miscellaneous	1,408,719 61	1,459,469 96
*Interest paid and accrued	5,392,037 45	6,022,776 79
*Dividends	5,387,164 96	5,799,359 32
Surplus for the year	604,506 70	631,007 34

* Includes respectively interest and dividends paid by lessors from rentals received from lessees as follows:

	1897.	1898.
Interest	$1,549,001 67	$1,666,068 34
Dividends	2,581,054 96	2,729,894 32

The Niagara Falls & Lewiston Railway (the Great Gorge line) operating down the bluff at Niagara Falls, carried 288,791 passengers during the year ending June 30, 1898, and ran 163,013 passenger car miles. Its average operating earnings per passenger were 25.4 cents, and its operating expenses 7.31 cents. Its total receipts, however, amounted to 29.64 cents per passenger, of which all but .15 cents was consumed in paying operating expenses and fixed charges. The cost of operation per car mile was 17.25 cents, and the total receipts per car mile were 52.44 cents. The total operating expenses and fixed charges on this line were 51.98 cents per car mile.

An incident showing the fallacy of some of the arguments put forth by the advocates of municipal ownership of street railways occurred in St. Joseph recently, when the St. Joseph & Benton Harbor Railway & Light Company secured the contract to light and heat the court house and jail at St. Joseph for three years for $3,900. The county formerly did this work itself, and paid over $6,000 for the years 1896, 1897 and 1898. The building committee refused to give W. Worth Bean, president of the above company, the contract for the lighting in 1899, but by persistent effort he finally secured it by showing actual results. The citizens are pleased at this saving to the county.

The work of reorganizing the Metropolitan West Side Elevated Railroad Company, of Chicago, Ill., is about completed, and the company will soon be placed on a sound financial basis.

The Chicago Electric Traction Company, of Chicago, Ill., has filed a mortgage for $500,000 to the Manhattan Trust Company of New York, and John Kean for first mortgage 5 per cent thirty-year gold bonds.

The Toledo Traction Company of Toledo, Ohio, principally through the efforts of Thomas H. McLean, general manager, has been able to entirely break up the labor union of its employees, and the leaders of the local union, which is known as Division No. 49 of the Amalgamated Association of Street Railway Employees of America, have surrendered its charter to the head association.

The Union Traction Company, of Rutherford, N. J., was sold at receiver's sale on Jan. 27, to the reorganization committee representing 90 per cent of the bondholders. The purchase price was $20,000 over the indebtedness, which, as shown by the receiver's report, was $852,000.

A serious head-on collision occurred on the line of the Worcester & Suburban Street Railway on Dec. 22, near Leicester, Mass. A very heavy fog hung over the tracks at the time, and an inbound car ran into an out-bound car that should have waited at the turnout. Neither of the motormen could see the other car until it was too late to avert the accident. Two persons were killed and several injured.

It is stated that inquiries from China for railroad material and electrical equipment of American make are very numerous, and there are prospects of extensive deals in these branches in the spring.

Vice-President Webb, of the Baltimore & Northern City Railway Company, which company has recently purchased the capital stock of the Baltimore City Passenger Railway Company, and the Baltimore, Middle River & Sparrow's Point Electric Railway Company, has made the following statement: "The property is in the hands of people who are financially able to carry out any contracts they may undertake, and it may also be assumed that they are not only able but determined to vigorously protect their interests from attacks by any competitor. While the syndicate has not yet fully developed its plans, the field has been sufficiently canvassed to warrant the statement that certain territory will be entered that will add largely to the revenue of the combined lines. As the purchase was made for investment purposes, it will, of course, be the general policy to fully develop the earning capacities of the three roads, and one of the most effective ways of doing this is to give every possible convenience to the public. The City Passenger system, as is well known, lacked suburban lines, and the consolidation with the Baltimore & Northern and the Middle River road will not only give to the new system a suburban mileage of fifty-three miles, but puts the new company in a position to acquire additional territory at any future time."

It was announced last month that the Fifth Avenue Stage Line, New York, had been purchased by the Third Avenue Railroad Company, and that automobile electric carriages would be substituted for the horse stages.

While sawing down a dead tree in Brooklyn, recently, a laborer was stricken insensible by an electric shock. The tree had been used for supporting a span wire of the trolley road, and in some way the insulation had become worn.

The Third Avenue Railroad Employees' Mutual Relief Association of New York gave its annual entertainment and reception at the Lexington Opera House, on Jan. 27. A very excellent vaudeville entertainment was given, after which dancing was indulged in. This relief association is one of the most prosperous in the country, its success being largely due to the interest taken in it by the officials of the Third Avenue Railroad Company.

The Northwestern Electrical Association held its annual convention in Milwaukee, Wis., Jan. 18, 19 and 20. The meetings were well attended and the papers and discussions were pronounced most interesting and valuable by all present.

The National Electrical Light Association will hold its twenty-second meeting in New York, May 23, 24 and 25, 1899. The headquarters of the association will be at the Murray Hill Hotel, where accommodations can be had on the American plan at $3.50 and upward per day, and on the European plan at $1.50 and up. The Electrical Exhibition Company will hold its annual electrical show at Madison Square Garden, under the auspices of this association during May.

The Manufacture of Special Work

The New York Switch & Crossing Company has made a number of additions to its works at Hoboken, N. J., during the past year, and is now better able than ever to supply all classes of special work. Among the new tools installed by the company is a large 16 ft. planer with a range of 36 ins. × 18 ins., used for planing switches, a new cold saw for cutting the deepest girder rails, several radical drills and smaller planers, a punch for punching a 1½-in. hole through 1-in. iron, an electric jib crane, etc.

The company reports doing an excellent business during the past year, and among other street railway companies supplied by it with special work were the Union Railway Company, of New York; Brooklyn Heights Railroad Company, and Coney Island & Brooklyn Railroad Company, of Brooklyn, the Consolidated Traction Company, and the North Hudson County Railway, of Jersey City and Hoboken, and the Hartford Street Railway, of Hartford, Conn.

The New York Switch & Crossing Company has also turned out a large amount of steam railroad and construction railroad parts, notably for the J. P. McDonald Company and for the United States Government railroads in the Brooklyn Navy Yard and Indian Head Proving Grounds. The company has also supplied a large amount of special work for export mostly of the T rail type.

New Interests in Compressed Air as a Motive Power

Late in December and early in January, there were organized several companies with large capital, intending to use compressed air for various purposes, and in view of the financial standing and importance of the interests involved in this movement to place upon the market a new motive power, it is advisable to explain the status of the parent and affiliated companies.

The American Air Power Company, of New York, was organized in January, 1898, as a consolidation of the American Air Power Company, of New Jersey, the General Compressed Air Company, of New Jersey, and the Compressed Air Power Company, of New York. The first two companies had been engaged in developing the Hardie motor, and the third the Hoadley-Knight motor. The capital stock of the consolidation company was $7,000,000, and A. A. McLeod, formerly president of the Reading Railroad system, became the company's president.

In January, 1899, the International Air Power Company, of New Jersey, was formed with a capital of $7,000,000. Later on it was announced that this company had secured from the American Air Power Company exclusive rights for all its letters patent in foreign countries; rights for all patents in North and South America, except those bearing directly upon street railway traction, were reserved by the American Air Power Company. The principal stockholders of the International Air Power Company are said to include some of the strongest and best known street railway and other capitalists in America.

Following the organization of this second company is that of the New York Auto Truck Company for $10,000,000, and the Chicago Auto Truck Company, while a similar company for Philadelphia is to be organized. The International Air Power Company will retain large holdings of stock in these three companies and in others which will be formed in different cities, and will manufacture and sell to them complete compressed air trucks intended to do a general city trucking business, replacing and gradually driving from the field the present horse trucks.

The directors of the New York Auto Truck Company are J. H. Hoadley, Richard Croker, ex-Senator Arthur P. Gorman, Robert McKinstry, Nathan Strauss and Lewis Nixon, owner of the Crescent Shipyards, of Elizabethport, and designer of the United States battle ships Massachusetts, Indiana and Oregon. The directors of the Chicago Auto Truck Company will include Joseph Leiter and associates.

The International Air Power Company has purchased for manufacturing purposes the works of the American Wheelock Engine Company, in Worcester, and the Rhode Island Locomotive Works, in Providence. The new auto trucks will be built at the company's Providence works, and air compressors for the auto truck business in Worcester.

The American Air Power Company is now equipping with compressed air motors and apparatus tweny cars for the Metropolitan Street Railway Company's Twenty-eighth and Twenty-ninth Streets crosstown line, and the Ingersoll Sargent Company has practically completed a four-stage compressor to furnish the necessary motive power. The compressed air power station for the Twenty-eighth and Twenty-ninth Streets line is located at the foot of West Twenty-fourth Street, and work is going on rapidly upon the engine foundations, boilers, etc., while in a small temporary shop near by, the motors are constructed.

A full description of the Hoadley-Knight motors of the American Air Power Company and of the engineering features of the four stage compression was given in the STREET RAILWAY JOURNAL for August, 1897, page 487.

Latest Progress in the Application of Storage Batteries to Electric Railways*

BY JOSEPH APPLETON

The history of the storage battery in this country is curious, and probably comprises more troubles and trials than any other branch of the electrical industry. I think it will be generally acknowledged that a storage battery "per se" should be one of the most useful adjuncts in every branch of electrical engineering, but the failures that were recorded in the earlier days proved that the storage battery was not then the commercial success those interested would have us believe. Until 1894, the use of storage batteries in this country proved most disastrous to all concerned. The reasons were many, but may be summed up briefly as follows:

1. The batteries were poorly designed.

2. No attention was paid to the mechanical features, the chief idea being to get the greatest capacity for the lightest weight.

3. The batteries were much over-rated, their full capacity being given as their normal working capacity.

In addition to this the storage battery business generally was in an unsatisfactory and weakly condition. Litigation was the principal cause. The fear of protracted and costly lawsuits prevented capital being invested in the business, and frightened prospective users from purchasing storage batteries.

Now, the conditions are very different. You are all familiar with the changes which have been made during the last five years in the commercial end of the business. All the disturbing elements have been removed, and the business has been put on a proper and substantial basis. These results are best seen from the diagram, Fig. 1. The figures for 1898 have not been tabulated, but they will show that the use of storage batteries is progressing more rapidly than ever:

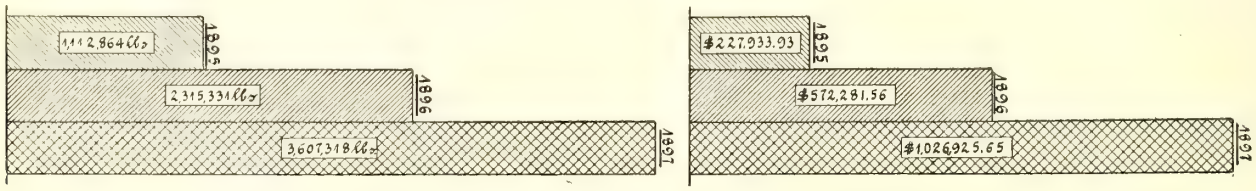


FIG. 1.—DIAGRAM OF SALES OF STORAGE BATTERIES

	Weight of plates alone.—Lbs.
1894	349,000
1895	1,112,800
1896	2,215,300
1897	3,607,300

(Or ten times the business of 1894.)

The storage battery is entirely different from any other piece of apparatus which is used for supplying electrical energy, being constructed and operated on the principle of chemical action, instead of mechanical motion. There must naturally be a vast difference between these two principles.

In the mechanically operated apparatus, or generator, the output of electrical energy is the result of the conversion of the mechanical energy applied to it while in action, and the regularity of the output is dependent on the steadiness of the mechanical energy applied, and the satisfactory running of the generator and motive power. The operation is purely mechanical, and is subject to the interruptions to which all moving machinery is liable. Again, such apparatus, if overloaded to an excessive degree, give visible signs of distress, and, if the overloading is very great, or is continued, will probably give way in some mechanical feature.

In a storage battery hundreds of horse power can be silently stored, and thousands of horse power delivered for a short period, with no apparent action or change in the battery. The action is purely chemical, and as long as the respective elements are there to be acted upon it will surely continue.

It is this fact that makes the storage battery so reliable. Such a thing as instantaneous failure or interruption of the delivery of energy is impossible, except, of course, in the case of mechanical injury to the battery from an external cause. Any mechanically operated apparatus is liable to interruption through breakage or injury to one of its parts, but in a storage battery the chemical action will continue, and consequently the output of energy until all the material on the plates has been converted.

An overload has not the same effect on a storage battery as on a mechanically operated generator. For a short period an overload, even of great extent, does not injure a storage battery. It causes the chemical action to take place more rapidly, or, to be more exact, causes more material to be subjected to the chemical action, and this, if not continued too long, or repeated too often, does not affect a good storage battery. Moreover, if the overload is continued too long, it does not mean the sudden failure and collapse of the battery and complete interruption of the output, but is shown by the premature depreciation of the plates in the battery. It may not be noticed for months or even years.

One of the most valuable features of a storage battery is that it will safely take care of any sudden and momentary overload in the system, such as grounds or short circuits, and if operating in parallel with generators or rotary converters, will relieve them of such overloads and consequent strain. I have frequently seen batteries burn out grounds on an underground system, discharging for a short time at an enormous rate. And in the case of batteries operating on railway loads, it is a common thing to see an occasional momentary discharge at a rate equal to twice the hour rate of the battery. The modern storage battery is designed to stand such occasional extreme discharges, and do so without injury.

It may be well to consider, before going further into our subject, the question of the rates of charge and discharge of storage batteries, and their capacity at different rates. Of course, this will vary somewhat with different types of battery, but not to a great extent. The more rapidly you discharge a battery the smaller is its available capacity. For example, the curve, Fig. 2, illustrates the available capacity of a storage battery when discharging at any rate between the ten-hour and one-hour rates. That is to say, when the battery is completely discharged in ten hours and in one hour. It is only within the last few years that a one-hour discharge rate has been possible with a storage battery, and it is very largely due to the fact that storage batteries can be discharged at such rapid rates that their use has been growing so rapidly.

In large engineering problems the storage battery is used chiefly to supply large amounts of electrical energy for short periods, and by increasing the allowable rate of discharge the size of the battery required is consequently reduced. In connection with this question of the reduced capacity of storage batteries at rapid rates of discharge, there is frequently a mistaken idea that if the capacity of a battery is thus reduced, the efficiency is correspondingly impaired. This is not so at all. It is only the available capacity of the battery which is reduced by polarization, or, in other words, the chemical action when taking place at such rapid rates can only reach the active material which is on the surface of the plates and immediately exposed to to the electrolyte. Hence, in reality, the actual capacity of the battery is not reduced, only the available capacity, and when the battery is recharged, only the active material that is acted upon has to be converted and not the entire amount of active material. There is a slightly greater loss in efficiency when discharging at a rapid rate due to the internal resistance of the battery, this being the C^2R loss.

Storage batteries are not free from trouble, any more than any other apparatus, but, under favorable conditions, the comparison is much in favor of the storage battery. No piece of apparatus yet made is perfect, and its usefulness and consequent general adoption may be said to be proportional to the predominance of its useful features, over its weaknesses or troubles. The rapid growth in the use of the storage battery during the last few years is the best proof possible that its troubles are very small compared to its advantages.

As is the case with all machinery and apparatus which have to be operated continually for any length of time, the results obtained depend not entirely on the design and construction, but on the care and judgment with which it is operated. This fact is particularly noticeable to any one who is constantly brought into contact with different plants and installations, as I am, and under different management, or sometimes mismanagement, in all parts of the country, and this subject alone would afford a very interesting and profitable topic for discussion and consideration.

In the early days the storage battery manufacturers, in order to maintain a bare existence, had to jump at every opening for the use of a storage battery, whether the conditions warranted it or not, and, in order to do business, accepted contracts drawn entirely from the purchaser's point of view, without regard to the capabili-

* Abstract of paper read before the New York Electrical Society Jan. 12, 1899.

ties of the storage battery, and guaranteed results which, to say the least, were extremely difficult to realize. What the results of all this was you know very well.

Now, things are entirely different. The business is on a commercial basis, and it is not a question of getting an order at any price, but securing business which will prove satisfactory and permanent. Now, storage battery manufacturers will insist on proper conditions for the operation of their batteries, or refuse to put them in. This is as it should be, and I think I am perfectly safe in saying that during the last four or five years there has not been a storage battery installed in this country, except under conditions which justified its use. Of course some experimental applications have been made which may or may not prove satisfactory, but this does not come under the head of the general application of the storage battery.

It should be distinctly understood that all conditions of electrical distribution are not suitable for the use of storage batteries, and that it is more to the interest of the manufacturer than the purchaser to confine himself only to those situations which are suitable, for every failure which is recorded is heard of one hundred times to every success.

Now, that by this method of doing business, confidence in storage batteries is being regained, and proper relations have been established between manufacturers and users, the growth of the use of storage batteries will be still more rapid, for it is now realized that when storage batteries are installed and operated under proper conditions the result will invariably be satisfactory.

The trend of electrical engineering is to-day toward the concentration of generating machinery, the highest possible economy in operation, and the utilization of motive power and generating ma-

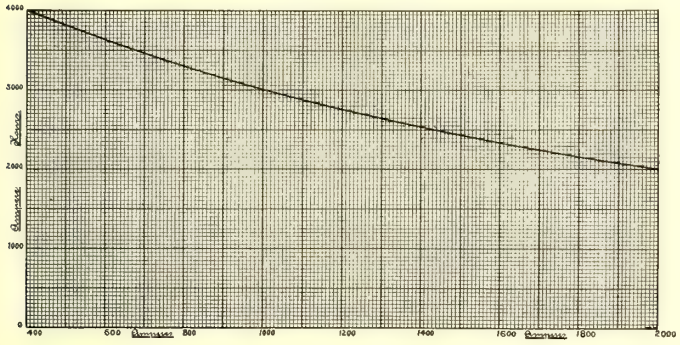


FIG. 2.—CURVE SHOWING CAPACITY OF CELL WITH DIFFERENT RATES OF DISCHARGE

chinery to the fullest extent, so that the investment may produce the greatest return. These conditions make the storage battery indispensable, for without its aid it is impossible to maintain a constant load on the power house.

Every application of electricity has its time of maximum output or "peak," and no matter how many different applications are supplied from the same system, their peaks will not fit in so as to even matters up, but, on the contrary, it is found that in many cases the peaks occur at about the same time. This is particularly noticeable with a railroad and lighting load. Again, concentration of generating machinery means a much larger area for distribution, and the necessity of sub-stations, in order to keep down the investment in conductors, and experience shows that in the majority of cases storage batteries are cheaper than the copper alone, which would otherwise be necessary, leaving out the advantages at the power house. This means that the storage battery will now play a most important part in all electrical problems, and be of sufficient importance and value to warrant the conditions being made suitable for its use instead of, as in early days, being dumped in at any time to fill up a gap and smooth over any difficulties which cropped up.

It used to be customary to refer to European practice, to show what could be done with storage batteries, and even now, I believe that some people think that European batteries and methods are superior to ours in this country. In connection with this idea there is one thing which I particularly wish to emphasize, and that is, the difference between American and European conditions.

In Europe storage batteries are not subjected to the severe work they have to stand here. They are looked upon more as a reserve, and are not expected to discharge at their maximum rate every day, and, perhaps, twice on some days.

As an example of this, I will tell you what one of the Tudor Company experts from Germany said when he was over here last spring. He was attending the National Electric Light Convention at Chicago, and one of the features of that convention was the large storage battery plant, which the Chicago Edison Company had installed. During one afternoon, while the convention was being held, a very heavy thunderstorm came on, and the battery was called upon suddenly for its maximum rate of discharge, and the full rated capacity was taken out. The maximum rating of this battery was a complete discharge in one hour. Our German friend thought that was doing pretty well, but, when I told him that this storage battery was installed under contract, which allowed the battery to be discharged at this rate every day during the winter, he was horrified, and said:

"You must not let them work the battery in that way; tell them they must hold it as reserve." We told him that if we did that we should not be able to do any business, and that we simply had to meet these conditions, and could do so without any difficulty. This instance will show why batteries are maintained at a lower figure in Europe than here, and why it has been customary to refer to the behavior of the battery in Europe. It is a fact that we have now in this country many storage battery installations which surpass any thing in Europe, both in size and method of operation.

The methods of applying storage batteries in connection with electrical engineering work are so numerous that it would be impossible to deal with them all this evening, so I have selected a few for consideration as showing clearly the great flexibility of the storage battery as an adjunct to any scheme contemplating the generation and transmission of electrical energy.

In a lighting and power station the maximum load occurs for only a very short period during the year. In one station I know of 50 per cent of the investment in generating plant and underground conductors is only used for 154 hours during the year. This statement may seem astonishing, but will be found to apply to many such stations. Where these conditions exist it will readily be seen how great are the advantages of storage batteries as auxiliaries. Their cost per kilowatt of output for short periods, such as these peaks, is less than the generating machinery which would have to be provided if they were not used, in addition to which there are other ways in which they prove advantageous in the operation of the plant.

The application of storage batteries to such stations, such as this, can be made in two ways, viz., at the main power house or in sub-stations. Each method has its own advantages, and should be determined in each case by the conditions which exist.

When batteries are placed in sub-stations they will relieve the generating plants of the maximum load as just described, and also effect a large saving in the underground system of conductors, as, at the time of maximum load, the conductors between the main generating station and the sub-stations are relieved of that portion of the load which is carried by the batteries, and distributed from the sub-stations.

The use of large water power as a motive power for generating stations from which electrical energy is transmitted and distributed over extended areas is growing. Take, for example, the Niagara and other plants. In connection with such installations storage batteries play a very important part. The power from such a plant is largely sold for manufacturing purposes and is charged for at so much per horsepower per annum, the power being available twenty-four hours per day, while mills and factories using this power do not usually run for more than ten hours per day. Therefore, a man who requires a maximum of 100 h.p. for ten hours a day, or 1000 h.p. hours, really has to pay for 2400 h.p. hours, while he uses only 1000, and probably less; for the average, rarely, if ever, exceeds 70 per cent in the maximum.

With a strong battery capable of supplying 50 h.p. for ten hours, or 500 h.p. hours, he need only pay for one-half the amount of 50 h.p. for 24 hours, as the battery will furnish the remainder, and can be charged during the fourteen hours he is not using the power. In addition to this, the battery will take care of any fluctuation above the average and enable the man to buy the average amount of power he requires, instead of the maximum.

Such an installation has been made by the Buffalo Street Railway Company. Before describing this installation, I would like to mention the different methods of installing storage batteries in connection with railway plants. These may be divided into two classes.

First—Where the battery is installed at the power house to take care of the peak of the load, and the fluctuation of the generators; and,

Second—Where the battery is installed at the end of a long feeder to keep up the pressure at that point, and to obviate the necessity of sending the maximum amount of current over the long feeders from the power house.

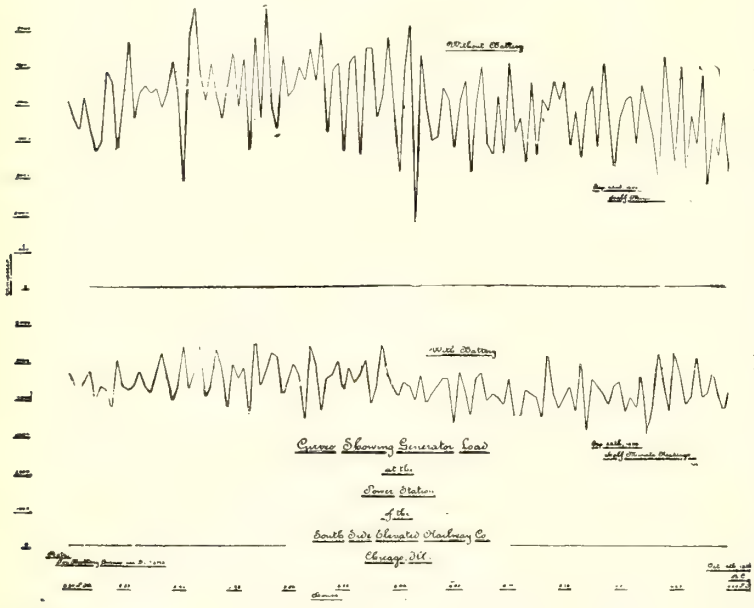
We will consider an installation of each kind and their respective methods of operation.

The Buffalo Street Railway Company's plant* is of the first class, and is especially interesting inasmuch as it is operated in connection with the Niagara Falls power. They operate practically all the cars within the city limits, and have a steam plant capable of

* See STREET RAILWAY JOURNAL, July, 1898.

delivering 7,000 electrical h.p., in addition to which they take 2000 h.p. from the Niagara Falls power, this current being transmitted in the form of high tension alternating current from the Niagara Falls to the power house, and being then transformed by rotary converters to the ordinary 550-volt direct current.

The storage battery is installed at the main power house and is connected directly in parallel with the steam plant and rotary converters. When a storage battery is installed at the power house, and is connected directly in parallel with the generators on the



FIGS. 3 AND 4.—CURVES SHOWING REGULATING EFFECT OF BATTERIES ON SOUTH SIDE ELEVATED RAILWAY

bus bars some means have to be provided for regulating the voltage of the battery to suit the generators. As you know, railroad generators are over compounded, the voltage rising as the load increases, while with the storage battery the reverse is the case, the voltage decreasing as the discharge increases. In order to make the battery work properly in parallel with generators of this type and take the fluctuation of the load, keeping the generators constantly loaded, means of compounding the battery have to be adopted. This is done by using a compound motor booster in series with the battery, which is so designed as to increase its voltage in proportion to the increase of the load, thereby enabling it to take its proper share and keep the load on the generators constant.

The battery discharges during the morning and evening peak, and is charged between times, and also at night from the Niagara Falls power. By the aid of the battery they are enabled to make very much more use of the Niagara Falls power. Before they installed the battery they were only able to shut down their steam plant from 11:30 P. M. until 5 A. M., during which time the rotary converters carried the entire load, which averaged about 600 h.p., while they were paying for 2000 h.p. With the aid of the battery they are enabled to shut down their steam plant from 7 P. M. to 7 A. M., and about eighteen hours on Sunday. In addition to this they are enabled to utilize very much more of the Niagara power.

An illustration of the second method of using storage batteries for railroad work is seen in the case of the battery in the installation of the South Side Elevated Company of Chicago. This company operates an elevated railroad about 9 miles long, all their trains being equipped with the Sprague multiple unit system. The power house is located approximately at the centre, and the two storage batteries near each end of the line, and are connected directly across the system without a booster. The charge and discharge of these batteries is controlled by the drop of the feeders from the power house to the batteries, this drop varying according to the load on the system from 10 to 80 volts. When the load of the system is light the drop in the feeders is small, and there is voltage enough to charge the battery. When the load becomes heavy the drop on the feeders is increased, this consequently causes the batteries to discharge into the line. The method of operating is entirely automatic, the batteries discharging at times of heavy loads, and charging at times of light load, thereby keeping the load on the generating station practically constant. The two battery rooms, each containing 248 cells, have a capacity of 1000 h.p. when discharging at the hour rate. The curves, Figs. 3 and 4, show the result which the batteries have had on their generating plant. The first curve, Fig. 3, shows the load on the generators when they were operating the entire system without batteries. The second, Fig. 4, shows the load on the generators under the same conditions with the batteries in use.

It will be noticed from these curves that when the power house was operating without the battery during the peak of the load the maximum load was 7500 amps., with sudden fluctuations of 5300 amps., while with the batteries in operation the maximum load at the power house under exactly the same conditions was 5700 amps., and the fluctuations only 2000 amps. Thus, the batteries have increased the capacity of the power house by about 2000 amps., and steadied the load on the generators to the extent of nearly 3000 amps. Those acquainted with the operation of street railway plants will appreciate such results.

Each battery is connected to the power house by two special feeders in addition to the general system of conductors, so that the proportion of charge and discharge can be regulated according to the conditions of the load.

If it is found that a battery is being discharged more than it is being charged, an extra feeder is connected between it and the power house, so that it will be relieved of a portion of the load. By this means a very complete control can be maintained of the battery from the power house, and the most efficient method of operation secured.

A battery installed at the end of a line in this way, not only increases the capacity of the power house and saves the investment in copper by making it only necessary to transmit over the feeders the average amount of current required, instead of the maximum, but at the same time it maintains the proper voltage at the end of the line, thereby enabling the motors to run at the point of highest efficiency. Of course the line must be long enough to justify the use of a storage battery and to supply sufficient drop in voltage over the feeders to make the battery operate automatically as the load varies.

A variation in voltage at the end of the line, between conditions of maximum load and minimum load of 10 per cent, is ample to make the battery self regulating, and take care of the fluctuating load without a booster. The following figures taken from a storage battery installation of this description installed some two years ago, will show the advantage from a commercial point of view.

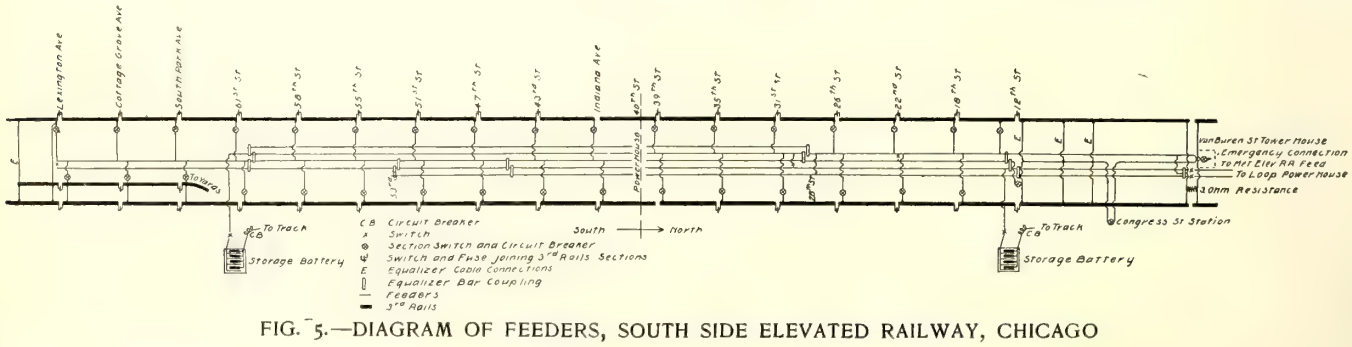


FIG. 5.—DIAGRAM OF FEEDERS, SOUTH SIDE ELEVATED RAILWAY, CHICAGO

The conditions were as follows: The length of this line at the end of which the battery was installed, was 7 miles from the main power house, running into the suburbs of a large city. The increase of traffic on this line warranted its extension 4 miles further, making a total of 11 miles from the power house. When the extension was made, it was found that the feeders were quite inadequate to carry the increase of load, and it was unnecessary to provide additional power at the end of the line, either by laying additional feeders, installing a small power house at that point, or putting in a storage battery sub-station. Each method was carefully considered, and the following figures show the result. If additional feeders were laid of sufficient sectional area to provide the proper working voltage at the end of the line the cost would have been $273,000, figuring on the basis of $1.00 per foot,

laid for 1,000,000 c.m. feeders. This was, of course, prohibitive. The cost of a small power house of sufficient capacity to take care of the load in that section of 750 kw. would have been $85,000. The cost of a battery sub-station complete, including real estate, was $33,000, or a saving of $52,000 over that of the power plant.

The cost of operation has proved exceedingly satisfactory, showing a saving of some $1,350 per month, or $16,000 per annum over the cost of operating a power house of such a size. The cost of operation includes all attendance, taxes and depreciation and interest.

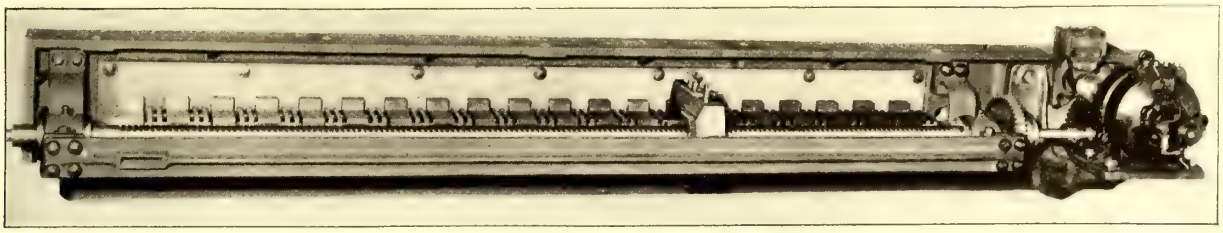


FIG. 6.—SWITCHING DEVICE FOR END CELLS

One of the most interesting and important storage battery installations recently made is that in connection with the underground trolley system of the Metropolitan Street Railway Company of this city. This company's system covers a large area, and it has utilized storage batteries in sub-stations. Two are now in operation, one at the foot of West Twenty-third Street and the other at Thirty-second Street and Fourth Avenue.

I will briefly outline this plant and method of operation. The battery consists of 540 cells, each containing fifty-one plates, 15 ins. square. The dimensions of the cells are 4 ft. x 21 ins. x 24 ins. The battery is divided into two sections, 270 cells in each, which are operated in parallel. This is done to keep the sizes of the cells within practical limits and to enable them to be more easily inspected and cared for. A cell 8 ft. in length, which would be the size if but one battery were used, is too large to be satisfactory. The capacity of the complete battery is 8000 amp. hours, with a one-hour rate of 4000 amps.

The function of this battery is to take care of a portion of the morning and evening peaks, and to take up the fluctuations of load at all times. The method of operation is as follows: Sufficient cells are provided so that the voltage of the battery just balances the average voltage of the system; consequently, when the battery is connected to it, it acts as an equalizer and does not charge or discharge except as the fluctuations occur. When the battery discharges on a peak and is being charged during the hours of light load, a booster is connected in series with it to regulate the amount of a charge and discharge. The output of the booster and, consequently, the charge and discharge of the battery, is controlled by varying the strength and polarity of the shunt field. This is done by a special form of switch which makes the operation very simple.

The daily work of the battery is about as follows: From 7 to 9 A. M. it discharges on the peak. From 9 to 12 it floats on the system as an equalizer. From 12 to 3 or 4 P. M. it is charging. From 4 P. M. to 8 P. M. it discharges on the peak. From 8 to 12 midnight it is floating on the system, and after midnight the battery is given its principal charge, this being continued until the battery is full.

An interesting application of this sort has recently been made on a small railroad plant in Montpelier, Vt.* This plant was, I believe, the first railway plant in this country operated exclusively from rotary converters with a storage battery auxiliary. The line operated is about 9 miles long, and the sub-station is located about 3 miles from one end. The power is furnished from a power house on the Winooski River, the current being generated by three-phase alternators at 2200 volts. This current is carried to step-up transformers and is raised to 6300 volts. At this pressure it is carried to the sub-station, a distance of 8 miles. In the sub-station step-down transformers reduce this to 480 volts, at which pressure it is fed into the rotary converter. The capacity of this converter is 160 kw., and is specially wound for running directly in parallel with a storage battery, its characteristic curve being similar to a shunt-wound generator. That is to say, as the load increases, its voltage would fall. By this means the battery will take care of all fluctuations, maintaining a fairly constant load on the rotary. The battery consists of 248 cells, each containing eleven plates 10 ins. square. The one-hour rate of this battery is 200 amps. The maximum load on the line is 300 amps. Of this the rotary carries 125 and the battery 175. The greatest amount of load on the line is nearly 300 amps. Such an installation shows clearly the advantages of battery regulations on a fluctuating load. The size of the rotary is reduced practically one-half and the load on it kept almost constant.

Most of the plants mentioned have been those of a large size, supplying a large amount of energy. It must not be imagined that storage batteries are applicable only to these large stations. The variation of load on the rotary is 50 amps., while the variation of results obtained from their use are just as satisfactory in the case of smaller stations, but I have referred to the larger ones as being of more interest.

* See STREET RAILWAY JOURNAL, September, 1898.

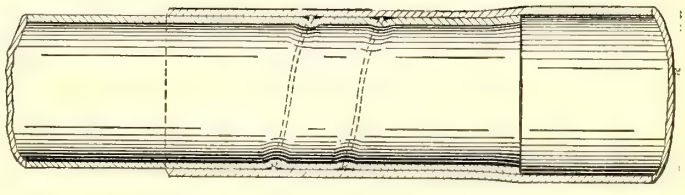
Increase in the Use of Aluminum for Electrical Conductors

The Pittsburgh Reduction Company, manufacturers of aluminum, report an extended increase in the use of this material for electrical purposes. The company itself has had 10,000 h.p. of current transmitted by aluminum conductors for the last two years, and the Niagara Falls Hydraulic Power & Electric Company has used a considerable amount of this material for electrical conductors. Among the longer lines which have employed this material is one at Snoqualmie Falls for the transmission of power from the Falls to Seattle and Tacoma, where more than 80 miles of wire is in use. The Standard Electric Company, of California, the Pennsylvania Railroad Company, the Bell Telephone Company, and others, have also employed the material to a considerable extent on their conductor systems for telegraph and telephone conductors.

The Pittsburgh Reduction Company is installing two 14-in. and four 10-in. mills with continuous drawing benches for the manufacture of aluminum wire for use as electrical conductors, and expects to have as large facilities as any mill in the country for this work.

Orders for Street Railway Supplies

Elmer P. Morris, of New York, manufacturers' agent for some of the largest and most representative supply houses in America, reports an unusually large number of orders during the past month for the specialties he handles. This is particularly true of assembled commutators, made from drop-forged copper and tubular-iron poles and brackets. A cut of the poles he carries in stock is shown herewith. These are made in two or three sections as desired, and at each joint are bound with wire, which is swaged and keyed into place in such a way as to give enormous strength to the pole. These are guaranteed to stand a hydraulic pressure from the inside of 200 lbs.



SECTION OF POLE

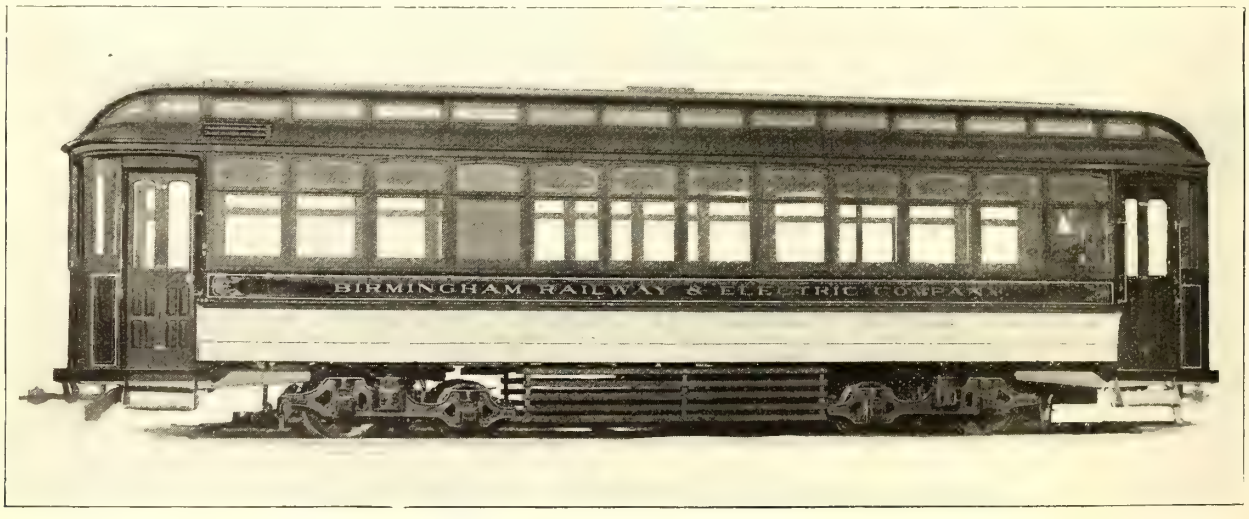
Mr. Morris has recently opened several new branch offices for the convenience of street railway companies at a distance from New York. One of these is in the Betz Building, Philadelphia, and will be in charge of George E. Pratt; another is at Niagara Falls, N. Y., and will be in charge of C. J. Harrington.

New Cars Built in St. Louis

The accompanying illustrations show two new cars recently built by the St. Louis Car Company for the Bloomington (Ill.) & Normal Railway Company and the Birmingham (Ala.) Railway & Electric Company. These furnish a good illustration not only of the new era in American street railway car building which has set in with the development of long suburban and interurban lines, and which has had no little effect upon street railroading in cities proper, but also of the good work of the St. Louis Car Company itself, which, with its new factory, now practically completed, will be one of the greatest street railway car manufacturing establishments in the world. The lines of these cars are graceful, and it is evident that careful thought and care have been given to every detail of their construction as affecting the carriage of passengers. The twelve windows of the Bloomington and Birmingham cars guarantee lightness in winter and lightness and airiness combined in summer. The square sides give roominess of car inside, and the patent vestibules of the St. Louis Car Company protect the motormen, conductors and passengers. In fact, the Bloomington car particularly, closely resembles in general appearance the passenger coaches of the Limited Express between New York and Chicago.



ELECTRIC CAR FOR BLOOMINGTON & NORMAL RAILWAY



ELECTRIC CAR FOR BIRMINGHAM RAILWAY & ELECTRIC COMPANY

These cars are mounted on the new No. 18 double track of the St. Louis Car Company, illustrated on page 115. Orders for large numbers of these trucks have already been taken by the St. Louis Car Company, in spite of the fact that they have been in the market but a short time.

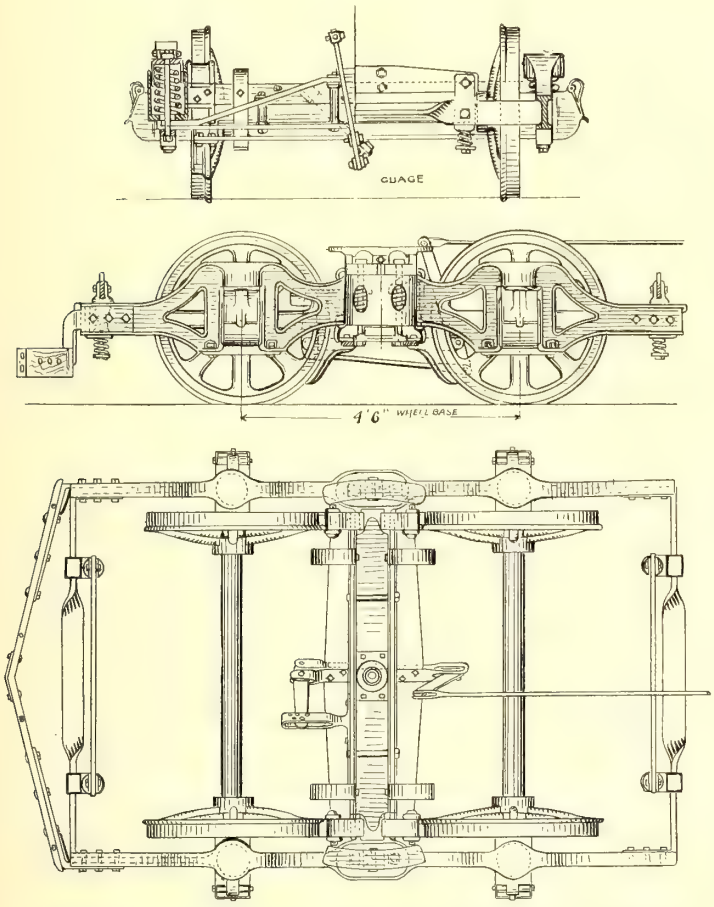
The Walker Company has received an order for the electrical equipment of eighteen cars in Krementschoug, Russia, and thirty-six cars for the Omnibus and Tramway Company, of Rome, Italy.

Electric Locomotives on the Orleans Railway Terminal in Paris

The plans for operating the terminal of the Orleans Railroad in Paris by electric locomotives, some particulars of which were given in the STREET RAILWAY JOURNAL for June last, have since been determined upon. The line, whose service is very similar in character to that of the Baltimore & Ohio Railroad in the Belt Line tunnel, in Baltimore, has a length of 3700 m., of which 3100 m. are underground, and electric locomotives are to be employed to avoid the gases of combustion in the tunnel. The substitution of electric locomotives for steam locomotives will take place at the Austerlitz Depot in the outskirts of the city, while a stop is made to discharge passengers, and from that point to the main station at the Quai d'Orsai trains will be drawn by electric power. The power station will be near the Tolbiac Bridge, and will contain two units of 1000 kw., each producing three-phase current at 5500 volts and 25 cycles. This current will be transmitted to three sub-stations, one in the power station itself, one at the Austerlitz Depot, and one at the Quai d'Orsai Depot, where it will be transformed to a 500-volt continuous current for lighting and traction. In the two latter sub-stations will also be located a battery of accumulators in parallel with the rotary converters to regulate the voltage and insure lighting at a period of the night when the power station is not in operation. Each power station will also contain static transformers for reducing the current from 5500 volts to 340 volts and two 250-kw. rotary converters operating at 500 r.p.m. Each of the batteries will have a capacity of 1100-amp. hours.

The electric locomotives will be operated by a continuous 500-

volt current by means of a third rail carried on blocks of paraffined wood resting on the ties. There will be eight locomotives supplied by the General Electric Company, similar in general appearance to the Baltimore locomotives. Each locomotive will be of 500-kw. capacity, will weigh, empty, 40 tons, and loaded, from 45 to 46 tons, the weight necessary to draw a train of 250 tons, including the locomotives, from the Quai d'Orsai



PLAN, END AND SIDE ELEVATIONS OF THE NO. 18 TRUCK

station to the Austerlitz station in seven minutes without intermediate stops. It is estimated that the traction consumption of power will be about 1,420,000-kw. hours per year for the normal number of 150 trains per day, empty or loaded. It is estimated that the trip from Quai d'Orsai to Quai Austerlitz in seven minutes without intermediate stops will consume about 27 watt-hours per ton. The average train of 200 tons, including engine, will absorb, it is thought, 600 kw. at starting and 250 kw. at full speed. The expense of building the power station, sub-station, supplying the rolling stock and building the transmission line is estimated at $610,600, and it is expected that the entire road will be in operation by January, 1900.

Calendars for 1899

Numerous calendars for the year are still being received, and many of these bear evidence of most careful designing, and in a number of cases very large sums of money must have been spent in their preparation. Among those received since Jan. 1 is one from the Joseph Dixon Crucible Company, of Jersey City, bearing an interesting reproduction of a young college girl in gown and mortarboard, evidently on the day of her graduation; another one, issued by the Ashton Valve Company, of Boston, Mass., shows two little girls at play; a very elaborate calendar, by Mayer & Englund, of Philadelphia, Pa., shows a large lithographic reproduction of a young woman's head in colors; the Peckham Truck Company, of New York City, is sending out its large wall calendar, which has become well known to the street railway field; R. D. Nuttall Company, of Allegheny, Pa., is sending out a calendar bearing a large cut of the Nuttall gears; the Van Dorn & Dutton Company, of Cleveland, Ohio, is sending one composed of twelve sheets, one for each month, each sheet showing and describing one of the Van Dorn specialties, including trucks, armature lifts, gears and pinions, etc. In addition to the above, two other very handsome calendars have been received, one from the J. G. Brill Company, and the other from the Sprague Electric Company. The one from the Brill Company is unusually elaborate, and consists of six large sheets, upon each of which is printed a reproduction of a famous painting, the six reproductions being "The Three Fates," "Spring," "Good Morning," "Love Wins," "Butterflies," and "Cinderella." Each sheet contains also the calendar for two months. The Sprague calendar is one of the handsomest and most thoroughly practical ones received. The upper part is a copy of a celebrated painting, while the calendar proper, printed from a good size type, forms the lower half. Both parts are mounted in a mat and nicely framed. D. E. Goe, manager of the advertising department of the Sprague Company, has a great reputation for doing this kind of work, and in doing it just right.

Convention of Manufacturers

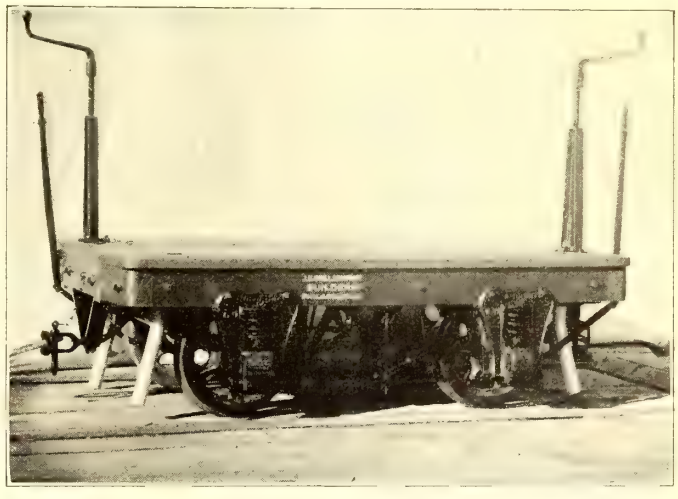
The fourth annual convention of the National Association of Manufacturers of the United States was held at Cincinnati, Ohio, Jan. 24, 25 and 26, 1899. The meeting was well attended, and subjects of interest to American manufacturers were discussed. The following officers for the next year were elected: President, Theodore C. Search, Philadelphia; secretary, F. P. Wilson, Cincinnati, Ohio; treasurer, Charles A. Schieren, New York. The next meeting will be held at Boston, Mass.

Special Number

The twentieth annual number of "The Tradesman" of Chattanooga, Tenn., is a very elaborate number. It has been most carefully prepared, and will be found valuable as a book of reference to all interested in the growth of Southern trade.

Electric Locomotive

The accompanying illustration shows an electric locomotive recently built for the Deadwood & Delaware Smelting Company by the J. G. Brill Company. It is a powerful little affair, although it measures but 8 ft. in length and is only 5 ft. 3 ins. wide. It stands 2 ft. 3 ins. to the floor, and is furnished with a w.p. No. 5 motor, with two K 10 controllers. The wheel base is 4 ft. and the gage of the track 36 ins. Its small size and compactness made it possible to use a light pedestal gear arranged to take the motors. Four Brill sand boxes are placed within the frame to give an equal and complete distribution of sand when it is necessary. The convenience of a machine of this kind is hardly to be estimated by those who have had no experience with them. One man can handle almost all the loads that may be necessary about an establishment.



ELECTRIC LOCOMOTIVE

In this case the machine is a flat car as well as a locomotive. It is intended for use within a mine and on the surface as well. A third rail transmission of power is to be employed, and the General Electric Company put on the necessary electrical equipment. It is interesting to note that an electric locomotive, as adapted to every-day commercial uses, is coming to be more and more employed. Electricity is available in a large percentage of all manufacturing establishments and railway tracks are equally commended. A small expense for overhead wires or for third rail conductors makes a machine of this kind possible, and its convenience is much greater than a pair of horses, while the economy is in favor of the electric machine, which, when not in use, is not "eating his head off."

Water-Softening Plants

BY N. O. GOLDSMITH

The advantages of water softening are not generally understood or appreciated in this country. The process was discovered nearly sixty years ago by Dr. Clark, of Aberdeen, Scotland, and since that time it has been extensively adopted in England, not only for softening the water supply of whole towns and cities, but also for various requirements of the mechanical arts. Hundreds of water-softening plants are in successful daily use in Great Britain, France, Belgium and Germany. The mechanical features of these may differ according to the ideas of the designer, but all make use of the same chemical process. These plants are softening water for steam boilers, railways, woolen and cotton mills, paper mills, iron works, dye works, tanneries, etc. From this it will be seen that the process is not a new and untried one, still in the experimental stage, but one which is as well established, and whose advantages are as well recognized, as are those of the exhaust steam heater in this country. As an apparatus for furnishing suitable and desirable feed water for boilers, it is also the cheapest purifier of any merit in the market. The common mineral impurities soluble in water are silica, iron, carbonate of lime and magnesia, sulphate of lime and magnesia, and chloride of lime and magnesia, also the chlorides and sulphates of soda or potash. The lime and magnesia and iron salts are known as the scale-forming impurities, and are the ones which are removed by water softening. At the same time that these are removed, the mud or silt which the water may contain is also removed, and the organic matter reduced. The sodium and potassium salts do not form scale and are not removed by this process, nor is it possible to do so by any process of purifying water, with or without the aid of heat. The only means of removing sodium or potassium salts from water is by distillation, and this is the process which takes place in the boilers. The lime and magnesia salts are held in solution by means of the acids with which they are united. Water softening, therefore, is a process of removing from the lime and magnesia these acids which hold them in solution. The expense due to softening water is extremly low, first, because the carbonates are generally more abundant in waters than the sulphates or chlorides; second, because the Clark process will remove a higher percentage of carbonates than any other method, which would be practical and economical enough to use for industrial purposes.

The following table is copied from the report of W. J. Dibdin, chemist for the London County Council, who conducted a series of experiments on water of the New River Company:

Date, 1895.	Before softening.		After softening.		Percentage of reduction.	
	Hardness.	Bacteria.	Hardness.	Bacteria.	Hardness.	Bacteria.
December 16..	17.4	96	5.4	12	68.4	87.5
" 18..	17.4	110	5.0	6	71.3	94.5
" 20..	17.4	60	8.5	16	51.2	73.4

Hardness is expressed in degrees, Clark, and bacteria given in colonies per cubic centimeters.

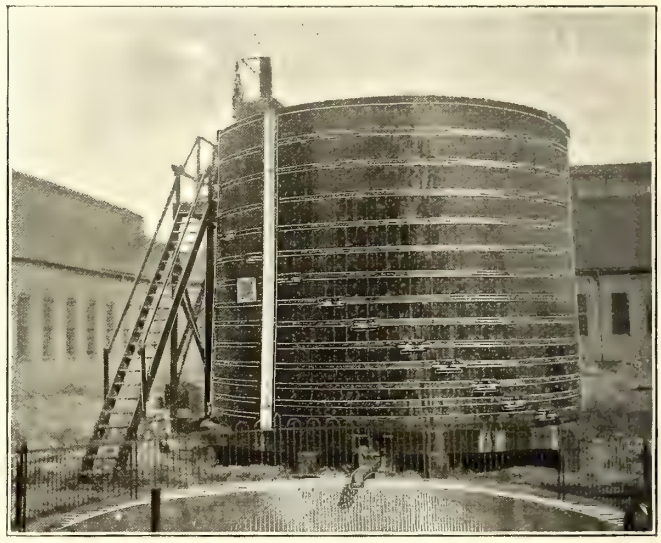
The most approved method for softening water is known as the intermittent settling tank plan, in distinction from the continuous method of purification, in which the water is always moving and is purified in transit. Where the quantity of water required is comparatively small, much more satisfactory results are obtained by using the intermittent settling tank plan than would be possible with the continuous system.

The apparatus is extremely simple, and consists of two or more open tanks, or one tank and a storage reservoir. These tanks may be constructed of wood or iron, as preferred. They are generally made cylindrical, and usually located out of doors, convenient to the boiler room. This has the advantage of not crowding up the boiler room, while there is no danger of the water in the tanks freezing while the plant is in daily use. The size of the tanks depends upon the quantity of water required per day, and the number of times it is convenient to fill them. Each tank is placed upon a heavy platform carried upon foundation piers, and is provided with a mechanical stirring device to be used in mixing water with chemicals. This stirring device consists of a paddle revolved by the simple gearing turned by hand, or preferably by light power. This paddle stirs up from the bottom of the tank the lime sludge of previous precipitation; this floats in the water, hastens the chemical reaction, and causes the new finely-divided precipitate to gather into large flocculent or wooly flakes, which settle quickly as soon as the water stops moving. The simplicity of this means for stirring and agitating the water is self-evident; it does not have to be cleaned to keep it in working condition; it requires from ½ h.p. to 3 h.p. to operate it, so that the amount of steam is extremely small.

The softened water after settling is taken from the tanks by means of a hinged floating outlet pipe, which rises and falls with the level of the water; by this means the clearest water is always drawn from top of the tank.

Inlet connections through which to fill the tank, and wash pipe connections through which to wash lime sludge from tanks, are placed in the bottom. The washing of the settling tanks need be done only when lime sludge becomes deep enough to interfere with stirring; ordinarily, once a week or a fortnight is sufficient. All that is required is to open wash valve, start the stirring device, and mix up the lime sludge with the water, which is always left in the bottom of the tank, for it is soft enough to run out through the wash pipe. The time and labor of cleaning is but a small percentage of that required for exhaust or live steam heaters, and it is not necessary to do the work on top of the boilers in a hot, stifling atmosphere.

A sheet iron chemical tank is placed on top of the settling tanks; in this are placed the reagents used for softening; they are mixed with water and washed into the tanks while filling. By reason of



WATER SOFTENING PLANT AT COLUMBUS

the currents of water caused by the water rushing into the tank, the chemicals are partially mixed with the hard water; this mixture is completed by the revolving paddles of the stirring device, which are started as soon as the filling of the tank begins, and continues to revolve until the tank is full. This method is very efficient, involves no expensive apparatus which requires constant cleaning and repairs, and is very economical in steam. Tank indicators are generally placed on tanks to show level of water, and operating platform is arranged alongside of tanks from which the man in charge mixes reagents and tests the water. The testing of the water is made necessary because of the exact treatment, and the variation which takes place in all waters. The test is extremely simple, and any man of ordinary intelligence can understand and use it.

The advantages of this apparatus are as follows:

First: There are no automatic chemical feeds which continually vary, and thus furnish either an excess or an insufficiency of the chemical solution.

Second: In moderate sized plants the apparatus can be operated by the engineer, or his assistant, without interfering with the regular work.

Third: The constant quantity of raw water collected in the tanks is treated with practically an uniform amount of chemical reagents, therefore an uniform character of softened water is furnished. The simplicity of this plant makes it possible for the unskilled workman to obtain as good results as an expert chemist.

Fourth: The mechanical stirring which results in agitating the raw water with the chemical reagents insures an intimate mixture, and very materially hastens and completes the chemical reaction.

Fifth: The sludge of previous purification which has settled to the bottom of the tanks is mixed with the water by the action of the stirring device; this insoluble matter moving in the water gathers up the new finely-divided precipitate and hastens the clarification of the water.

Sixth: The sludge collected in the settling tanks relieves the filter beds, so that the filter can be run five or six times as long,

without cleaning, as would be the case if all the sludge was intercepted by the filters.

Seventh: The settling tanks do not require washing oftener than once a week therefore, the amount of water required for cleaning is a very small percentage of the total amount purified.

Eighth: The length of time which the water stands is necessary in order to get complete chemical reaction. No chemical reaction is instantaneous, therefore the element of time is necessary.

Ninth: The perfect quiet of the water gives an opportunity for most complete settling, rendering unfiltered water clearer than that from any other apparatus not using filters.

Tenth: The operations of this apparatus are the same as those followed by the chemist in the laboratory, with only such modifications as are necessary to suit the conditions.

Eleventh: This arrangement of settling tanks permits an accurate daily report to be kept of the amount of water evaporated in the boilers.

Inasmuch as it is not practical to use settling tanks having capacities sufficient to permit the water standing long enough to perfectly clear itself, we advocate passing the water through a mechanical filter, merely to clarify it by removing the floating lime sludge. For this purpose all that is necessary is to employ gravity or pressure filters, and use a sand-bed as a filtering medium. By this means perfectly clear, soft water is obtained.

There are twenty-three water softening plants in this country, erected in accordance with the most approved plans. These plants are furnishing softened water for ice factories, dye works, laundries, electric light plants, street railway power houses, steel works and various manufacturing concerns, some of which have been in daily use over three years, and all are giving most satisfactory results. The illustration shows a 2,000 h.p. water-softening plant, which has been in service since April 26, 1896, at the Columbus Central Railway Plant, Columbus, Ohio. It was installed by the We Fu Go Company, of Cincinnati, which controls the sale of these plants.

The following is an analysis of the raw water from the wells of that company, before softening, in grains per U. S. gallon:

Silica	1.25
Oxide of iron	4.250
Carbonate of lime	10.650
Carbonate of magnesia	5.325
Sulphate of lime	5.525
Chloride of soda	.670
Total residue	27.675

A sample of the softened water from the plant while in actual service, was sent to Professor Webber, of Ohio State University, in May, 1896, and was analyzed by him, and found to contain the following impurities in grains per U. S. gallon:

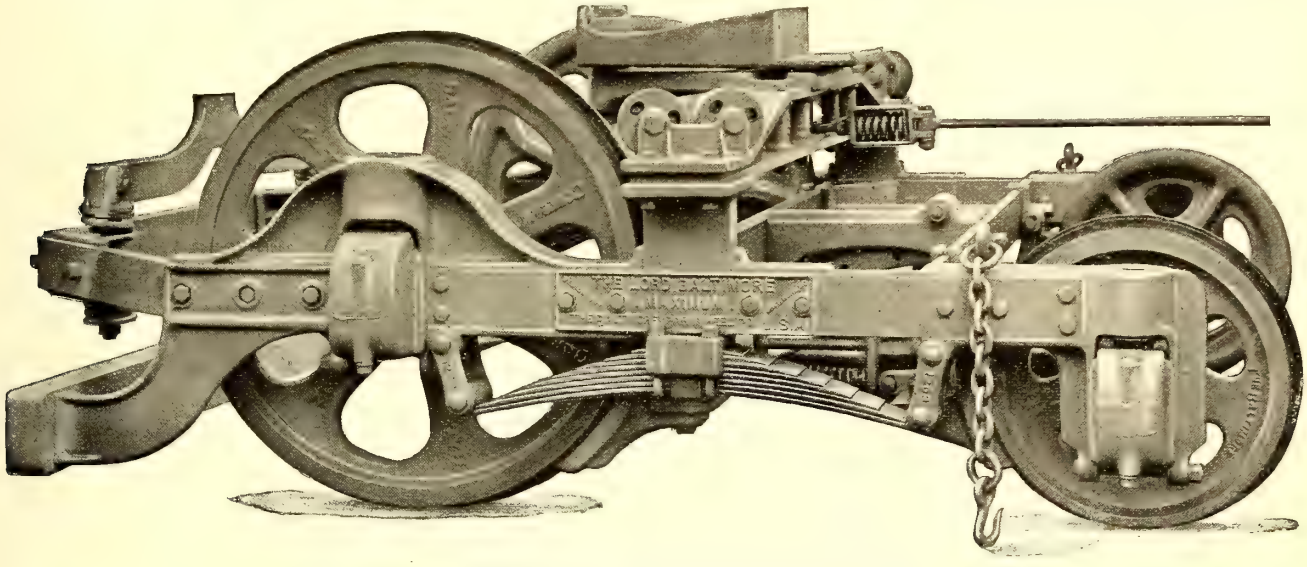
Silica	1.067
Oxide of iron	None
Carbonate of lime	1.508
Carbonate of magnesia	0.202
Sulphate of lime	1.609
Chloride of soda	None
Soluble salts (sulphates and chlorides of sodium and potassium)	8.490
Total residue	12.876

The Tramway Company of Brussels reports for the eleven months ending Nov. 30, 1898, gross receipts, 4,838,402 francs; number of car kilometer, 6,183,939. A little over 40 per cent of the car kilometer run was by electric cars.

Maximum Traction Truck

The illustration accompanying this article is the latest design of a maximum traction truck of the Lord Baltimore type, manufactured by the Baltimore Car Wheel Company, and of which some particulars were published in the last issue without illustration. The design of the truck is such as to bring 66 per cent of the weight upon the driving wheels, without it is claimed any liability of derailing the small wheels. The metal bolster centre plates, as shown, may be pivoted directly above or near the centre of the driving axle; the body bolster centre plate at its front end is recessed to receive the main car body bolster, to which it is secured by bolts through the base and end. Double taper roller side bearings are provided, as shown, upon which the chafe plates of the body press. These rollers are self-oiling, by being made hollow, and packed with saturated waste, and revolve upon steel thimbles.

The truck frame is made up of cast steel pedestals, having housings for graduated spiral springs, which rest on top of the journal boxes, so that the entire load is cushioned. The side members are bolted directly to the pedestals, and are diagonally braced securely between the wheels. The end cross bars are bolted to the main pedestals, and are drawn in at an angle to support the suspension bars, so that in curving these members do not come outside the rail. The truck is so designed that the motor is mounted outside the driving axle. There are two half elliptic springs suspended below the side frames by links, and to which the weight of the body and load is transmitted by steel flat-posts depending from and secured to the truck bolster, which play in guides formed by the bars of the side frames.



LORD BALTIMORE MAXIMUM TRACTION TRUCK

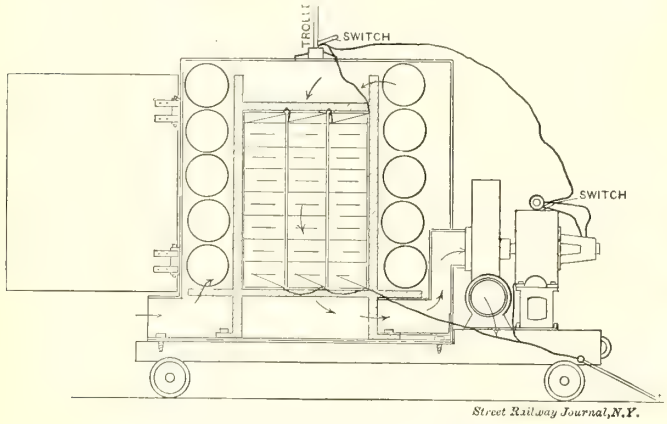
The brake mechanism is so designed that the shoes are applied to the inside of the wheels, and the levers are so proportioned as to bring about 70 per cent of the braking power upon the driving wheels. The brake beams are operated by levers, acting from the pivotal point of the truck; the top end of the operating lever works in a channel in the base of the truck bolster centre plate, so that they are always held in line and no quadrant is required for operating the brakes on curves. Spiral springs are introduced in the brake rods between the trucks, which equalizes the braking power on each truck, so that each wheel receives its proper proportion of the braking force.

All the working parts of the brake mechanism have large bearings with steel thimbles and suitable oil holes, and are placed at the centre line of the trucks, out of the way of mud and dust thrown up by the wheels. These trucks have all the stability claimed for centre bearing trucks of most approved design with the advantage of maximum weight available for traction. With the exception of the brake shoes and wheels, all parts are of steel and malleable iron; and in the design, special attention has been given to relieving the shearing strain upon the bolts. Dust-proof and oil-tight axle boxes are provided, in which either felt or waste feed may be employed as desired. The care and thoroughness with which the trucks are built is in keeping with all the products turned out from this well-known establishment.

The Barcelona (Spain) Tramway Company has petitioned for a number of additional rights for extending its trolley system.

Portable Hot-Air Blower

The accompanying engraving shows an interesting portable hot-air blower for drying armatures and fields, invented by W. R. Gaither, auditor of the South Chicago City Railway. The importance of keeping the insulation of these parts of an electrical



PORTABLE HOT AIR BLOWER

motor dry, and the advantage of doing this artificially after the motors have been in service on a wet day, is generally recognized by repair men, but the trouble and expense of removing armatures and fields from the casings and transporting them to a drying oven are so considerable that it is not often done. It is to simplify this process that the portable blower illustrated is intended.

The blower, which is mounted on flat wheels and is adapted to be drawn by hand, is brought alongside of the cars in the car house at night, over the pits as they stand. The blower is equipped with electric heaters and blowers, and has a trolley for making contact with the overhead wire. Upon reaching the car the blower is put in operation and the hot air is blown through the nozzle directly into the motor casing so that it acts directly on the armature and field insulation, accomplishing the same results as if the armature and fields were dismounted and transported to a stationary oven. Mr. Gaither estimates that it will require only 6 h.p. to generate 200 deg. of heat in a volume of air discharged from the nozzle at a rate of 300 cu. ft. per minute. This would reduce the cost of current for operating the device to about 50 cents for ten hours' use, and he thinks that in very wet weather the blower would pay for itself in a very short time in preventing burn-outs, especially with the open style of motor.

The special advantages claimed for the device are: First, that no extra labor in drying out armatures and fields is required, as the device takes only a few minutes and no skill to operate it or move it; second, the blower is valuable anywhere that current can be obtained, and of course wherever there are cars whose motors should be dried out, this condition prevails; third, the blower is portable and cleanly; fourth, it can be used without the heaters if desired, to blow out dust and dirt from the motors; fifth, the heat can be regulated to any degree, so that quick or slow drying can be secured.

Boiler Tube Cleaner and Flexible Shaft

The device illustrated in the engraving herewith is for the purpose of removing scale from the tubes of boilers of the water-tube type. The cleaning device consists of a conical shaped head, having a taper of about ¾ in., and composed of discs, with pivoted arms between each pair. At their outer extremities, these arms carry tooth cutters about 1⅛ ins. in diameter, and these arms with their cutter discs are set spirally in the head. A series of guide bars placed on the shaft back of the head not only serve to guide the tool in the tube, but provide bearings in which the operating shaft revolves. In the process of cleaning, the cone which is somewhat smaller than the tube, is inserted, and given a rotary motion up to about 1600 r.p.m. The centrifugal force causes the arms to fly out, bringing the cutters by the impact of vibratory movement in contact with the scale on the walls of the tube. This action causes the teeth to cut into and disintegrate the scale, which is then flushed out by means of a stream of water that is fed continuously into the tube by a hose as the process goes on. The cutting wheels not only remove scale, but when it is removed lose their vibratory motion and simply burnish the tube, and do not injure or expand the tubes, no matter how thin they are. The effect of burnishing the tubes after cleaning, serves to polish the interior by removing even the mill scale and so makes it impossible for scale to adhere

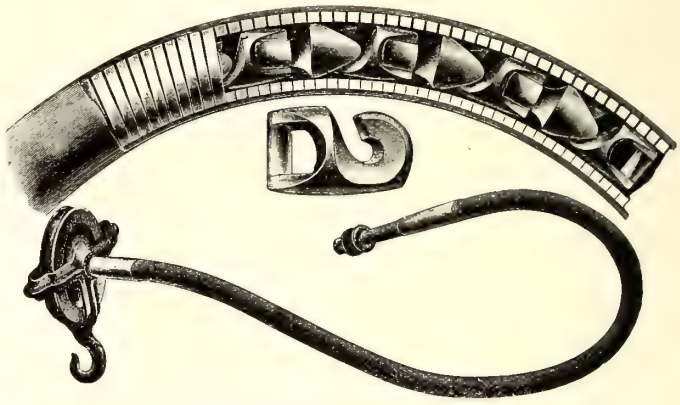


FIG. 2.—CLEANER FOR CURVED BOILER TUBES

tenaciously. This renders subsequent cleaning relatively easy, while it adds greatly to the efficiency of the boilers, by improving the circulation, increasing the radiation, and thus economizing in fuel consumption. The head is adjusted in the tubes by means of a sectional rod united by snap couplings. The rod is given a rotary motion by means of a driving pulley, having a sleeve with a key way through which the rod slides, and by means of a handle at the outer end the operator can move the head at will back and forth in the tube, while the rotary motion continues.

For cleaning curved tubes, a flexible head of the same shape

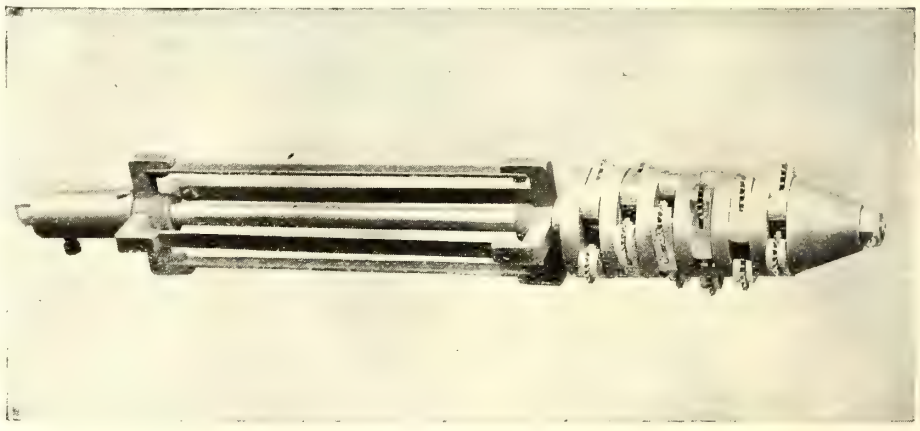


FIG. 1.—HEAD FOR BOILER CLEANER

and a flexible shaft are employed. This shaft, as shown in Fig. 2, is composed of solid brass links of peculiar shape, which hook into each other, and in turn are enclosed in a closely fitting spirally wound tube, which is flat on the inside, and provides a smooth bore in which the link chain operates. The whole is then encased in a tube of specially prepared rubber which is not effected by oil, which allows for oil lubrication of the flexible shaft, while it protects it from the flushing water, which is led into the tube in the same way as described for the straight shaft.

The tube cleaner and shaft are manufactured by the Union Boiler Tube Cleaner, whose works occupy part of the Imperial Power Building, 240 Penn Avenue, Pittsburgh, and which is equipped with a very complete assortment of metal working tools. The tube cleaner was put on the market in 1895, and the company has received many flattering testimonials as to its efficiency, and guarantees that it will sustain all the claims made for it. It is the practice of the company either to sell the tube cleaning device outright, or rent it to steam users by the year. The company also contracts to clean boilers for a stipulated sum per horse power. In all cases where a sale or lease is effected, an expert is sent without charge to install the device and give instructions for setting up and using. With this machine a man can clean from twenty to fifty tubes a day, depending upon their condition, and whether it is the first or second cleaning.

The use of the flexible shaft, which the company manufactures, is not confined to the operation of the tube cleaner, but may be employed in any situation where power is to be transmitted, or has been transmitted by any other type of flexible shaft. It is stronger in construction than most shafts of this character, and is especially adapted for use with portable electric motors for drilling or reaming bond or bolt holes in track rails or steel plates of any description.

A New Type of Cast Welded Joint

The application of the system of cast welding in rail joints has become so general that any new methods of cast welding the ends of rails are matters of public interest. The accompanying engravings illustrate a new type of cast welded joint brought out during the late fall of 1897 and the season of 1898 by the Milwaukee Railjoint & Welding Company, of Milwaukee, Wis. As will be seen, this joint differs from other cast welded joints both in form and substance. It extends along the sides of the rail for about 15 ins., and projects out at the joint of the rail, but not below the rail. It is composed of both cast iron and steel and is put upon the track by cleaning a small space around the rail joint about 2 ft. square down to the top surface of the ties and by cleaning the rail ends by the use of sandblast. A steel sleeve, shaped so as to form a cavity around the rail ends, is then riveted upon each side of the rail at the joint. After the rail ends have been heated, this sleeve is filled with melted iron. The latter fuses to the web and flanges of the rail and the steel sleeve, making a solid joint composed of both steel and cast iron.

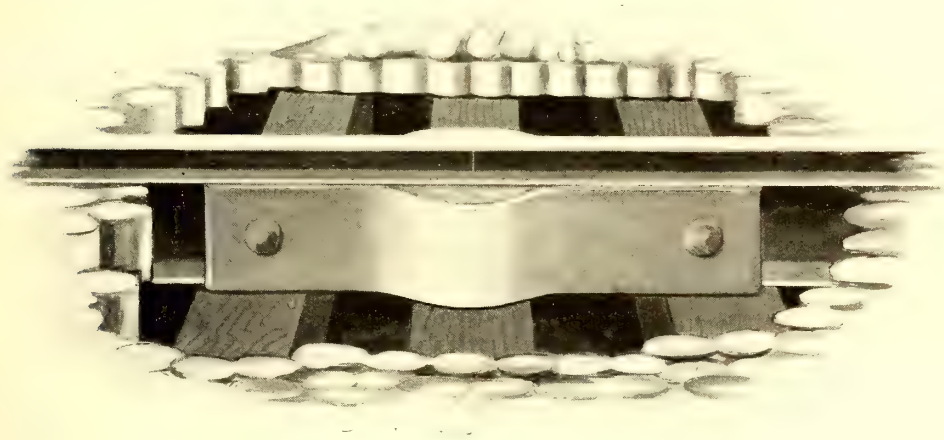


FIG. 1.—SIDE VIEW OF JOINT

As will be seen from this description but little work is required on the part of the street railway company in preparing its track for cast welding on joints upon this system. It is not necessary to remove or displace any ties. The roadbed is not disturbed, and the blocking removed from around the joint is quickly replaced.

About half a mile of track was welded with these joints in the late fall of 1897 upon the line of the Milwaukee Electric Railway & Light Company, of Milwaukee, and during the year 1898 ten thousand joints were welded upon the lines of the same company, including the welding of a suburban line from the city of South Milwaukee to the city of Milwaukee, a distance of about eight miles of exposed track. On this line to South Milwaukee a joint was used at distances from 500 to 1000 ft. to provide for the contraction and expansion of the rails where they were exposed; but subsequent welding on other lines of exposed rail demonstrated that it is not necessary to have a slip joint in order to make a cast welding of rail joints upon exposed track. The work being properly done, these joints will hold as well on exposed rails as upon embedded tracks, and the contraction and expansion seems to be entirely overcome by the strength of the joint.

This method of joint also seems to afford a perfect electrical bond. The electrical conductivity of the line welded between the city of South Milwaukee and the city of Milwaukee, by tests made by the Milwaukee Electric Railway & Light Company, varied from 118 per cent to 126 per cent, thus exceeding the conductivity of the rail itself from 18 per cent to 26 per cent, being the highest conductivity upon record given to any electric rail.

The success of the joint is proved by the work it has done, the welding made in the late fall of 1897 having stood to the present time without a single joint breaking, and the percentage of breakage upon the 10,000 joints welded during the year 1898 has been less than one-half of one per cent.

In the spring of 1898 the Milwaukee Electric Railway & Light Company gave to the Milwaukee Railjoint & Welding Company

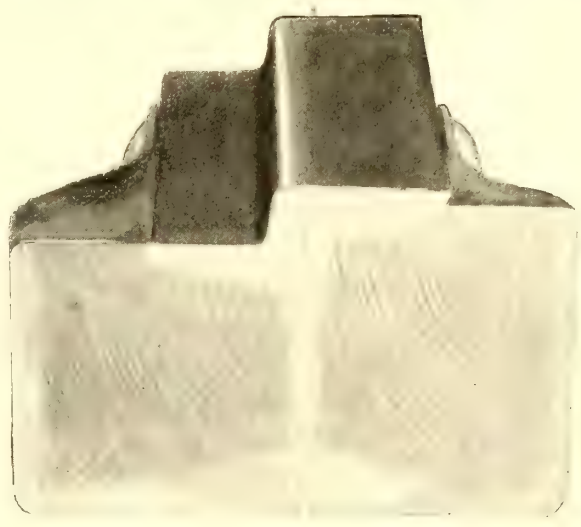


FIG. 2.—SECTION OF JOINT

a contract for 1,000 joints, and in the summer another contract for 10,000 more joints, and when these were completed, gave it a contract for 1899 for 20,000 joints, which will complete the welding of the entire system of the Milwaukee Electric Railway & Light Company in the city of Milwaukee, it having had welded, during the season of 1896-97, about 15,000 joints made by another company.

One of the cuts herewith shows the joint longitudinally as it looks upon the track, with the necessary paving cleared away to enable the making of the joint. (Fig. 1.) Fig. 2 shows a sectional view of the joint sawed one-half of an inch from the meeting of the rail ends. It shows the steel jacket around the outer part of the joint, the web of the rail in the center united to the cast-iron filling, which is fused to the rail web and flanges and to the steel jacket around the joint.

The Milwaukee Railjoint & Welding Company reports a very encouraging outlook for a large amount of welding during the season of 1899. It has its own patents, which, the company claims, cover very broadly this form of joint.

A New Repair House

The Advance Electric Company, which is an old established supply house in Indianapolis, has opened a department for the repair of street railway motors and other electrical apparatus. The company has engaged as foreman of its shops, David Fryer, a man of eighteen years' experience in this class of work, and whose ability and skill are recognized by many electrical men throughout the Central States.

The company tests all its windings and coils before sending them out, and is proud of the fact that in a long experience in the lighting field, it has never yet had a single piece of work returned on account of bad workmanship. Eighteen years' experience in the shop has bred a familiarity with every type of machine on the market, and the company keeps constantly on hand armatures and field coils for all the standard machines.

Located in Indianapolis, one of the best railroad cities in the Central States, the shipping facilities of the new company are unexcelled. The company's standard is best work and best material at moderate prices. The company has lately been reorganized with increased capital and is able to do street railway repairing on a large scale. Harry B. Marsh, the newly elected president, and Charles H. Talmage are in charge of the active management, and the reputation of these gentlemen is a guarantee that their work will be satisfactory.

A street railway company of San Diego, Cal., is using salt water for sprinkling its tracks. Electric sprinkling cars are employed.

New Combination Car of the California Type

The Brooklyn Heights Railway Company has just put in operation a new car of the California type, which, from its large size and arrangement of details, is of considerable interest. It is very similar in general appearance to the large cars recently put in service by the Metropolitan Street Railway Company of New York, but differs from them in several important details.

The first thing to be noticed is the fact that there is no step on the sides of the closed body of the car, and the body has no hand-rail. Experience with other cars of this style showed that this was a very necessary and important change. In the cars previously built for the Metropolitan Railway by the Brill Company, the sill ran through from crown-piece to crown-piece. This, of course, raised the rear platform, or that of the closed end of the car, very high, and considerable difficulty was found when old people and children attempted to enter. In the new car the sills run only to the end of the body, and the platform is dropped in the usual way, by the use of platform knees. This slight alteration brings the platform down practically as low as that of the open car, enabling it to be reached by a step only 13¾ ins. from the rail, with a 13-in. riser. All the new cars now in course of construction for the Metropolitan road are also having this change introduced.

The length of the car over the corner posts is 36 ft., the length over the buffers being 44 ft. It is 6 ft. 6 ins. wide at the sills and 7 ft. 2 ins. at the post. On the front or open end of the car the platform is 3 ft. 8 ins. Ample strength is secured for the side sills by plating them with iron. The closed section is 11 ft. 2 ins. over the end panels, and has two double doors. The open section has seven cross seats, two of which, setting against the forward bulkhead, have stationery backs. Along the open portion there are the usual folding steps at the sides. These steps are 18½ ins. from the ground, with a 13-in. riser. The height in this case from the head of the rail to the under side of the sill is 28 ins. Brill maximum-traction trucks with a 4 ft. wheel base are used under the car. The wheels are respectively 30 in. and 20 in. in diameter. There are two w.p. 50 motors.

The ends of the car are provided with angle-iron buffers, and gates are used on one side of the rear platform, with a Brill folding gate on the opposite side. The seats in the closed compartment are longitudinal and covered with spring rattan, seating fourteen passengers; the open portion accommodates thirty-five, making a total of forty-nine seats. The closed compartment is finished in



COMBINATION CAR IN BROOKLYN

cherry throughout, with three-ply quartered oak ceilings. Cherry and ash are used for the finish in the open section.

Push-buttons are placed on each post, to signal the conductor. There are two 12-in. Dedenda gongs with disappearing buttons. There are two sand-boxes. The headlights are in the dasher. The trolley board extends the whole length of the car. The grab-handles of the posts are of ash, set in solid bronze sockets. Each of the seats in the open part of the car is fitted with a Brill round-corner seat end panel; by their use it is possible to bring the curtains down to the floor without catching or tearing—a feature which renders the open part of the car dry and comfortable in storms, and is one of the reasons why cars of this class are being so favorably received.

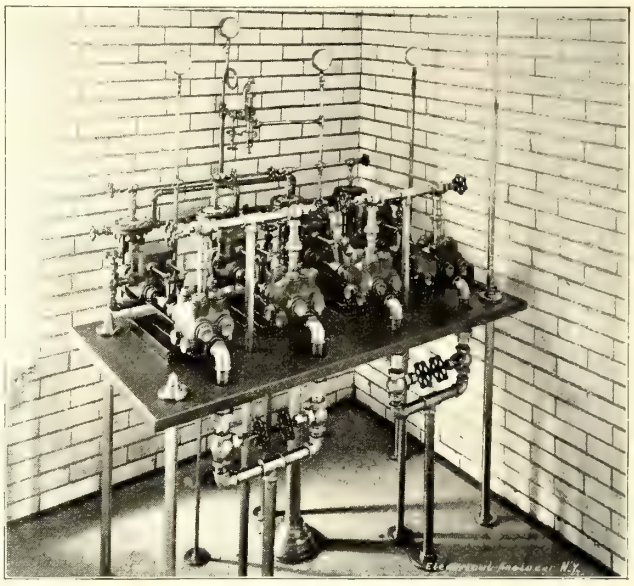
The weight of the car without motors is 17,200 lbs. The trucks weigh 3,250 lbs. each. The California car, with the modifications which are going on in its design and construction since its introduction in the East, is rapidly coming into favor wherever a large traffic has to be accommodated.

The Compagnie des chemins de fer sur routes, of Algiers, has ordered eight new cars with double Walker equipment and Dickinson trolley.

Automatic Lubrication

The economy of power generation in an electric railway system is often the determining factor in the financial success of the road, and the modern power station is equipped with every device which tends to reduce the operating cost. Among the many minor improvements in this line there is none which has met with greater favor, perhaps, than that of the automatic oiling of the wearing parts, for it not only reduces largely the labor of attendance, but provides a sure and cleanly system of lubrication.

A very ingenious, but simple and effective, system of oil distribution is that used in the power station of the Missouri-Edison



PUMPS FOR LUBRICATORS

Electric Company, of St. Louis. The system was designed by the Siegrist Lubricator Company, of that city. The oil is circulated under pressure, and the arrangement of the pumping apparatus is shown in the accompanying engraving. These pumps, which are four in number, are of the smallest size of duplex steam pumps, were especially designed for this work, and are mounted on a slate-top table in a corner of the engine room. The pumps are connected in pairs, and one of each pair serves as a relay. One pair is designed to pump the engine lubricating oil, and the other the cylinder oil. The oil is pumped to the different bearings, where the sight feed-oil cups are located. The rate of drip from each oil cup can be regulated at will by a thumb screw, but the piping system is so arranged as to close the drip feed if the pressure on the piping system is lowered more than 2 lbs. The only thing required then to control the oiling system is to open or close the one globe valve placed in the main oil-supply pipe The closing of this valve stops the oil at every oil cup within a few seconds, thus preventing any waste of oil after the engine is stopped. The oil is piped back from all drips of the engines and generators to filters located in the basement.

The cylinder oil is controlled in the same way as the engine oil, through sight-feed lubricators for each cylinder, placed at a convenient height from the floor. The pressure maintained in the cylinder lubricating system is, of course, slightly higher than the steam pressure.

The lubricators employed in the system are illustrated in section in the accompanying engravings. Fig. 2 shows an ordinary pressure oil cup, which is placed in the same position as an ordinary oil cup. The opening D connects with the feed. As soon as the oil enters the cup it acts upon the diaphragm, raising the small valve from the seat C, thereby allowing the oil to flow in drops or in a stream, according to the wishes of the engineer, who can regulate it by the small regulating screw A. When the pressure is relieved the valve automatically closes the cup, as already described, preventing the waste of oil.

The cylinder-lubricator is illustrated in Fig. 3. This device is screwed in the steam pipe in the same position as the ordinary lubricator, and the opening D is connected to the cylinder oil-pipe line by a small ¼-in. pipe, so that the lubricator would be supplied with cylinder-oil under pressure. As soon as the oil enters the

lubricator it acts on the diaphragm B, lowering the small valve from the seat C, thereby forcing the oil in drops or in a stream up through the water in the sight-feed glass and into the steam pipe, to be carried by the steam into the cylinder of the engine. The rate of feed in this cylinder can be regulated by the screw A. The

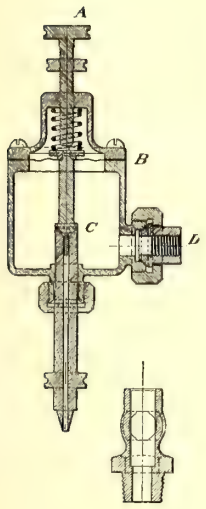


FIG. 2

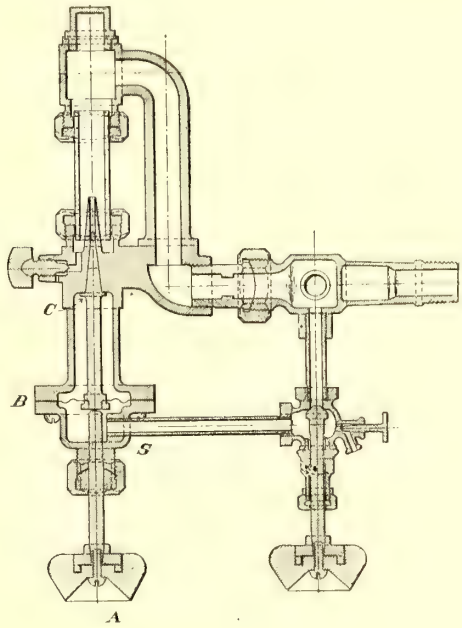
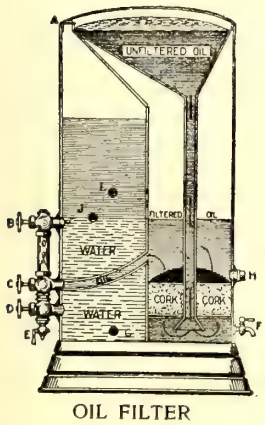


FIG. 3

steam connection shown beneath the diaphragm acts instantly to close the valve in case the oil pressure should fall below that of the steam, thus keeping the glass free from oil.

Oil Filters

The handsome oil filters of the Kosmic Oil Filter Company, of Easton, Pa., are now found in many of the largest power stations throughout the country. In this filter the oil, instead of being clarified by passing downward simply through some straining material, is passed upward through a layer of cork, and, in addition, is permitted to rise for a considerable distance through a body of water, this latter process effectively removing all impurities that might possibly make their way through the cork.



OIL FILTER

As will be seen from the cut, a partition divides the filter into two compartments, this arrangement possessing the advantage of enabling one part to be cleaned without interfering with the other. By regulating the center valve, which controls the flow of oil from one compartment to the other, the degree of purity can be seen as it passes up through the water in the glass tube, and the whole process can be regulated by the engineer in charge according to the purity of oil desired.

Carbon Brushes

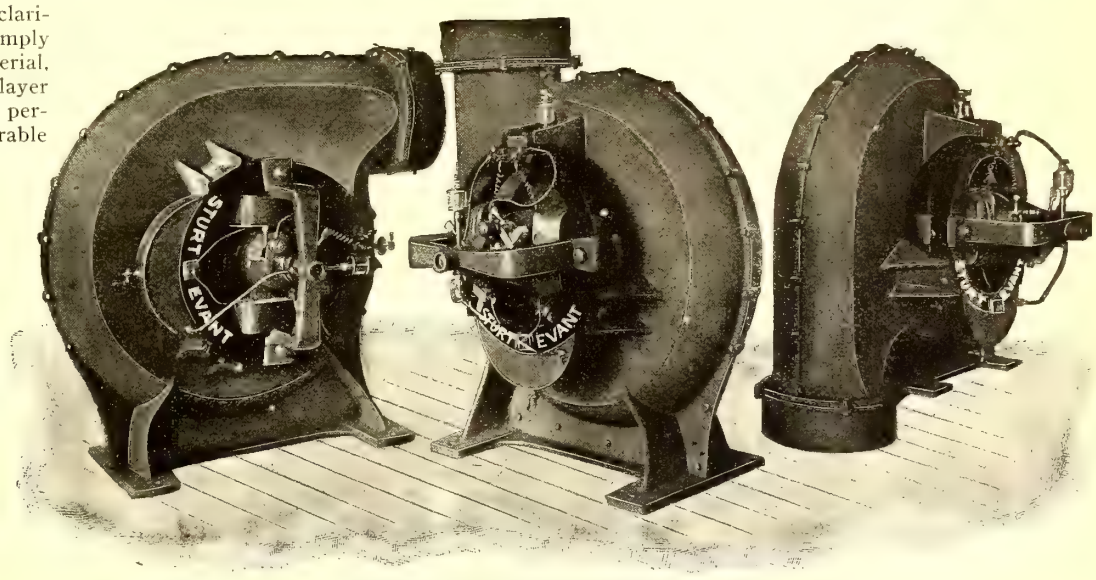
A treated carbon brush for motors, generators and dynamos, especially designed for saving the commutator, is manufactured by the Le Valley Vitæ Carbon Brush Company, of New York. This brush has come into very extensive use, and numerous testimonials to the satisfaction given by it are being received, one street railway company writing that the Vitæ brush had run nearly 19,000 miles on one of its street railway motors. Although these products have been in use for only two years they have been adopted as standard by a number of leading street railway and electrical companies after severe tests.

The manufacturers claim that the Vitæ brush does not cut or wear the commutator, that it wears many times longer than other brushes on the market, is thoroughly self-lubricating, never gumming the segment tips, requires little attention, runs from 7 to 10 deg. cooler than other brushes, and having great conductivity it conveys the current without loss; and, further, that it leaves no deposit of dust in the motor, which is one of the causes for short circuiting.

Special Types of Electric Fans

The rapid development in the employment of electric fans for ventilating and other purposes, has led the B. F. Sturtevant Company, of Boston, Mass., to prepare special designs suitable for special conditions. The shells of those illustrated are of cast iron, like the regular monogram blowers and exhausters manufactured by this company. The one upon the left, as is evident from the position of oil cup and oil tank, is designed to be attached to a vertical wall, and to discharge directly upward. That at the centre may be placed upon the floor to discharge in the same direction, while that upon the right is designed for vertical downward discharge.

The motor is of the bi-polar type, the field rings and pole pieces being of wrought iron, and the frame accurately centered and held securely in place by bolts introduced through lugs projecting from the side of the fan. The general internal construction consists of drum-wound armature, having a commutator with ample brush surface, and of reaction brush holders with fibre graphite brushes. Yokes extending from either side of the field ring, and provided with ring oiler boxes, serve to support the armature shaft. All trouble from oil is avoided by conducting the overflow through tubes to the small receiving tank beneath and attached to the field ring. Fans of this type are built in sizes ranging from 18 ins. to 6 ft. high, and designed to deliver air under pressure ranging from 1 oz. to 5 ozs.



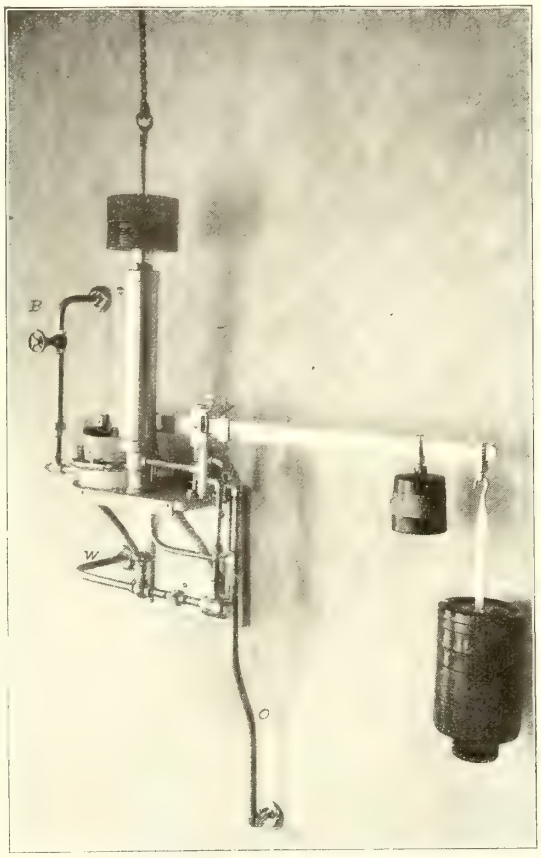
SPECIAL TYPES OF ELECTRIC FANS

An instance of the progressiveness of the technical press was recently shown by "Lomotive Engineering" of New York. This paper's entire editorial office was burned out in the recent Home Life Insurance Building fire, and yet the paper appeared very nearly on time with its usual amount of valuable and interesting matter. This necessitated almost superhuman efforts on the part of the editors and managers, and they are certainly to be congratulated upon their success.

Improved Hydraulic Damper Regulator

A machine for accurately regulating the steam pressure of boilers by regulating the admission of air to the fires through the dampers is shown in the engraving herewith. This regulator can be easily erected in the boiler or engine room and connected to the dampers to control from one to twenty boilers.

Referring to the illustration, B is the steam pipe connection coming through the wall from the boilers, W is the water connection for supplying the water that operates the damper motor. and S is a strainer to prevent foreign matter from getting to the damper water valve. By unscrewing the cap at the end of the strainer any collection of matter can be cleaned out without breaking the pipe



HYDRAULIC DAMPER REGULATOR

connection. The overflow pipe for carrying off the discharge water is shown at o. The valve controlling the water passing to and from the damper motor is operated by a lever, to which weights are attached, and by placing the proper weights upon the lever, the regulator can be set to close the dampers at any desired steam pressure. The machine can also be used for testing steam gages without removing them from the boilers.

All the parts of the apparatus have been carefully designed from a scientific and engineering standpoint, and it is claimed that for simplicity of construction, neatness in finish and sensitiveness in operation this regulator is not surpassed by any other on the market. It is guaranteed that a change of one-half pound to the square inch of boiler pressure will open or close the heaviest dampers. The apparatus is made by the Patterson Damper Regulator Company of Baltimore, Md., and was designed by George F. Patterson, president of the company, who has been for many years almost exclusively engaged in handling damper regulators, and is, therefore, well acquainted with the requirements.

The Increasing Demand for Car Fenders

The danger to life and limb incident to the increased speeds at which electric cars are now run through crowded city thoroughfares as well as through less densely populated suburband and interurban districts has brought very forcibly, and often very painfully, to the minds of street railway general managers the necesity of equipping their cars with proper and efficient life-saving devices Up to a comparatively recent period, fenders, if used at all, were generally added as an afterthought, whereas now they are rapidly coming to be considered a nearly indispensable part of the equipment, and are often given considerable attention in the specifications for rolling stock.

The magnitude to which the car fender business has grown is shown by a recent report of the Consolidated Car Fender Company, of Providence, R. I., manufacturer of the Providence fender. Since starting in business four years ago, this company has equipped 5000 cars with its device, and the Providence fender is now in practical use in more than eighty cities and towns in the United States and Canada. The Metropolitan Street Railway Company, of New York, has alone purchased 1188 equipments.

The Consolidated Car Fender Company reports that orders and inquiries already received this year clearly indicate that the demand for its fender during 1899 will far exceed that of any previous year. Among the orders just completed are fenders for all the motor cars of the Auburn City Railway Company, Auburn, N. Y.; the Middletown-Goshen Traction Company, Middletown, N. Y.; the South Chicago City Railway Company, Chicago, Ill., and the Van Brunt Street & Erie Basin Railway Company, of Brooklyn, N. Y. A large number of Providence fenders were also recently furnished the Ottawa Car Company, Ottawa, Ont., and will be placed on new cars now being built for street railway companies in Canada. The Consolidated Company is daily receiving orders from one or more of the many roads using its device for new equipments to be placed on new cars that are being added to the various systems. The business received in this way alone is sufficient to keep its factory running full time without the new business that is continually coming in. In order to fill all demands promptly, it is found necessary to carry in stock not less than 1000 full equipments.

The steady and rapid growth of the business of the Consolidated Car Fender Company is a practical illustration of making "the best" regardless of the first cost.

Personal

MR. S. DANA GREENE has been appointed general sales manager of the General Electric Company.

MR. A. E. BURLAND, superintendent of the Newport Street Railway Company, of Newport, R. I., on Dec. 25, was presented a testimonial of esteem by the employees of the line.

MR. F. P. MOONEY has resigned his position as general superintendent of the Cortland & Homer Traction Company and the Cortland & Homer Electric Company, of Cortland, N. Y.

MR. H. A. EVERETT has been elected president of the Cleveland Electric Railway Company, of Cleveland, Ohio, in place of Mr. H. E. Andrews. Mr. Charles L. Pack has been appointed vice-president.

MR. O. M. RAU, chief electrician of the Milwaukee Electric Railway & Light Company, will temporarily fill the position of superintendent of the lighting department, in place of S. G. Coleman, who recently resigned.

MR. HENRY N. RANSOM, who is well known in the street railway field as New York representative of the Consolidated Car Heating Company, will soon be married to Miss Gillet, daughter of Mr. Ainslie M. Gillet, of Albany.

MR. T. H. ANDERSON has been elected general manager of the Somerset Traction Company, of Skowhegan, Maine, to relieve Mr. R. B. Shepperd, the president of the road, who has heretofore held the title of general manager also.

COL. EUGENE GRIFFIN, of the Volunteer Engineer Corps, and first vice- president of the General Electric Company, was recommended last month for appointment as Brigadier General, for valuable service rendered in Porto Rico during the late war.

MR. J. M. SHENK has resigned from the presidency of the Lebanon & Annville Street Railway Company and the Lebanon & Myerstown Street Railway Company, both of Lebanon, Pa., on account of other duties requiring his attention. Mr. S. P. Light was elected president in his place.

MR. H. F. PARSHALL, of London, has secured the gold medal of the British Institution of Electrical Engineers, for his paper on "Earth Returns for Electric Tramways," delivered before the Institution on April 28, and reprinted in the Street Railway Journal for June, 1898, page 322.

MR. F. C. ARMSTRONG, engineer with Dick, Kerr & Company, Ltd., of London, was married on Jan. 11, at Cobourg, Ontario, to Miss Helen R. McCallum, of Cobourg. Mr. and Mrs.

Armstrong sailed for Liverpool on the steamship Teutonic, Jan. 25, and will live in one of the suburbs of London.

MR. CHARLES SHELDON has resigned the position of general manager and treasurer of the Consolidated Car-Heating Company, of Albany, N. Y., to become manager of the Chihuahua & Pacific Railroad, with headquarters at Chihuahua, Mexico. Mr. Frederick W. Kelley, who has been Mr. Sheldon's assistant, has been appointed general manager and treasurer of the Consolidated Car-Heating Company.

MR. WM. E. COOKE, representing the London syndicate controlling the tramways system at Perth, Western Australia, arrived in Perth late in December and commenced immediately upon the work of converting the horse tramways to electric. He states that owing to the heat of the climate, the hilly nature of the city, the badness of the roads and the large and scattered area within the city boundaries, Perth is an excellent street railway city.

MR. J. W. HICKS, superintendent of the Rochester Railway Company, and Mr. Thomas Hicks, assistant superintendent, were very pleasantly surprised by beautiful gifts from employees of the road, at Christmas time. These gentlemen are very popular with the company's men, and to show their esteem the employees raised a fund and presented Mr. J. W. Hicks with a handsome parlor cabinet of solid mahogany, and Mr. Thomas Hicks, with a fine easy chair of solid mahogany.

MR. W. R. MASON, who was representing the Walker company at St. Louis at the time of the consolidation of that company with the Westinghouse, has been appointed manager of the St. Louis office of the Siemens & Halske Electric Company. Mr. Mason is well known in the street railway field, and his large acquaintance, railroad experience and characteristic energy and perseverence would naturally make him a valuable acquisition to any company closely identified with the electric railway or lighting interests which secured his services.

EX-BALLIES H. CRAWFORD, THOMAS MASON AND MICHAEL SIMONS, ex-members of the town council of the city of Glasgow, Scotland, and Mr. J. Murry Smith, of the "Glasgow Evening News," are in America, and will visit a number of the principal cities of this country. The main object in making this trip is to interest the American Government in the International Exposition to be held in Glasgow in 1901. This exposition will afford American manufacturers an excellent opportunity to exhibit their goods to the Scottish people, and advantage will undoubtedly be taken of this opportunity by a large number of firms. The gentlemen from Glasgow will also pay particular attention while in America to electric railways, and will inspect a number of prominent systems.

MR. JOHN E. ANGER, recently with the John Stephenson Company, Ltd., has accepted the position of master car builder of the Electric Railway & Tramway Carriage Works, of Preston, England. The formation of this company was mentioned in a recent issue of the STREET RAILWAY JOURNAL, and it proposes to do a large business in the manufacturing of tramway cars. Mr. Anger is well known in the car building industry in this country. He began his career in this business with the Gilbert Car Manufacturing Company, of Troy, N. Y., in 1869, and remained with that company until the close of the year 1876, when he accepted a position in the car building shops of the New York Central Railroad Company. He remained with this latter company for about five years, when he resigned to enter the employ of the Jones Car Manufacturing Company, whose factory was then located at Schenectady, N. Y. When these shops were leased by the Gilbert Car Company, Mr. Anger was offered a position with this company again as first foreman, but was soon promoted from one position to another until he was made superintendent of the Schenectady plant. When the Gilbert Car Manufacturing Company abandoned its Schenectady plant, Mr. Anger removed to the company's Green Island plant, where he was assistant to Mr. F. A. Stanley, then general superintendent. He remained with the Gilbert company until it became insolvent, when he accepted a position with the Jackson & Sharp Company, of Wilmington, Del., with whom he remained for about four years, or up to last spring, when he became associated with the John Stephenson Company, at its Elizabeth plant. He installed the entire machinery at the latter plant and remained with the Stephenson company until the middle of December, when he decided to accept the offer of the Electric Tramways & Carriage Company. Mr. Anger is forty-five years of age, and being naturally of an inventive turn of mind has made many improvements facilitating the construction of cars. He has also taken out a number of patents in the line of trucks and car seats, and at the present time is engaged on several other improvements in car building. He has always won the good will and best wishes of his employers and associates.

Obituary

MR. W. BARTLETT, chief engineer of the St. Louis & Suburban Railway Company, of St. Louis, Mo., died at his home on Jan. 16, 1899.

MR. E. K. STONE, for many years general manager of the Quincy Horse Railway & Carrying Company, of Quincy, Ill., died recently at his residence in Quincy.

MR. M. C. BULLOCK, for many years president of the Bullock Manufacturing Company, of Chicago, Ill., died in that city on Jan. 12. Mr. Bullock was born in 1838, at Granville, N. Y., and spent the early years of his life on a farm. Being attracted to the trade of a machinest, he served his apprenticeship in a shop near his home, and then traveled from State to State for the purpose of gaining wider experience in his chosen vocation. He was connected with a number of well-known manufacturing companies, and also did considerable engineering work, until 1878, when he started the Bullock Manufacturing Company. Through his tireless efforts this business was placed upon a successful basis, and he gradually broadened its scope until it included the manufacturing of rock drills, air compressors, hoists, diamond drills, steam engines of all kinds, etc., the latest being the Willans high-speed engine. Mr. Bullock has been failing in health for over a year, but his death was unexpected.

AMONG THE MANUFACTURERS

DICK, KERR & COMPANY, LIMITED, of London, have sold five Walker car equipments for the West Hartlepool Tramways, owned by the British Electric Traction Company.

MESSRS. McCLAVE & HAMILTON, of New York, are representing in New York and vicinity, James Bonar & Co., manufacturers of steam appliances, and the Pittsburgh Feed Water Heater and Engineering Company.

JOHN A. ROEBLING'S SONS' COMPANY, of Trenton, N. J., has published its new price list for all kinds of bare and insulated telegraph, telephone and trolley wires, underground cables, lamp cords, etc.

THE COLUMBIA INCANDESCENT LAMP COMPANY, of St. Louis, Mo., is sending out its new catalogue, containing five full-size reproductions of the various styles of direct and alternating-current incandescent lamps which it manufactures.

GEO. A. PARMENTER, Cambridgeport,, Mass., manufacturer of the Parmenter fender and wheel guards, reports that among other orders lately closed is one for the equipment of the entire system of the City & Suburban Railway Company, Washington with Parmenter fenders and wheel guards.

CARD CASE.—The Electrical Installation Company, of Chicago, Ill., general street railway contractors, are sending to their friends a very handsome and useful pocketbook and card case. The case is made of black leather and contains compartments for cards, papers, etc. This little souvenir will be heartily appreciated by all those fortunate enough to secure one.

PENCILINGS.—One of the daintiest catalogues of the season has just come from the press of the Dixon Crucible Company, of Jersey City, N. J. This little pamphlet bears evidence of most careful thought in its preparation, and tells in a very lively and interesting manner what the requirements of a good lead pencil are and how Dixon pencils fully fill all these requirements.

THE BIBBER-WHITE COMPANY, Boston, is sending to its friends a very acceptable souvenir, consisting of a combined calendar and thermometer for desk use. The Bibber-White Company reports that the past year has been an unusually good one in the street railway line for it, while business for the new year is starting off with a pace that bids fair to tax its present capacity.

THE BAKER HEATER, manufactured by Wm. C. Baker, of New York, claims to satisfactorily solve the problem of heating street cars, particularly long interurban cars. This system of heating was fully described in the last issue of the STREET RAILWAY JOURNAL, and the company reports that its apparatus is in use on a number of systems, and that inquiries and orders are being constantly received.

THE AMERICAN ENGINE COMPANY, of Bound Brook, N. J., has found it necessary, on account of the increased growth of its business, to establish a branch office in New York City. This office will be located in the White building, 95 Liberty Street,

and will be in charge of Edwin S. Boyer, formerly of Philadelphia. All orders or inquiries sent to the New York office will have prompt attention.

THE CARNEGIE STEEL COMPANY, LIMITED, Pittsburgh, Pa., has placed an order for 5000-h.p. Pittsburgh feed-water heater and purifiers for its new plate mill. This is the third order placed with the manufacturers of these heaters by the Carnegie Company, and is good evidence of the fact that they are giving good satisfaction. This makes 33,500-h.p. Pittsburgh heaters in the Carnegie plants.

JAMES BONAR & COMPANY, of Pittsburgh, Pa., have made arrangements for special agencies for the sale of their Pittsburgh feed-water heater and purifiers, Bonar gage cocks and Bonar oil filters for the New York territory, with Messrs. McClave & Hamilton, 141 Broadway, New York, N. Y., for New England, with F. W. Ashcroft, 63 Oliver Street, Boston, Mass., and for Mexico, with Robert J. Campbell, City of Mexico.

THE CHAPMAN VALVE MANUFACTURING COMPANY, of Indian Orchard, Mass., announces that it has a complete stock of Chapman gate valves for water, high and low pressure steam, gas, oil, ammonia, air and brine. This stock has been placed in Philadelphia, so that the trade and users of valves in the Middle Atlantic States can have orders filled without delay. The headquarters of this company in Philadelphia are at 40 North Seventh Street.

THE SPRINGFIELD MANUFACTURING COMPANY, of Bridgeport, Conn., has met with pleasing success in the introduction of its wheel-grinding machines. A number of these are now in course of construction, and several have been shipped within the last few weeks. Among these may be mentioned one for the Boston Elevated Railway Company, and one to South America. One of the grinders now building will go to a large road in Japan.

HEYWOOD BROTHERS & WAKEFIELD COMPANY, of Boston, Mass., among other contracts, recently supplied all the seats for the three handsome cars built by the Laconia Car Company for the Newton Street Railway Company, of Newton, Mass., and which were described in the last issue of the Street Railway Journal. These seats are of the Henry reversible type, and were chosen for their handsome appearance and strength and simplicity of construction.

LUNDELL MOTORS.—The Sprague Electric Company, of New York City, has published another of its elaborate and valuable catalogues for which this company is famous. This pamphlet is devoted to a detailed description of the Lundell motors and their application to Linotype machines, printing presses, metal and woodworking machines, elevators, horseless carriages, etc. The book contains a number of curves showing the remarkable efficiency of these motors.

THE M. MITSHKUN COMPANY, of Detroit, Mich., reports that its business has increased largely of late, and that prospects in general are excellent. The company has been established a long time, and is well known throughout the entire country. It is able to furnish at short notice steel rails of any desired weight, and these are kept in stock and ready for immediate shipment. The company also has on hand locomotives suitable for construction purposes, steam shovels, and other railway and contractors' supplies.

A GOOD LIGHT for night construction, shop work and heavy metal heating is a nearly indispensable part of the equipment of an up-to-date street railway. One of the best lights for this purpose on the market is the Wells light, manufactured by the Wells Light Manufacturing Company, of New York, and it has been adopted as standard by many of the leading railways and contractors of the country. It is being used extensively in the new conduit construction of the Metropolitan Street Railway Company in New York.

THE SIMPLEX ELECTRICAL COMPANY, of Cambridgeport, Mass., in its new catalogue for 1899 fully describes its very complete line of electrical heating apparatus. This company has gone very extensively into this subject, and manufactures heating and cooking articles of almost every conceivable description, including portable stoves, tea-kettles and stands, electric chafing-dishes, boilers, flat-irons and radiators, and heaters for waiting rooms and electric cars. The car heaters are in extensive use, and are giving good satisfaction.

ELECTRICAL SPECIALTIES.—The Sterling Supply & Manufacturing Company, of New York City, has issued its catalogue for 1899, and in this will be found descriptions of the numerous street railway "Sterling" specialties. These include registers, safety brakes, insulation, commutator bars, car fenders, sand boxes, etc. There is no line of goods in the street railway industry more widely or favorably known than the "Sterling" specialties, and the company reports an excellent business for the past months and splendid prospects for the coming year.

THE BERLIN IRON BRIDGE COMPANY, at East Berlin, Conn., has just shipped several carloads of bridge material to the Hawaiian Islands. It is believed this is the first American bridge that was ever put up in these islands. The contract for this bridge was obtained through the Berlin Iron Bridge Company's regular established agency located at Honolulu, and men will be sent from the United States to put up the bridge, which is for highway travel. It consists of one span of 200 ft. 40 ft. wide, and will be located across a river in one of the larger towns of the islands.

W. B. UPTON, who has been engaged as the principal assistant engineer of the Capital Traction Company, of Washington, D. C., in its work of changing its cable railway to the open conduit electric system and in the building of the new power station illustrated in the last issue of the Journal, has resigned from that position, as his work has now been completed. Mr. Upton has resumed his practice as consulting engineer, with headquarters in the Washington Loan and Trust Building, in Washington, and is making a specialty of open conduit electric systems, electric power stations and building engineering.

THE BONNER RAIL WAGON COMPANY, of Toledo, Ohio, is putting upon the market an express wagon so built as to be mounted on a truck adapted for electric railway track. Until recently three of these wagons have been running between Toledo and Bowling Green. They are connected up in a train, and are drawn by an ordinary motor car to distribution points. The rail wagon is then switched out of the main track, the wagon is run off the track, horses are attached, and distribution is commenced. On the return trip the wagon reaches the main track, is run upon the truck and taken in train to the central city. This system appears to have some advantages in special places.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., on account of the increasing demand for its goods in the Northwest, has decided to establish an agency at Chicago. The agency has been placed in charge of George B. Foster, late of J. Holt Gates & Company, who will make his headquarters at room 1519, Marquette building, but will spend considerable of his time traveling through the territory of the Northwest, placing before the companies of this section many Wagner specialties. Mr. Foster's territory includes the States of Minnesota, Wisconsin, Iowa, Northern Michigan, the western part of Southern Michigan, the northern part of Illinois, and the northern part of Indiana.

MESSRS. J. G. WHITE & COMPANY, are the consulting engineers and purchasing agents of the Deep Leeds Electric Transmission Company, of Victoria, Australia, a company organized to erect a complete plant for supplying energy for all mining purposes to three mines in Victoria. Contracts have already been made for electric apparatus with the General Electric Company, for engines with the Buckeye Company, for boilers with the Babcock & Wilcox Company, for condensers and pumps for power house with the Wheeler Condenser & Engineering Company. The mine pumps themselves, which are to be mounted on the same bed-plate with the motors, but geared to them, are to be manufactured in Australia.

THE UNION ELEKTRICITATS GESELLSCHAFT, which owned the German rights for all the patents of the General Electric Company, of America, took possession on Jan. 1, 1899, of the electro-technical factory, operated hitherto by the Aktien Gesellschaft, Ludwig Loewe & Company, whose entire business consisted in manufacturing the apparatus required by the Union Company. Wilhelm Laue, formerly on the board of directors of Ludwig Loewe & Company, has become a member of the board of the Union Company, and will occupy the position of managing director. The Union Company announces that the large increase of its capital in manufacturing facilities enables it to comply most promptly with the steadily increasing requirements of its business.

THE WORKS of the New Process Raw Hide Company, of Syracuse, N. Y., were destroyed by fire Dec. 19, resulting in a complete loss of the plant. At the time of the fire the company was running overtime on orders. Since the day of the fire this company has been working with its characteristic hustle to get a new plant in operation, and will be ready to run again by the first day of February. The new works will be located at 305-309 North State Street, Syracuse, the business office remaining at 348 West Washington Street. The product of the New Process Raw Hide Company has become known in about every section of the world that there is machinery in operation. Its raw-hide pinions are

well known in the electric railway field for their lasting qualities and freedom from noise.

HERMANN HEINRICH BOEKER & COMPANY is the name of a new firm organized Nov. 15, 1898, in Berlin, the members of which are H. H. Boeker, formerly connected with the Bergische Stahl-Industrie, of Berlin, and Moritz Boeker, engineer, of Remscheid. The selling business of the Bergische Stahl-Industrie, which is primarily a manufacturing company, having become too large to be well taken care of under its own name, it has turned this business over to the new firm, which intends to furnish a medium between manufacturers and customers of different countries, to handle agencies, etc. For instance, the new firm has received of the Standard Air Brake Company, of New York, the exclusive right of selling its air brake equipments in Germany, and other agencies are desired.

LARGE ORDER FOR BOILERS.—The Babcock & Wilcox Company has received from Westinghouse, Church, Kerr & Company the largest stationary boiler order that has ever been placed. The boilers are for the power plant which the Westinghouse Electric Company have contracted to build for the Third Avenue Railroad Company, of New York, at 218th Street and Harlem River, and which is to be constructed by Westinghouse, Church, Kerr & Company. The order covers sixty Babcock & Wilcox forged steel-type boilers of 520 h.p. each, or an aggregate of 31,200 h.p. The boilers are to be capable of carrying 200 lbs. steam pressure. They will supply steam for compound condensing engines of 64,000 nominal h.p. in the aggregate. Further particulars of this order were published in the last issue of the STREET RAILWAY JOURNAL.

ARTHUR W. FIELD, of Boston, is doing an excellent business in the many street railway specialties for which he is agent. Mr. Field is now the representative in New England of a number of the most important manufacturing companies in the country, and represents the Peckham Truck Company, American Car Company, Ruggles' rotary snow plows, Price's friction brakes, Wheeler reflectors, Brandon metal paints, etc. In fact, Mr. Field is ready to supply practically anything which goes into the equipment of a company's rolling stock. By enterprise, ability and careful attention to the wants of his customers, he has succeeded in securing an excellent business. His recent calendar is extremely attractive. Mr. Field has also just sold, as New England agent for the American Car Company, fifty open nine-bench cars and thirty open twelve-bench cars to the Boston Elevated Railway Company, delivery to be made May 1.

J. HOLT GATES & COMPANY, Marquette building, Chicago, report the following recent sales: Armour Glue Works, Chicago, one 225-kw. 500-volt generator, two 150-kw. 500-volt generators, seven 50-h.p. motors, two 100-h.p. motors, two 150-h.p. motors, one 30-h.p. motor, two 25-h.p. motors, all made by the Card Electric Company, Mansfield, Ohio; Deering Harvester Company, Chicago, seven 500-light transformers, five 400-light transformers, three 200-light transformers; Elkhart Lake Electric Light Company, Elkhart Lake, Wis., two 10-h.p. single-phase motors and transformers and direct dynamos, attached to large storage batteries for electric launches, Armour Glue Works, Chicago; one $3,000 switchboard, Pierce & Robinson, Chicago; one $700 switchboard, residence of P. D. Armour, Jr., Chicago; one 300-light electric light plant, with Nash gas engine direct connected.

ONE OF THE handsomest souvenirs that has come to hand is being sent out by the United States Projectile Company, of Brooklyn. The souvenir is for use as a paper-weight, and is a six-pounder projectile such as was used so effectively by our navy at Manila, Santiago and other places, but has been nicely nickel-plated so it will not rust. To comply with the Government ballistic test one of these projectiles must penetrate a steel plate 3 ins. thick without showing a crack or fracture of any kind. The United States Projectile Company is well known to the electric railway field as manufacturer of the patent hot-pressed pinions, of which upward of 50,000 have been sold since their introduction. The company has a very extensive and model plant, and during the war with Spain the Government orders for projectiles kept the plant running day and night, almost to the exclusion of all other work, but the company reports that it is again prepared to fill orders with reasonable promptness for its well-known pinions.

WIRE GAGE AS A SOUVENIR.—A very convenient souvenir in the shape of a combination foot rule and wire gage is being sent out by the Standard Underground Cable Company, of Pittsburgh, Pa., as a reminder that it is prepared to promptly fill all orders, large or small, for bare copper, iron or steel wire, weather-proof annunciator, office or magnet wire, galvanized steel strands, rubber-covered wire or cables, lead-covered cables for underground or aerial use, armored submarine cables, cable hangers, terminal or junction boxes and underground conduits. These various products are the results of many careful and costly experiments and tests by the corps of skilled experts constantly in the employ of the company, and the sixteen years of experience that the Standard Underground Cable Company has had in this line guarantees its competency to satisfactorily fulfil all contracts intrusted to its care. The little rule and wire gage is made in three sections, which fold upon each other, and it will be found very convenient for frequent use.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has recently booked many orders from England for street railway motors. There are 262 motors and eight generators to be turned out with all possible speed. An abstract of the contracts on hand is as follows: For the Hull Tramway Company, ninety-two electric ralway motors to equip forty-five cars and one track sweeper; for the Halifax Tramway Corporation, twelve motors to equip six cars; for the Bradford Tramway Corporation, forty-eight motors to equip twenty-four cars; for the municipality of Norwich, which has control of the tramways in that city, eighty motors to equip forty electric cars, and four electric generators to be installed in the power house of the Norwich Tramway Corporation, to generate the current for the operation of the line; for Coventry, twenty motors have been ordered to equip ten cars, and the order has been augmented by a call for two power generators. Plymouth has an order for ten motors and two power generators for operation of local electric railways.

THE WARREN ELECTRIC MANUFACTURING COMPANY, of Sandusky, Ohio, has appointed J. Holt Gates & Company, 1426 and 1427 Marquette building, Chicago, general agents for its apparatus in the Western territory surrounding Chicago. The Warren Electric Manufacturing Company has recently placed, through J. Holt Gates & Company, a 15,000-light alternating-current plant for the great new power and light plant of Armour & Company, at their extensive works at the Union Stock Yards, Chicago. This plant will consist of one machine of 7000 16-c.p. light capacity, at 1100 volts and 7200 alternations; also two 3600-light machines, at 1100 volts and 7200 alternations. These alternators are of the inductor type, and will be operated by rope drive from Corliss engines of 2000 h.p. and 1100 h.p. each, to which engines will also be attached Walker direct-connected power generators. It is stated that the Warren alternators were selected on account of their close regulation, high efficiency, low temperature and ability to stand "grief." The Warren Electric Company is now prepared to build 10,000-light machines, both single and two-phase, in its new factory, and has about sixty machines on order at the present time. Its new plant at Sandusky, Ohio, is modern and up to date.

RECENT DESCRIPTIVE MATTER CONCERNING MECHANICAL DRAFT.—The B. F. Sturtevant Company, of Boston, Mass., has brought out within the past few weeks a number of new pamphlets and circulars setting forth the advantages of mechanical draft for factories, power stations, etc. One of these circulars, entitled "Draft Without a Chimney," explains why the B. F. Sturtevant Company has taken down its tall chimney and substituted mechanical draft, and states that an annual fuel saving of nearly $1,000 has been secured thereby. The company has also found it necessary to issue a second edition of the lecture on mechanical draft for steam boilers, delivered at the Cornell University by Walter B. Snow, of the engineering staff of the B. F. Sturtevant Company, in order to meet the demand for information on this important subject. In addition to its mechanical draft system the B. F. Sturtevant Company manufactures generators and motors and direct-connected units for all classes of service. Its catalogue, Bulletin G, illustrates a unique generating set, in which both the engine and generator are entirely inclosed, although practically accessible through suitable doors. Such a device is of manifest utility wherever the atmosphere is laden with dust. All these circulars will be mailed on request.

BENT GLASS.—It is a well-known fact that bent glass adds to the attractiveness of any building or store front, in fact, a single pane gives extra tone to the whole structure. To those contemplating building or making alterations, it is important to know that common double thick glass can be bent to any part of a circle not exceeding half circle. Polished plate can also be bent in the same manner. The difference in appearance between the two lights after bending is hardly perceptible, in fact, when set in a building it would require an expert to detect any difference at all; however, there is quite a difference in the cost; bent double thick glass is only about one-fifth of the cost of bent plate glass, which is considerable of a saving in the construction of a building. The curving or bending of double thick glass takes away the waviness, gives a polish to the glass, and adds to its strength

and resistance to high winds and severe storms. This was clearly demonstrated in the city of St. Louis by the tornado that visited that city May 27, 1896. The largest manufacturer of bent glass exclusively in the United States is the Oriel Glass Company, of St. Louis, Mo. This company manufactures all kinds of bent glass for buildings, show cases, fancy furniture, etc., the product being all of superior make and finish, and shipped in large quantities, not only to all points in the United States, but also to Canada and Mexico.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, Mo., has had a successful career of eight years in the general electrical supply business, and has experienced a phenomenal growth in its various departments. This is especially noticeable in the street railway department, which has developed through the company's tireless efforts to supply what the trade demand, into a very satisfactory and gratifying business. This company carries in its St. Louis stock a very large and complete assortment of all supplies pertaining to street railway business, and it has succeeded in establishing an excellent reputation for making shipments with promptness and despatch, and its growth is undoubtedly due to a large extent to its prompt delivery of goods, as street railway companies fully appreciate the advantages of being able to secure the majority of their goods from stock, thus obviating the necessity of tedious and often exasperating delays on the part of manufacturers. It seems more than likely that the Western Electrical Supply Company, situated as it is, in the Southwest, which enables it to reach a large and spacious territory, will continue to increase its large business in this line, and receive the hearty support of street railway companies. This company represents some of the largest and best-known manufacturers of street railway supplies in the country, and is therefore able to furnish many specialties in this line which a street railway may require. It has recently issued a very complete catalogue, confined strictly to street railway supplies, and which may be had for the asking. This book was described in the January issue of the STREET RAILWAY JOURNAL, and will be found of value to all street railway companies.

New Publications

Powers of Municipalities. By Allen Ripley Foote. Paper. 79 pages. Published by the Robert Clarke Company, of Cincinnati, Ohio.

This is a discussion of the report on the municipal problem of the special committee of the National Municipal League.

The Customs Tariff of Japan, in Effect January 1, 1899. Paper. Published by Japan-American Commercial and Industrial Association, Times Building, New York.

In this pamphlet are given the ad valorem and specific duties contained in the new tariff law published March 29, 1897.

Massachusetts Institute of Technology Courses in Electrical Engineering and Physics. Paper. 65 pages. Published by the Institute.

This contains a full description of the laboratories, etc., of these courses, which have come to be the most popular in the Institute.

American Trade Index. Flexible linen. 276 pages. Published by the Association at its office in Philadelphia.

This is a descriptive and classified membership directory of the National Association of Manufacturers of the United States, arranged for the convenience of various buyers, and is a valuable book for its purposes.

Mechanical Features of Electrical Traction. By Philip Dawson, A. M., I. M. E. Paper. 16mo. 123 pp. 14 plates. Published by authority of the Council Institute Mechanical Engineers, London.

This is an excerpt from the minutes of recent proceedings of the Institute of Mechanical Engineers, containing a paper read by Mr. Dawson before the Institute and the discussion thereon. Many of the plates and tables are of much value.

Third Rail Electric Traction. By Charles Henry Davis and W. G. Howells. 84 pages. Paper. Illustrated. Reprinted from the "Municipal and Railway Record," New York.

In this article, which has been printed in pamphlet form, the authors briefly review the subject of surface contact and underground electric railway conduit systems. The greater part of the article is devoted to illustrations of the chief systems which have been proposed or are in use, and the authors deserve great credit for having collected and put in permanent form so much interesting data of this character.

The Technology Review. A Quarterly Magazine published at 71 Newbury Street, Boston, by the Association of Class Secretaries of the Massachusetts Institute of Technology. Price $1 per annum, 35 cents per copy. Volume I. No. 1. 143 pages.

This is a new quarterly of interest chiefly to the students and alumni of the Massachusetts Institute of Technology, but containing articles of general interest to those working in scientific fields. Its first number contains an article on the "Function of a Laboratory," by Silas W. Holman, together with reprints and fac simile of early institute documents and letters descriptive of the new buildings, and general institute news.

Up-to-Date Air Brake Catechism. By R. H. Blackall, Air Brake Instructor and Inspector on the D. & H. R. R. 240 pages. Illustrated. Price, $1.50. Published by Norman W. Henley & Co., 132 Nassau Street, New York City.

The increased use of heavy double truck electric cars has made the subject of air brakes an extremely interesting one, so that the book mentioned contains much of value to the street railway engineer. It is written in the popular catechism style and contains nearly a thousand questions with their answers. It is fully illustrated, and the engravings include two large folding plates of the Westinghouse quick-action automatic air brake and the 9½-in. improved air brake.

The Story of the Railroad. By Cy Warman. Cloth. 12mo. 280 pages. Illustrated. Price, $1.50. Published by D. Appleton & Company, New York.

This book pictures the building of the earlier transcontinental lines across the true West. It tells the story of the engineer who found the way and who was the pioneer of permanent civilization among the Indians and the buffalo of the plains and in the mountains. Historically, the book is valuable, because it gives a comprehensive sketch of a great subject in a brief compass, and, furthermore, the strange and picturesque phases of life which are depicted are full of immediate interest. An actual war, now forgotten, for the possession of a cañon in Colorado, is vividly described by the author, who has shared in the work of the railroad men, and who made a special journey through the West to gather fresh material for this valuable and entertaining book.

Matter, Energy, Force and Work. A Plain Presentation of Fundamental Physical Concepts and of the Vortex-atom and Other Theories. By Silas W. Holman, Professor of Physics (emeritus) Massachusetts Institute of Technology. 257 pages. Price, $2.50. Published by the Macmillan Company, New York.

To all who know Prof. Holman's keen, clear and intelligent brain, and his ability in putting before a student or reader an accurate conception of fundamental physical facts and theories, this book will instantly appeal as a valuable addition to their engineering library. Chapter I. deals with the established fundamental facts about substance and matter, motion energy in its various forms, force work and measurements. Part II. deals with speculations on matter and energy, including treatises on the function of theory and hypothesis, the kinetic theory of gases, Le-Sage's theory of gravitation, the vortex-atom theory, and the nature of energy and matter.

Trade Catalogues

"Nir" Rubber Wire. Published by the National India Rubber Company, Bristol, R. I. 24 pages.

Electric Fans. Published by the B. F. Sturtevant Company, of Boston, Mass. 8 pages. Illustrated.

Who Uses Mechanical Draft? Published by the B. F. Sturtevant Company, of Boston, Mass. 18 pages.

Lundell Motors. Published by the Sprague Electric Company, of New York City. 72 pages. Illustrated.

Pencilings. Published by the Joseph Dixon Crucible Company, Jersey City, N. J. 16 pages. Illustrated.

Electric Heating. Published by the Simplex Electrical Company, Cambridgeport, Mass. 50 pages. Illustrated.

Columbia Lamps. Published by the Columbia Incandescent Lamp Company, of St. Louis, Mo. 24 pages. Illustrated.

Catalogue. Published by the Sterling Supply & Manufacturing Company, of New York City. 32 pages. Illustrated.

Rubber Covered Wire and Strands. Published by the John A. Roebling's Sons Company, of Trenton, N. J. 6 pages. Illustrated.

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Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, MARCH, 1899. No. 3.

NEW POWER STATION, REPAIR SHOPS AND CAR HOUSES OF THE CONSOLIDATED TRACTION COMPANY OF PITTSBURGH

There are few street railway companies in the country, whose systems were equipped several years ago, that have so thoroughly changed over their methods and appliances to adapt them to the requirements of the hour, as the company named in the title of this article. The changes made, constitute, in some cases, radical innovations from standard practice, not only in the electrical equipment, but also in the mechanical and architectural departments, so that a study of the system is a particularly interesting one. The chief engineer, who is also manager of the system, originated all the plans and details, and is to be congratulated on the satisfactory results that have been reached, and commended for the original and novel manner in which the peculiar local problems have been met and mastered.

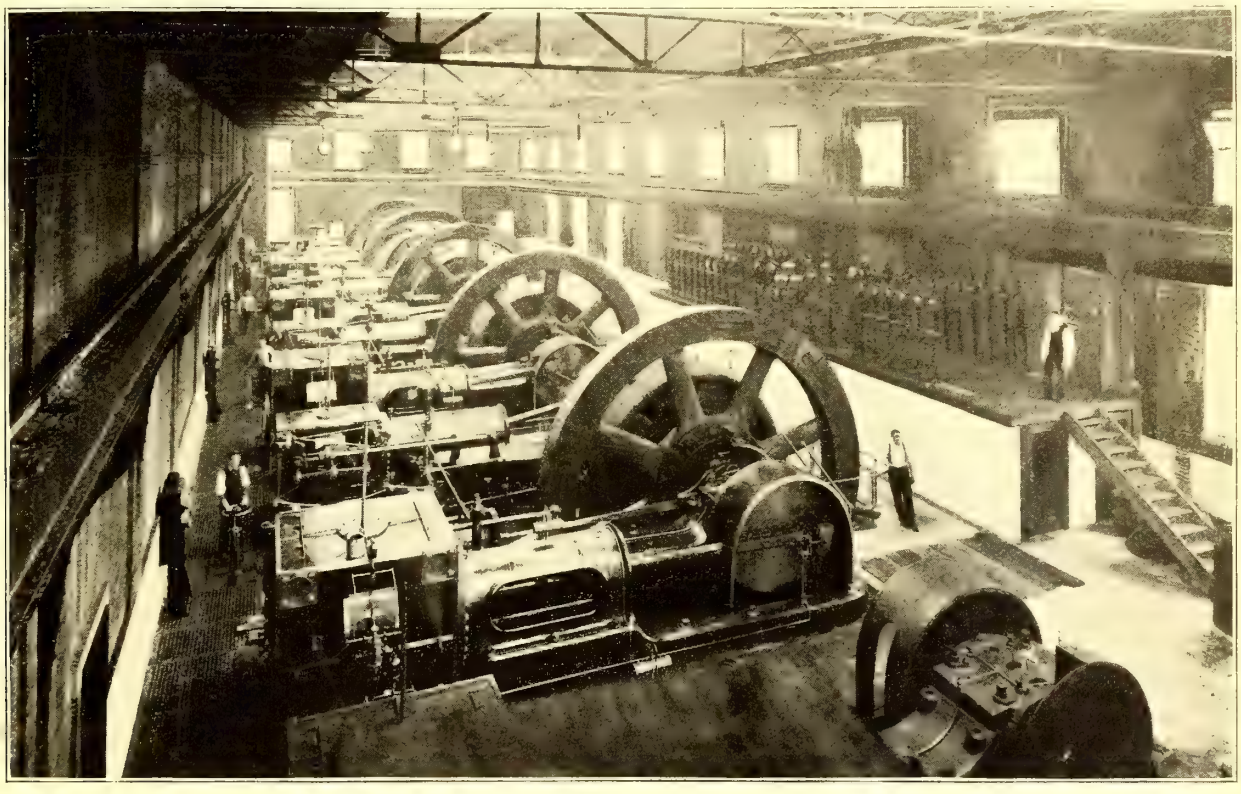
When the various cable and electric lines in the city of Pittsburg were consolidated, the new company found itself in possession of seven power houses; four of these, namely, Washington Street, Oakland, Wylie Avenue and Thirty-fourth Street, were cable power houses of the usual type; the other three, Forty-seventh Street, Ben Venue and Allegheny Traction, were electric power houses.

Before, and during the reconstruction of the system, these electric power houses were, of course, kept in operation, but there arose the problem as to what arrangements must be made for supplying power to the much larger system when completed. An examination of the list and map on the following page will show the situation as it stood.

It will be seen that none of these plants were well situated with regard to coal and water supply, the most important factors in the location of a large power house. The cable power houses were necessarily located on the streets along which the cables were operated, and therefore little regard was paid to coal and water supply. These plants stood on valuable ground, the cost of hauling coal by wagon was large, and lack of water rendered the use of condensing engines impractical.

The electric power houses were somewhat better off in regard to coal supply, but Forty-seventh Street and Allegheny Traction were too far from centre of system, while Ben Venue had no suitable water supply, and only one source of coal supply. It became evident, therefore, that one or more new power stations were demanded in localities not too far removed from centre of system, and where coal and water were easily and surely obtainable.

In deciding between one large plant and two or more smaller ones, Pittsburgh's marked geographical peculiarities largely influenced the result. The street railways converged in the crowded business portion down town, and again at East Liberty, after traversing a district of heavy grades. This brought the centre of the system in the midst



VIEW IN CENTRAL POWER STATION—CONSOLIDATED TRACTION COMPANY, PITTSBURGH

of the hills, as shown on the map, at a considerable distance from available coal and water supply, hence it was impracticable to put power house in this part of the system. Railroads are compelled to follow the Monongahela and

Power Data of Original Stations.

Letter.	Name.	Boiler.		Engines.			Total I. H. P.	Machine Driven.
		H P.	Type.	No.	Size.	Type.		
A	Allegheny	750	W. T.	2	14x28x20	V.C.C.C.	500	2-200 kw. gen.
	Traction ..			1	21x42x30	"	750	1-500 kw. gen.
B	Ben Venue....	1200	T. T.	2	32x60	H.	1200	2-500 kw. gen.
				1	2-22x42	H.	450	1-375 kw. gen.
				1	2-24x48	H.	600	1-500 kw. gen.
C	Oakland.....	800	R. T.	2	28x60	H.	1000	1-800 kw. gen.
D	47th St	300	R. T.	3	11x19x24	H.T.C.C.	600	3-100 kw. gen.
E	34th St	800	R. T.	3	28x60	H.	1500	Cable Machine.
F	Wylie Ave ...	100	R. T.	3	2-28x60	H.	1500	" "
G	Washingt'n St.	200	R. T.	1	22x48	H.	250	" "

R. T.—Return Tubular.
V. C. C. C.—Vertical Cross Compound Condensing.
W. T.—Water Tube.
H. T. C. C.—Horizontal Tandem Compound Condensing.

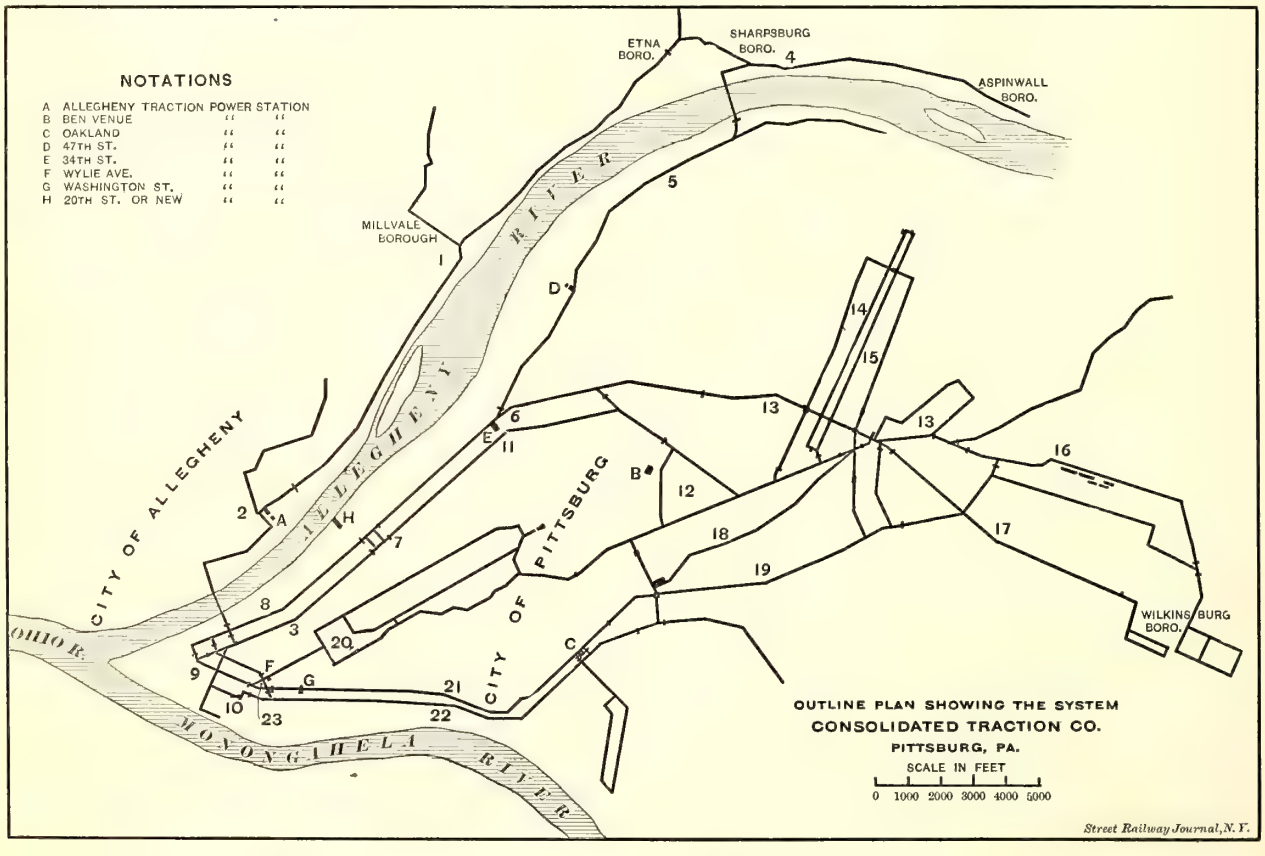
Allegheny valleys, so that both coal and water are readily obtainable along the banks of these rivers. A location on the Allegheny River, on the other hand, offered advantages of far better water, with equally good coal facilities, nearest to the centre of the system, and of less difficulty in obtaining land.

With so little choice in location, the advantages of a single power house, rather than two or three in different parts of the city, seemed to the managers of the company evident. Danger of fire and of accident to a single plant can be eliminated by proper construction, while much of the initial cost and operating expense of the plant is independent of the size, and therefore, as great for each of the smaller plants as for the large one. To illustrate the economy of a single power station over the several original ones, it might be stated that the operating expenses of five of the old plants as compared with the new one are about two and one-quarter times as great.

The new station is larger than the combined capacity of the old stations considered, yet runs for less than one-half the daily operating expense. The value of the real estate of the separate plants is sufficient to cover the cost of construction of the new station.

The location finally obtained was at Twentieth Street, between Railroad Street and the Allegheny River; the property being 177 ft. deep, and 360 ft. to harbor line; the length of the building was limited to 265 ft. by a private right of way. Coal can be secured from either the B. & O. system, the Pennsylvania Railway, or from the river, while an unlimited supply of fairly good water is close at hand.

The station is designed for a 12,500 nominal h.p. equipment, which will consist of eight units, six of which are at present installed. Each unit comprises a 1560 h.p. engine of the cross compound condensing type, with "Corliss" valve gear direct coupled to a 1000 kw. generator. The cylinder dimensions are 30 ins. and 54 ins. x 48 ins. The rating given above is based upon a cut-off in the high pressure cylinder of 23 per cent and a terminal pressure in the low pressure cylinder of 6 lbs. above absolute vacuum, and running at 80 r.p.m., but with a higher percentage of cut-off the machines are easily capable of developing 2500 h.p. each. The steam and exhaust valve are operated by separ-

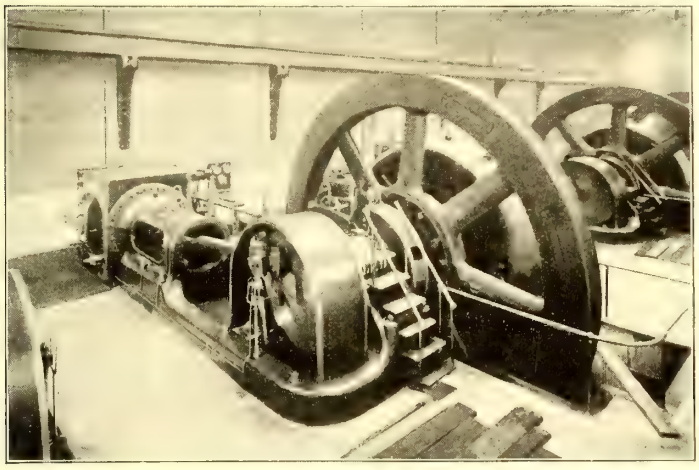


ate eccentrics, and the governing mechanism controls the steam in both cylinders. Reheating receivers are placed between the high and low pressure cylinders, being located beneath the floor of the engine room, and the steam and exhaust pipes are attached to the under side of the cylinders. In this way there are no steam pipes visible in the engine room, and there is nothing to interfere with the operation of the traveling crane which is provided for handling all heavy parts.

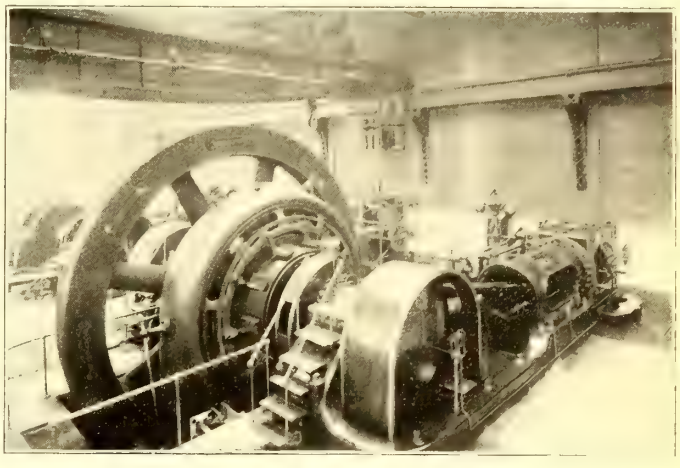
In the design of the engines, horizontal engines were chosen, because it was found that the type selected could more readily accessible for attendance and repairs, and less be put in even less floor space than vertical engines, are expensive.

At first sight, there is nothing very striking in the design of these engines, except that the outlines are graceful

for so large a mass of metal, but there is a combination of simple factors which renders them exceptionally efficient. The bed plate is of the Tangye type, the plate and pillow block being cast in one piece, while the cylinders are overhanging and supported on a rest plate, which is adjusted for the support of the cylinder, after expansion has taken

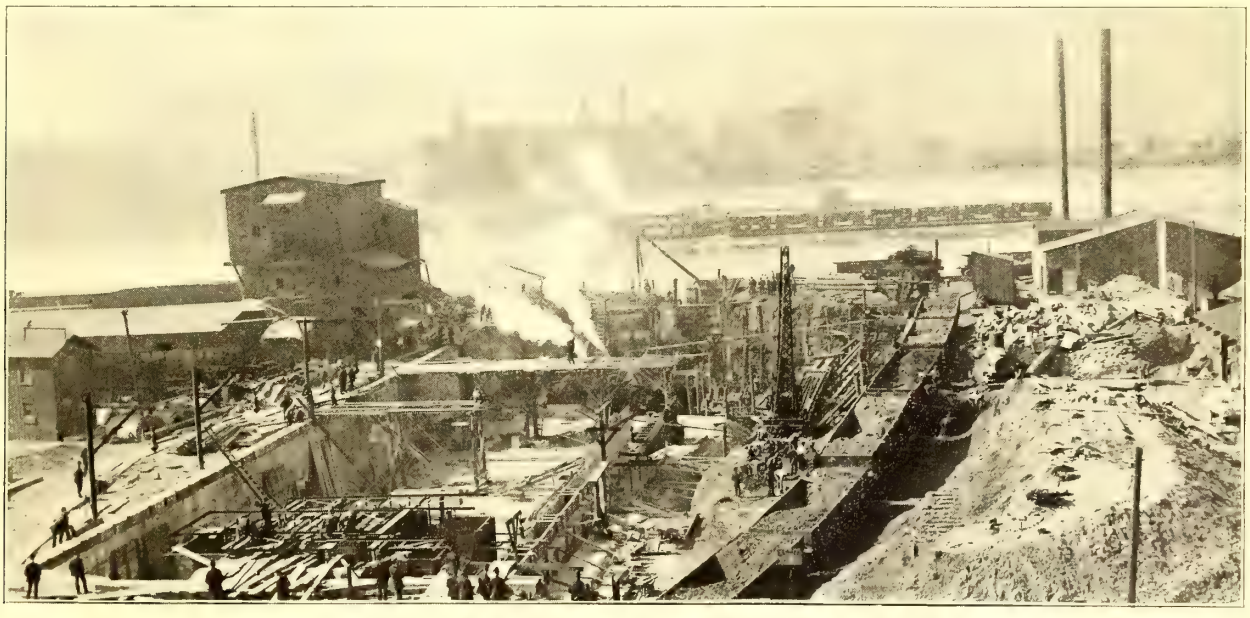


LOW PRESSURE SIDE OF ENGINE



HIGH PRESSURE SIDE OF ENGINE

place from the action of the steam. Each pair of cylinders are steam jacketed, the barrel and jacket being cast together. All the journal bearings and the connections for the valve gear have screw and wedge adjustment. The journal bearings have the adjustment on the sides, but the wedges are accessible through the top cap. The main bearings are 20 ins. in diameter, and 40 ins. long; this may seem very wide for a 44,000-lb. armature and 110,000-lb. fly wheel, but the engineers prefer to distribute the wear over a large surface, believing that there is much less danger of the bearings wearing to a dangerous degree. The fly wheels are each 20 ft. in diameter and weigh 110,000 lbs.



CONSTRUCTING FOUNDATION FOR STATION

An automatic oiling system is used, and the caps of the main bearings have each three oil cavities protected by brass strainers. From the different bearings the oil is led to filters in the basement, from which it is pumped to elevated tanks, and descends by gravity to the different bearings. The air pumps of the jet condensers are of the double acting type, and are operated by a rod from the extension of the crank pin of the low pressure side. The condensers and auxiliary steam equipments are located in the basement of the structure, or rather chambers provided for them in the engine foundations, which are built up of concrete to the height of 17 ft. above the foundation floor. The condensing water is lifted by pumps from an intake pipe 40 ft. below engine room floor, and which extends under the bed of the river. The engines were built by the Pennsylvania Iron Works Company from specifications furnished by the engineers of the Consolidated Traction Company.

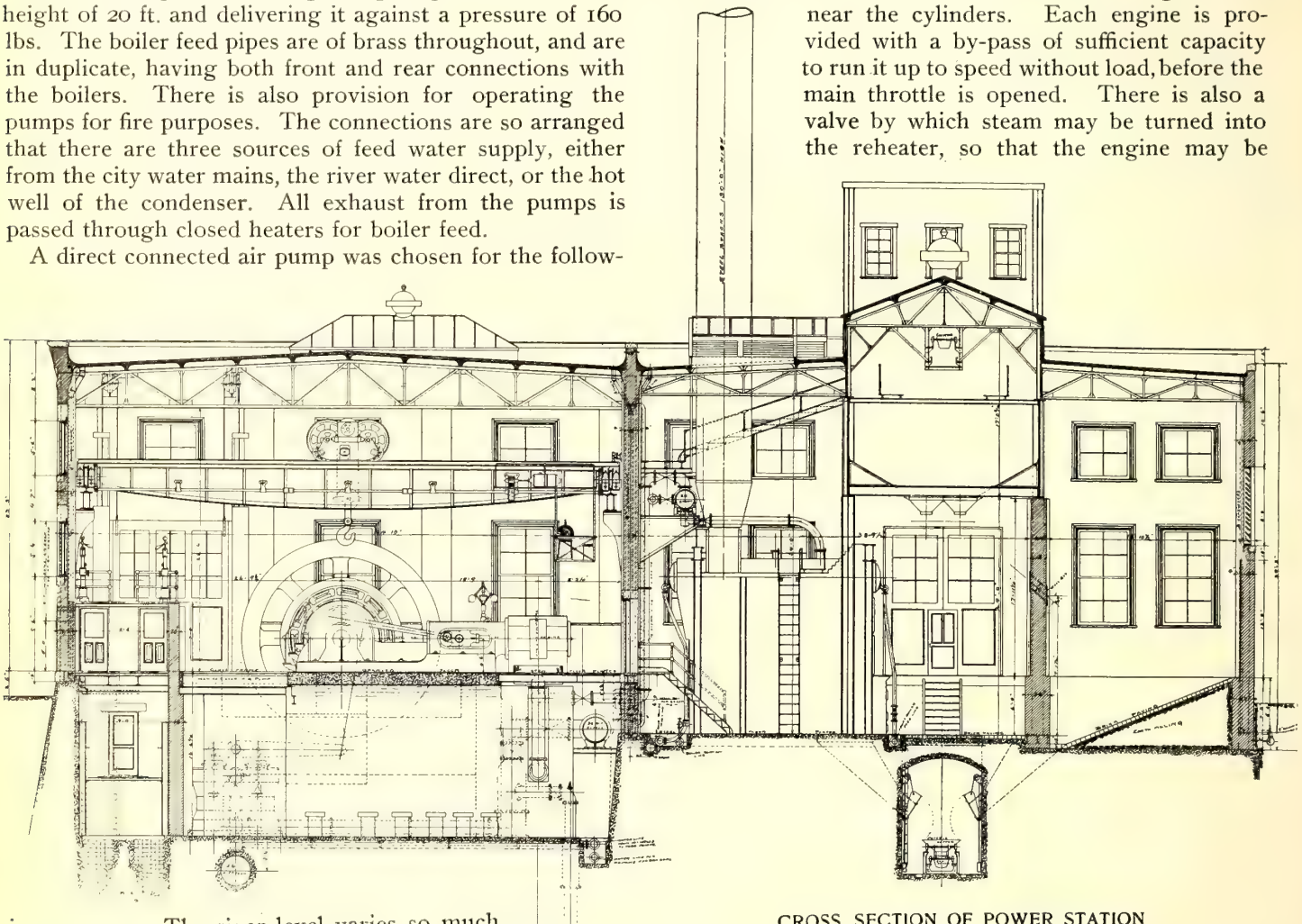
The boiler equipment consists of six batteries of forged steel type sectional water tube boilers of special design made by the Babcock & Wilcox Company. Two boilers constitute a battery, and each battery is rated at 750 h.p. In order to economize floor space, these boilers are shorter and higher than the usual type. Each is made up with three 36-in. drums, 20 ft. long, and 18 sections of tubes, each 15 ft. long, giving about 4000 sq. ft. of heating surface. They are designed for a pressure of 200 lbs., and were tested under hydraulic pressure to 300 lbs. The fire boxes are equipped with the Hawley down draft furnaces, having a grate surface of 66 sq. ft. The furnaces are guaranteed to show 10 per cent greater efficiency than the ordinary flat grate and to be able to burn 40 lbs. of coal per square foot

of grate per hour, and to reduce the smoke by 92 per cent. The boilers with the Hawley furnaces are guaranteed to develop 75 per cent efficiency with less than 1 per cent of moisture at full load, or 1½ per cent at 50 per cent above rating. In tests which have been made the above guarantees have been attained. There are six unlined iron smoke stacks, one for each battery. Each stack is 66 ins. in diameter, and rises 147 ft. above the grate bars, giving a draft of 1 in. to 1½ ins. of water under ordinary conditions. The breechings and stacks are carried on special supports entirely independent of the brick boiler setting.

The feed pumps are three in number, of the Worthington duplex direct acting type, with outside packed plungers, and are capable of lifting 240 gals. per minute to the height of 20 ft. and delivering it against a pressure of 160 lbs. The boiler feed pipes are of brass throughout, and are in duplicate, having both front and rear connections with the boilers. There is also provision for operating the pumps for fire purposes. The connections are so arranged that there are three sources of feed water supply, either from the city water mains, the river water direct, or the hot well of the condenser. All exhaust from the pumps is passed through closed heaters for boiler feed.

A direct connected air pump was chosen for the following reasons: The river level varies so much that any style of pump would have to be designed to do more than is ordinarily required of it, hence the pump will rarely be running at full load, and will therefore be less economical than in the case of more uniform water supply; the effect on the economy, it was thought, would be less, however, in the case of a direct connected air pump where it practically forms part of the friction load of a large compound condensing engine, than in the case of either a single separate pump or a number of smaller pumps designed for economy. Moreover, separately driven pumps, it was thought, would be more expensive (if equal workmanship is obtained) because the cost of steam cylinders and valve gearing is added to that of the pump itself; starting with a direct connected air pump is very much easier, and practically no attendance during operation is required. The main disadvantage, of course, is that the engine must be run non-condensing in case of break down of its own pump.

The steam piping is of cast steel throughout, and each boiler is connected to a 20-in. steam main, which is located along the top of the boiler room above the back end of the boilers, and this main is provided with two copper expansion loops. The main is divided by valves between each battery of boilers, and the steam enters it from the boilers through pipes having a long radius bend, which are tapped into the under side of the main. The pipes leading to the engines lead out from the top of the main and bend down along the wall and out under the floor of the engine room. The valves are of the Chapman manufacture, and are operated from a gallery that runs along the entire side of the boiler room, back of the steam main. The throttle valves and by-pass valves are operated from wheels on four valve stands on the floor of the engine room near the cylinders. Each engine is provided with a by-pass of sufficient capacity to run it up to speed without load, before the main throttle is opened. There is also a valve by which steam may be turned into the reheater, so that the engine may be started by the low pressure cylinder, should the high pressure side be on the center. The exhaust steam pipes terminate at each end of the building above the roof in two Marlin exhaust steam heads. These are each 15 ft. high and 12 ft. 6 ins. in diameter at the top, being among the largest exhaust heads so far erected in this country.



CROSS SECTION OF POWER STATION

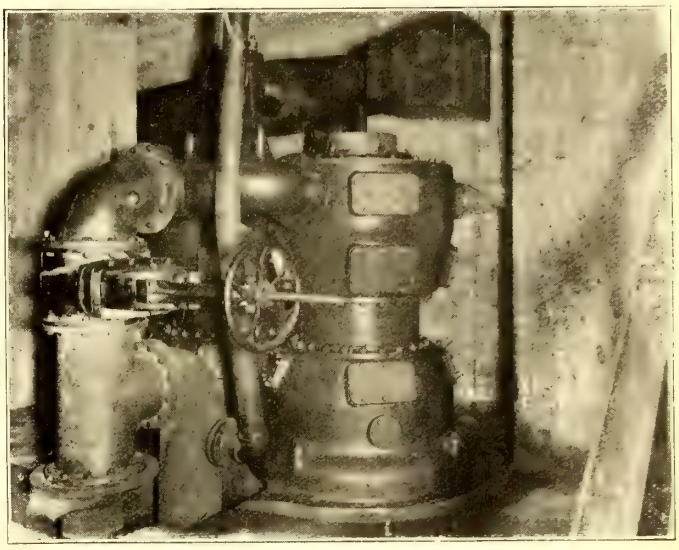
Adjoining the boiler room, and separated by a wall running the whole length, is a storage bin for coal, in the lower part of the separating wall are coal chutes which eventually will be used as ash pits whenever the station is enlarged, the structure being so designed that the coal space can be utilized for a boiler room whenever the capacity of the station is to be increased. The main coal bunker, however, is an elevated steel structure made of plate girders 10 ft. deep and extends the entire length of the boiler room. This bunker has a capacity of 6 tons per running foot, or a total capacity of 1632 tons. A Mead coal conveyor with an automatic weighing bucket with a capacity for handling 40 tons per hour is used. This con-

veyor is driven by an electric motor, and takes about 15 h.p. to operate it. The coal is received by rail at the river end of the boiler room, and, after being weighed, is elevated about 50 ft. and passed to the coal bunker, being dumped anywhere desired. Afterward the conveyor passes into tunnel beneath the boiler room and is utilized for removing ashes.

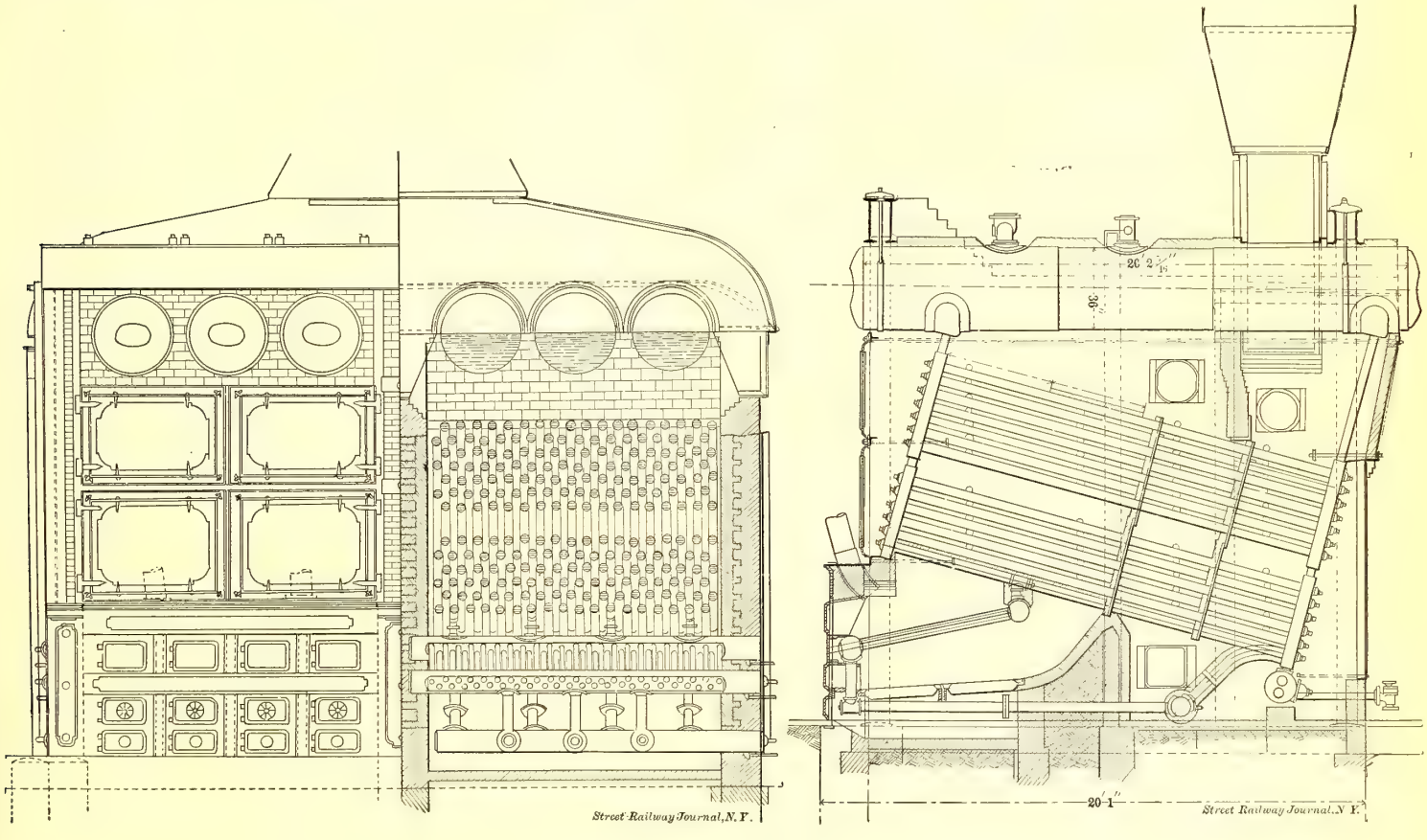
The exterior of the building is of Pompeiian brick with Cleveland sandstone trimmings; the interior of the engine room is Pompeiian brick with enameled brick wainscotting, having a slate cap. The floor is of Mosaic known as "granito," with slate border. The roof is supported on steel riveted girders of the Warren type, having one inclined top chord. The specifications for the framework called for open hearth steel having a tensile strength of from 60,000 to 65,000 lbs. The roof is cinder concrete with iron stiffing bars, having felt and crushed slag imbedded in pitch on the upper surface. Large ventilating and lighting areas with wire screen guards as a protection against falling glass, are also provided.

In the design of the foundations, it was necessary to avoid the possibility of a flood stopping the plant, hence the engine room floor level was fixed 1 ft. above the highest recorded level of the river (a stage of 33 ft. 8 ins. in 1884), normal pool level being stage of 6 ft. On the other hand, the intake pipe must at all times be completely covered with water, thus requiring the top of the pipe to be below stage minus 1; the pipe had to be kept below this level underneath the engines, to keep the vacuum from being lost in times of low water, hence there was required an excavation over 300 ft. in length and over 40 ft. deep from the surface, or 13 ft. below normal river level. This pipe was surrounded with concrete to make it permanent, and to secure good foundation for the engines above. Concrete was chosen because of the ease of handling it in difficult places, such as under caving banks, without removing bracing in water, etc.

The ground dimensions of the entire structure are 272 ft. x 115 ft., while the engine room is 55 ft. wide and the boiler room 60 ft., including the coal storage bin above described. An electric traveling crane of 90,000 lbs. capacity spans the engine room and serves for the quick handling of any piece of machinery or piping. To provide for the lifting of the condensers, areas are left in the engine room floor. These spaces are covered with iron grating that can be readily removed. Similar provision is made in the floor between the back wall and engine cylinders for reaching the steam piping and the reheaters. The foundations of the building contain 20,000 cubic yards of concrete, the side walls being in some places 7 ft. thick. The whole foundation is built as a unit, and has a bed of river gravel upon



DOUBLE ACTING DIRECT DRIVEN AIR PUMP WITH BALANCE LEVER



SIDE ELEVATION AND SECTION OF BOILERS

which it rests. In the process of building, a concrete mixer, referred to more particularly later, was used. The material, or rather the sand and gravel for the foundation was obtained from the river near by, and the material was hauled from the boats up an incline and delivered to an automatic measuring cylinder, which delivered the material, sand, gravel and cement in proper proportion to the mixer.

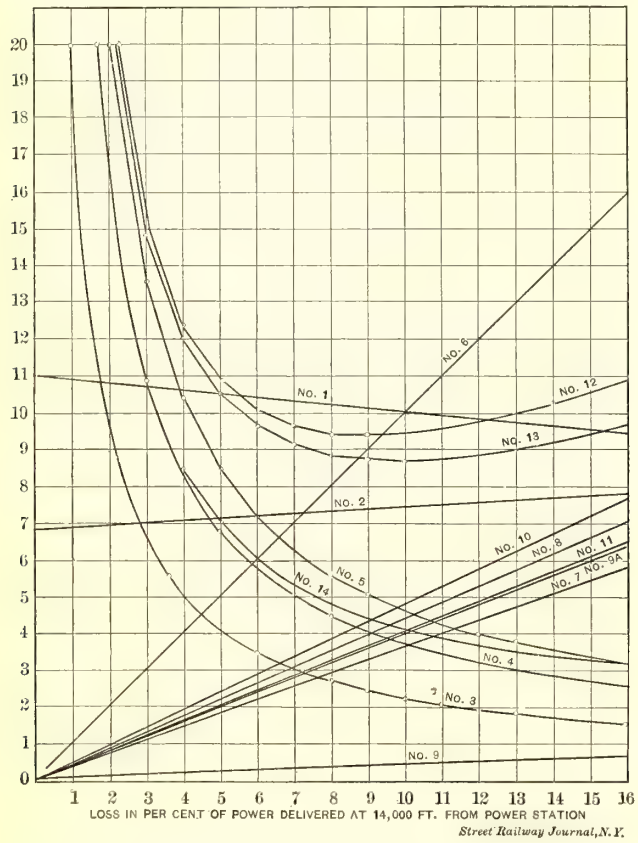


DIAGRAM SHOWING METHOD OF DETERMINING MOST ECONOMICAL ARRANGEMENT OF STATIONS

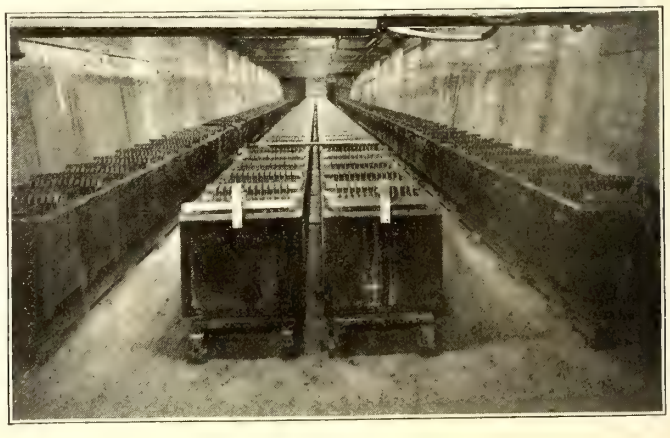
No. 1—Volts at motor, with 1110 at switchboard; scale 100 volts.
No. 2—Amperes at motor for 1000 h. p.; scale 100 amps.
No. 3—Circular mils required, $\frac{2160 \times \text{dist.} \times \text{watts delivered}}{\text{per cent. loss} \times [\text{volts at motor}]^2}$; scale 1,000,000 c. m.
No. 4—Capital invested in line, at $1,645 per mile of 500,000 c. m. cable; scale $10,000.
No. 5—Interest and depreciation (12½ per cent) on No. 4; scale $1,000.
No. 6—Power lost in line; scale 10 h. p. May also represent necessary increase in power station capacity.
No. 7—Value of wasted power at $36.50; scale $1,000.
No. 8—Cost of wasted power yearly at $44 per h. p.; scale $1,000.
No. 9—Interest 10 per cent, depreciation, etc., on increase in power house capacity, at $40 per h. p.; scale $1,000.
No. 9A—Increase in power house investment at $40 per h. p.; scale $1,000.
No. 10—Sum of No. 8 and No. 9; scale $1,000.
No. 11—Sum of No. 7 and No. 9; scale $1,000.
No. 12—Total variable portion of annual expenditure, sum of No. 5 and No. 10; scale $1,000.
No. 13—Total variable portion of annual expenditure, sum No. 5 and No. 11; scale $1,000.

STORAGE BATTERY STATIONS

There are three storage battery stations, each located about 3 miles from the power station, and so distributed that they serve to balance the load in a very satisfactory manner. The first of the battery stations was installed in 1897, and the second soon after. The equipment of these two stations consists of 248 cells each, having a capacity of 500 amps. The third, the one recently installed, has a capacity of 1000 amps. For this station a new building has been recently erected on one of the business streets in East Liberty. In addition to its use as a battery station, the first floor will serve as a receiving house, as the batteries occupy the basement. The rear portion of this building will accommodate an emergency wagon of the automobile type, for which storage batteries will furnish the power. The rear of the second floor is finished up with sleeping and toilet rooms for the accommodation of the emergency force, and is fitted with a pole down which the men slide when a call comes, as in fire department stations.

SWITCH ROOM

The generators are of 1000 kw. capacity each, and as mentioned in the Street Railway Journal for February, 1898, are designed for operating the line by the three-wire system. The switchboard and all the connections are also thus wired, but the road is being operated by the single wire system at present. The term switchboard in connection with this plant is a misnomer, for there is no switchboard in the ordinary sense of the term, but in its place there is a four-deck vault or room, 48 ft. x 9 ft., one side of which is formed by the foundation and brick wall, while the remaining walls are of brick. The floor is of slate supported on steel girders, making the chamber fireproof. The cables, which are of 1,000,000 c.m. capacity, lead out from each machine, through tile ducts located in the floor of the basement. These communicate with the lower gallery of the switchboard room, and from this the nine cables from each machine lead up into the second gallery, being held by iron supports having mica bushing, so that there none of the weight is supported by the circuit breakers. The circuit breakers are arranged in rows on each side of the second gallery, while the double throw switches are supported from the ceiling, and all are arranged to be operated by pneumatic appliances from stands on the upper deck. The circuit breakers are thrown in by single acting air cylinders, while there is also a small cylinder for tripping the circuit break when necessary. The switches are



STORAGE BATTERY

controlled by a double acting cylinder. There are thirty-two 1,000,000 c.m. cables which form the return circuit, and these are connected to a vertical bus bar located in the middle of the second chamber, this, in turn, is connected to the neutral bars above. The bus bars proper are placed in a horizontal position and are located between two sets of I beams, the lower of which forms the support for switches in the room below, and the upper set supports the slate walks of the third chamber, being in plain sight and easily accessible. The bus bars, both for the positive, negative and neutral limbs, are each made up of fifty copper strips of 3 ins. x ⅛-in. section, each being of sufficient capacity for the distribution of the current of all of the 1000 kw. generators, when it becomes necessary to operate by the three-wire system.

On the walls of the third chamber are placed two watt meters, rheostat face plates, air pipes, ammeter leaves, etc. In the center of this chamber are the rheostats, which are

protected by a perforated metal cover. The controlling stands are located on the upper deck, which is really a platform overlooking the engine room. From this platform all the current controlling appliances are operated. These stands are numbered, and there is one for each feeder and one for each generator. These stands are arranged in two rows, with one stand in the middle, on which is placed the air pressure gage, alarm bell for low air pressure, and air valves for lighting switch and circuit breaker of the station lighting circuit. This latter is so connected to the leads of any of the generators, that should all the generator circuit breakers go out, the station would not be left in darkness. On the top of each controlling stand is a red tell-tale lamp, which lights automatically when the corresponding circuit breaker is thrown out. Below this is an ammeter illuminated by a shaded lamp, while near the middle of each stand are two handles which operate the air valves for circuit breakers and switches. These handles are so interlocked that the switch cannot be operated when the circuit breaker is in, nor can the circuit breaker be closed when the switch is in, so that it is impossible for the attendant to make a mistake. The generator stands have, in addition to the above, a small hand wheel for operating the rheostats, and a receptacle for plugs for connecting the volt meters to the different generators. At the middle of each row of stands is a revolving stand, on one of which are three volt meters, and on the other three ammeters, which can be turned so that they may be read by the attendant at any point on the platform. One volt meter is connected to the plug switch, and the other two give the voltage of the positive and negative bus bars, respectively, while the three ammeters give the current of the positive, negative and neutral bars. The instrument for the negative bar is double reading, and shows which side of the three-wire system has most load.

From the switchboard the lead covered cables are carried through a subway to a brick tunnel, which leads off through the foundations of the building in the direction of Penn Avenue, and which extend a distance of nearly 600 ft. The interior dimensions of this tunnel are 5 ft. x 7 ft., or sufficient to provide for the ultimate capacity of 40,000,000 c.m. of feeder cable, beside room for the free passage of the employees. In the construction of this tunnel, there was imbedded in the concrete foundation in two rows extending the whole length of the tunnel thirty-two girder rail conductors, the rails being 63 lbs. section per yard. The ends of these rails are double bonded, and to these the return feeders are attached. At Penn and Liberty Avenues the cables are brought up through large distributing poles, from which they lead off in eight directions, being supported from the trolley poles.

The diagram opposite shows graphically the calculation to determine the most economical size of feeders to employ, consideration on the one hand being taken of the loss of power through resistance, and, on the other, of the interest on the investment.

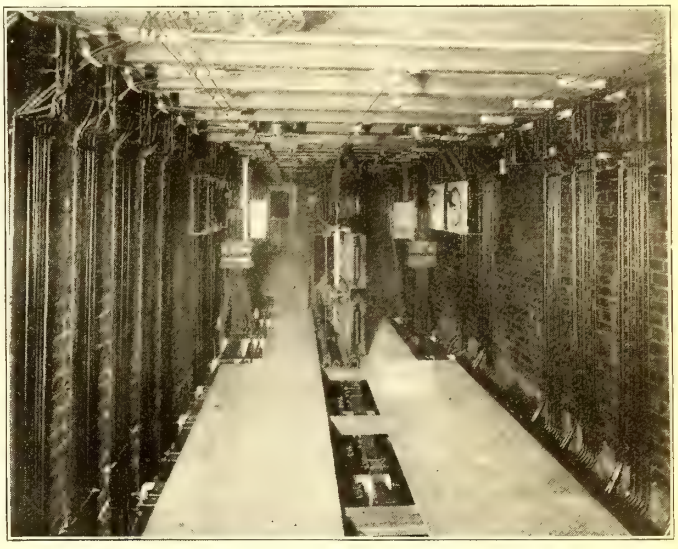
CONSTRUCTION OF PLANT

Excavation for the power station was begun Sept. 1, 1897, the material being shoveled directly into cars on the siding leading on to the property. After the excavation deepened, and the grade became so heavy that this method became impractical, two machines were used, one a bucket conveyor, the other a traveling hoist. The total excavation amounted to about 35,000 cu. ft.

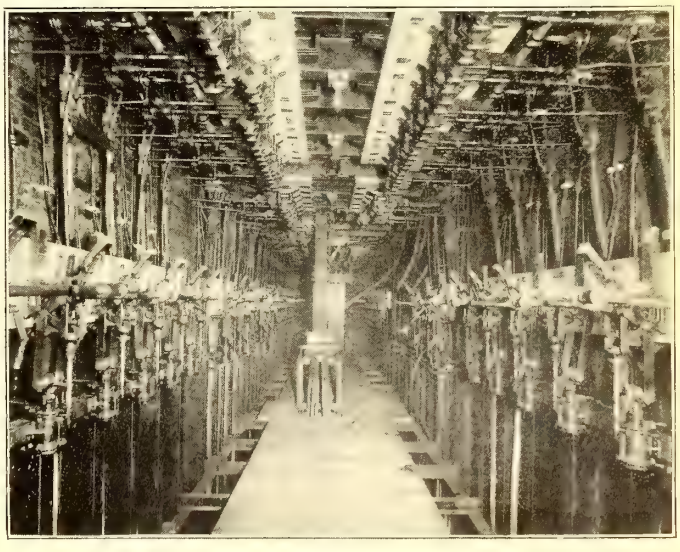
As the walls and the foundations proper of the engines, as well as of the building, were of concrete, hand mixing was out of the question. A machine mixer was therefore erected. It was about 20 ft. x 16 ft. and 32 ft. high, and although largely experimental, did good service, turning out on some days over 500 cu. yds. per day of twenty hours, when that amount could be used, and making a total of about 20,000 cu. yds. The following table gives



CONTROLLING STANDS ON TOP GALLERY



UPPER GALLERY, SHOWING BUS BARS AND RHEOSTATS



LOWER SWITCH GALLERY, SHOWING CIRCUIT BREAKERS ON SIDES AND SWITCHES OVERHEAD

the cost of mixing concrete by the mixer, as estimated from actual experience during the past year:

Cost of materials	1-4-10	1-3-8	1-2-5
American Portland cement, @ $2.05 per bbl.	$1.37	$1.69	$2.66
Sand, @ 2½ cents per bu.	0.30	0.29	0.29
Gravel, @ 2 cents per bu.	0.38	0.38	0.37
	$2.05	$2.36	$3.32

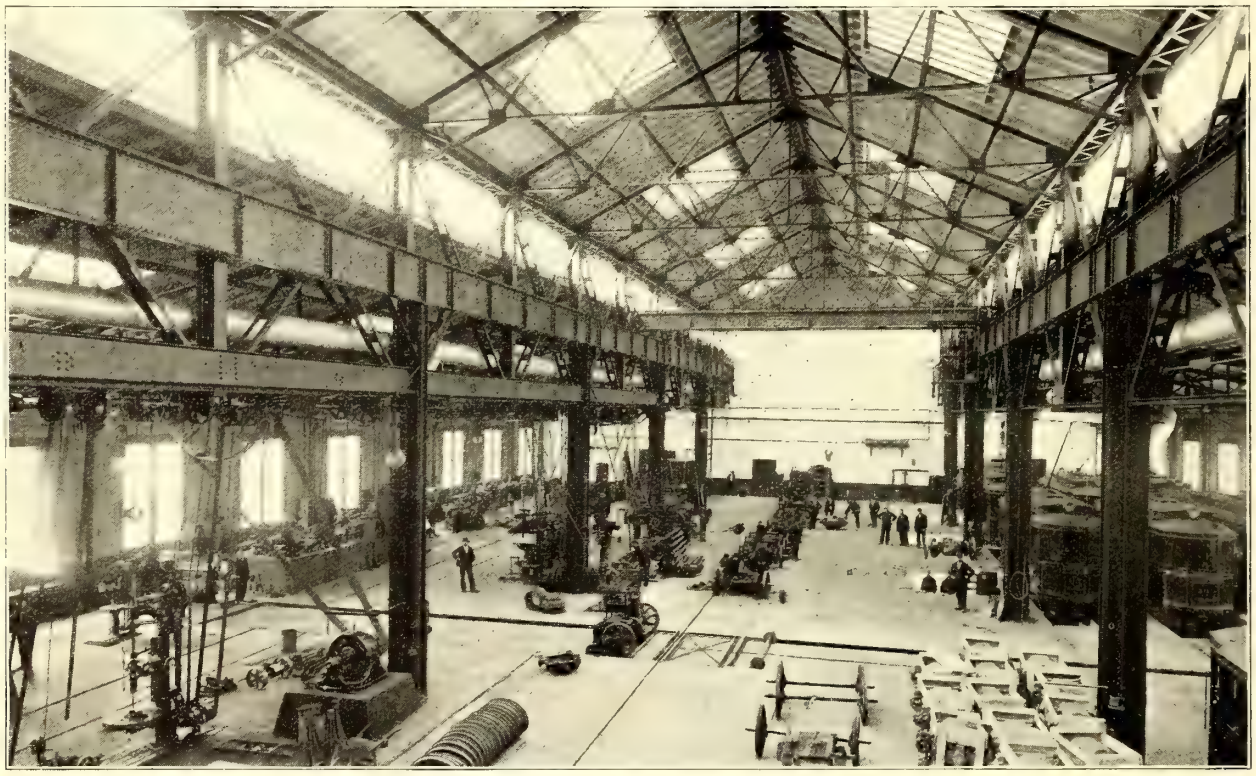
Cost of delivery to Mixer of materials	$0.07
Cost of measuring and mixing	0.05
Cost of delivery 150 ft. and return by wheelbarrow gang	0.23
Cost of tamping	0.18
Total cost of labor	$0.53

(The above represents the average of an ordinary day's run, but does not include share of cost or depreciation of mixer plant.)

An American Portland cement was used throughout, mixed with sand and gravel in proportions varying from 1-3-8 to 1-2-5; no broken stone was used as actual tests on concrete blocks showed that an equally strong concrete could be secured at lower cost by the use of gravel alone.

brick floor cement grouted. The second building in line is the repair shop proper, is 135 ft. x 576 ft. and is divided into the iron tool department, wood shop and erecting department and paint shop. The operating house is 135 ft. x 400 ft., and between it and the machine shop is a large area occupied by twelve storage tracks, all connected by a diagonal cross track, having both single and double slip switches. The warehouse is located just outside the storage tracks, and is 50 ft. x 150 ft. Near it, and on a line with the main shop is the boiler house, in which is a battery of tubular boilers which generate the steam for heating the buildings.

The iron working tools in the repair department are driven by power derived from a 50 h.p. electric motor, which is belted to overhead shafting. There is also a motor of equal capacity for operating the wood-working tools in the carpenter department. This motor is located beneath the floor, as is also the main shafting, so that the individual tools are driven by belts that come up through the floor. In the machine shop the iron-working tools occupy one



INTERIOR OF REPAIR SHOP, SHOWING TOOLS, DISMANTLING PITS, TRAVELING CRANE AND TRANSFER TABLE

Each engine foundation contains about 350 cu. yds. and is quite complicated in shape. If brick work this would have cost at least $6 per yard, while the actual cost in concrete was 50 cents for material and labor in erecting and removing the forms, and $4 for the concrete itself.

REPAIR SHOP AND CAR HOUSES

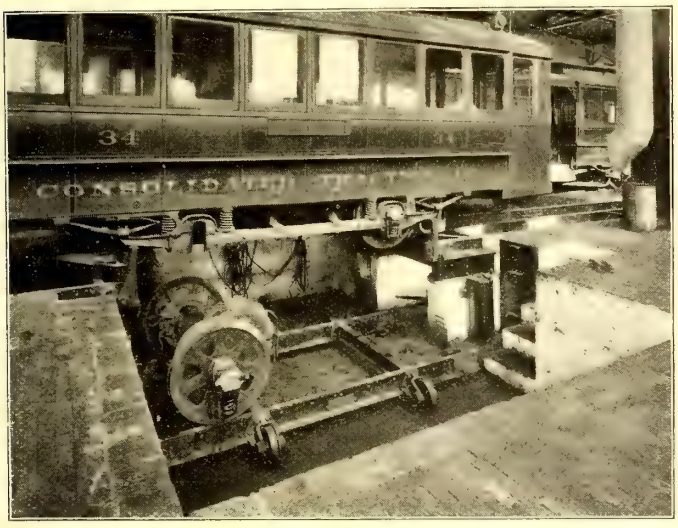
The company has six new car houses, conveniently located in different parts of the city, and all have the same general equipment. The repair shops and principal buildings, however, are located on Frankstown Avenue, and are known as the "Homewood Car Shops and Houses."

This station comprises four large buildings, with two small buildings, all of brick, with the roofs supported by steel truss riveted girders of the Fink type, and all about the same general design. The three main buildings are placed in line with each other in the direction of their longest dimension, and are all of the same width. The first is known as the storage house, and is 135 ft. x 220 ft. with a

side of the floor to the left of the main bay, and adjoining this space is the winding department. The tool equipment consisting of drills, planers, lathes, wheel-boring machines and slotters is very complete. There is also a lathe equipped with an axle key seating device. Along one side of the room adjoining the wall, a space is fenced off for a small tool room, which is in charge of an attendant who issues the cutting tools to the men on checks. This department is supplied with three machines for making small tools, consisting of a Brown & Sharp universal grinder, a milling machine of the same makers, and a small engine lathe.

The main floor of the repair shop, which is paved with brick, is devoted to the overhauling and cleaning of motors and the replacing of wheels. The shifting is all done by means of a traveling electric crane of 40 ft. span, and a capacity for lifting 20,000 lbs. It is operated by an attendant from a cage suspended from the main girder of the crane. The most interesting features, however, of the repair shop

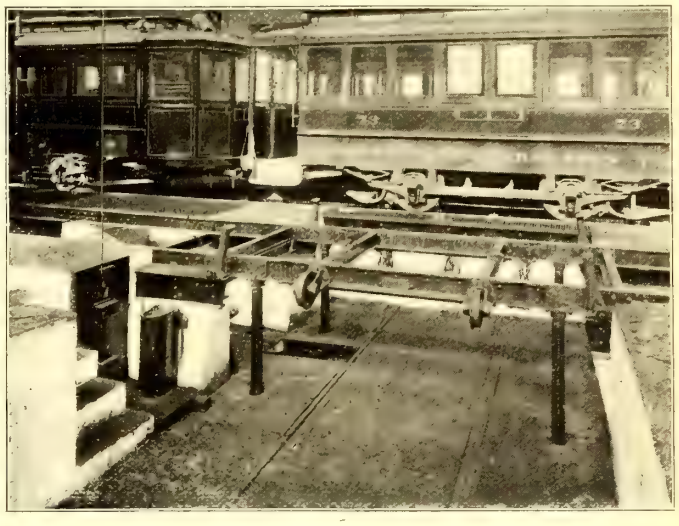
are the dismantling pits, which are located at one side of the main floor near the center of the shop. These pits are so designed that a pair of wheels, or both axles with their motors, can be removed from the truck and a new set substituted within the short space of twenty minutes. Five men only are required in this operation. The track over the pits is supported on steel girders, and is braced across, forming a truck, having small wheels on each side. This section of the track or truck is mechanically lowered or raised by means of four heavy screws, which are placed in the corners of the pit, and are operated simultaneously by means of connecting shafts and beveled gears. These screws are driven by a railway motor placed in a chamber to one side of the pit, and operated by an ordinary type "D" Westinghouse controller. In the operation of the device, the car is run over the pit, when the ends of the truck are supported by means of four folding props, which can be turned out of the way when the car is to be run on or off. The motor connections being severed and the brake mechanism unshipped, the portion of the track carrying the wheels is lowered quickly by means of the screws. When the side wheels of the section rest upon the track placed in the bottom of the pit at right angles with the car track, the truck with its load is readily rolled to one side. This brings



DISMANTLING PIT IN OPERATION

the wheels and motors into position to be readily picked up by the crane, by which they are deposited at any convenient point on the main floor. Here they are opened, inspected and cleaned. A new set of axles and motors are replaced by reversing the process. The crane deposits them on the truck, which is then run under the car, and the motor being started, each wheel is lifted to its place and secured in position, when the necessary motor connections are made.

The inspection pits of the shop are conveniently located adjoining the dismantling pits, and the rails are supported on posts, thus giving free access from one to the other, beneath the iron grating floor which covers the space between the pits. Another important machine in the shops is a Murphy wheel grinder, by means of which wheels are ground without removing them from the car. This apparatus is placed over one of the pits, near the entrance to the main floor, and is fitted with a frame work which supports a set of shafting and pulleys above the car. The truck is then supported independently of the wheels, when a portion of the truck under each wheel is removed. There are centering lathe heads on each side, so that by removing the journal box covers the axles are readily centered and left to rotate, and are operated by their own motors from the trolley current. In order to provide for proper control under these conditions, a section of the trolley wire over the cars is partly cut out of the main circuit by means of resistance coils, but there is sufficient current left in the trolley to bring the car into position. The emery

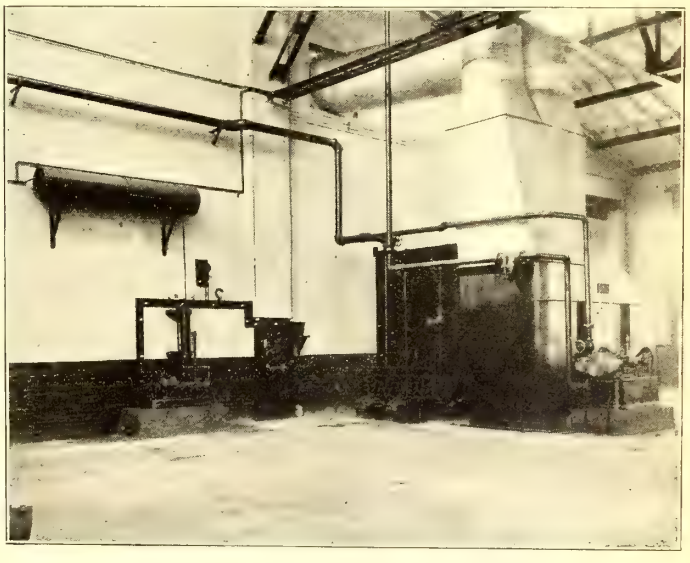


DISMANTLING PIT READY FOR CAR

grinding wheels are so placed that they come in contact with the tread of the wheel on the under side and are revolved in a direction opposite that of the car wheels. The emery wheels are driven by belts from the overhead pulleys, the power being supplied from an electric motor placed beneath the floor, and belted to the overhead shafting.

The blacksmith shop occupies one corner of the main floor, from which it is separated by a brick partition. There are four forges with draft flues, so designed as to remove all the smoke and fumes, a feature that is rarely found working successfully in shops of this character. The equipment includes surfacing plates and the appliances usually found in this class of shops.

Another interesting feature is the method of heating the



HEATING AND VENTILATING FAN, AIR COMPRESSOR AND TANK

various departments of the shops and the operating house. This apparatus consists of two large fan cases, located at the sides and at the end of the main floor of the repair department. The case incloses a nest of steam pipes, which is open on one side, when, by the revolution of the fan, which



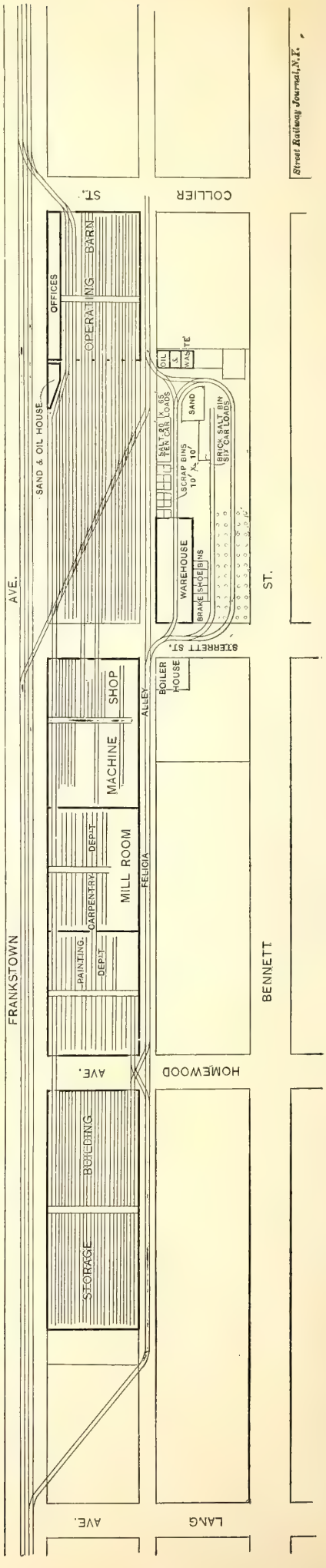
WOOD WORKING AND ERECTING DEPARTMENT

is driven by a small steam engine attached, the air is drawn in between the heated pipes and is forced out into large mains of galvanized iron, which lead in both directions along the ceiling. They are supported by the structural portion of the roof, and are furnished at suitable distances with branch pipes which lead half way down the posts that support the structure, and open at angles, so that the heated air is delivered in a downward stream. Steam for operating the engines of the fans is brought from the neighboring boiler house previously described. A similar equipment serves for heating the operating house.

Compressed air is used for blowing out motors, for cleaning car cushions and for removing the dust and shavings from the wood-working machines. The air is led to the various stations through pipes which terminate in a section of rubber hose with suitable nozzle valves. The air pressure is generated by means of a rotary compressor, driven by a 2 h.p. motor, which is started and stopped automatically by means of a pressure regulator in connection with the storage tank. This regulator shuts off the



PAINT SHOP, SHOWING ELECTRIC TRANSFER TABLE, BRACKETS FOR SCAFFOLDING AND HEATING TUBES



PLAN OF HOMEWOOD CAR SHOPS AND HOUSES

motor when the pressure reaches 100 lbs., and it starts up when it has fallen to 60 lbs. The use of compressed air as above described is considered by the general foreman as a very economical feature in connection with car cleaning and repairs.

The wood-working and erecting department has a full set of wood-working tools, consisting of band and circular saws, planers, gaining and mortising machines. These are located on one side of the main floor, and are driven as before noted, by an electric motor. In addition there is an electric transfer car, which serves for shifting the cars from the main track to any of the side tracks. Similar electric transfer tables are used in the other two departments of the building.

The paint shop occupies the last section of the main building. Between each of the tracks is a row of posts which are equipped with pivoted iron brackets, which when swung into position toward a car serve to support the scaffolding, by means of which the painters are able to reach the sides and roof of the car. When not in use, these brackets are swung around in line with the cars, and are not in the way of the workmen. On one side of the paint shop is a small room, fenced off by a brick wall, in which the paints are mixed, and which is fireproof. Fire buckets filled with sand are placed in suitable position with which to extinguish an oil fire, should one start. There is also a separate room for storing the sash and blinds, and a curtain department in which the necessary supplies of trimmings, etc., are kept; the main supply being kept in the main warehouse.

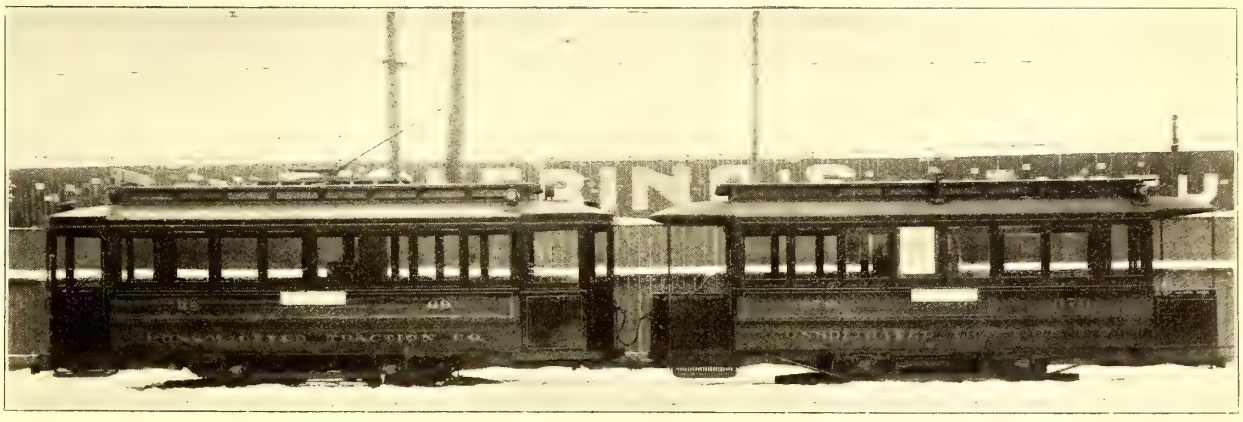
The operating house, which is also a receiving station, is provided with inspection pits, and with suitable appliances for washing and cleaning cars. The offices of the receiver and the operating foreman occupy one side of this building. These offices are finished in Georgia pine, and the counter of the receiver's office before each window is a marble slab, which furnishes a smooth and durable surface, over which the envelopes and money are passed. In the partition are suitable letter chutes through which the conductors deposit their reports. Adjoining the receiver's office is a long room designed for a waiting and lunch room for the employees. Here are suitable tables and chairs and lockers, which are arranged along each side of the room, and also in a row down the middle of the floor. The lockers number 298, and are in double deck rows. As noted above, the main buildings have about the same general structure, and for ventilating the main floors, the deck lights on each side of the monitor roof are arranged in sections, each including a number of lights, so that every other one can be slid in front of the other. The supporting frames are fitted with rollers and a track on which they run to allow this to be done. The alternate sash can be readily shifted to any degree of ventilation by means of small chains that come down near the main floor, and which are readily accessible.

The operating house, as well as all the other operating houses, with the exception of the one noted above as the storage house, are designed only as washing and inspection stations, as the cars when clean are run out and held on the storage tracks ready for service, an arrangement that saves largely in the insurance rates on the buildings. For shifting cars about the Frankstown station, dummy motor cars are employed. These cars have short bodies and are provided with electric and wheel brakes. For operating the trolley pole, the trolley cord is continuous, and passes through from end to end of the car under the ceiling with rollers so arranged that the motorman can free the trolley from the wire, reverse and return it, for running in the opposite direction without leaving the cab. These cars readily handle six or seven trail cars in a train, and pull them from the operating house to the storage tracks, where the motor cars, by means of the diagonal track above noted are able to pick up a trailer from any one of the storage tracks, and move with it to the street.

The warehouse to which all supplies are delivered has a sunken track down the middle, so that goods may be delivered to the platforms on either side from cars or trucks.

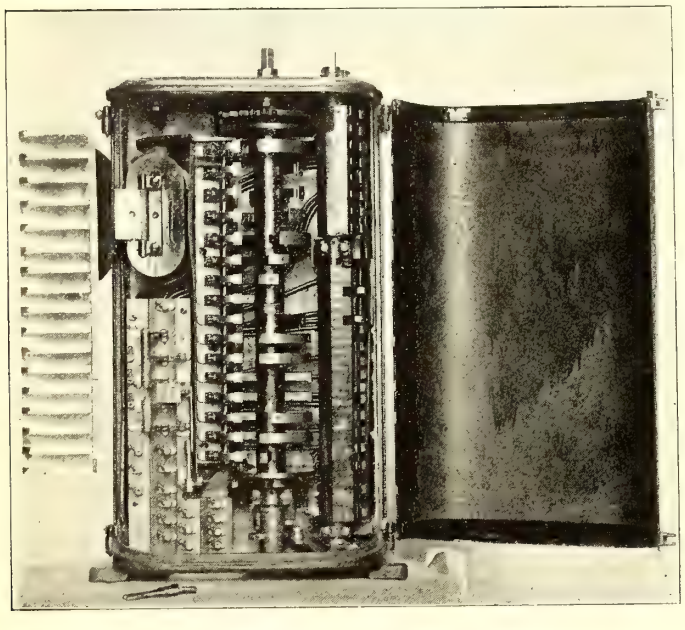


STORE ROOM, SHOWING RACKS FOR MATERIAL

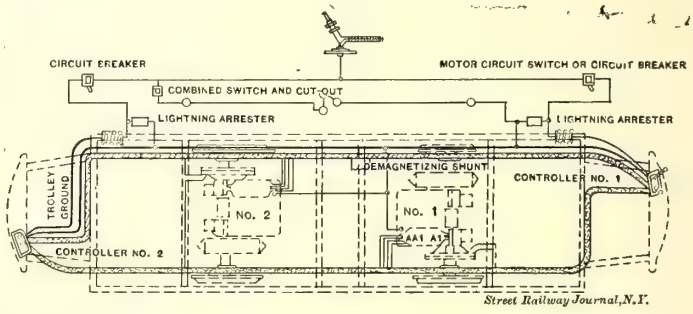


ELECTRIC TRAIN WITH ELECTRIC BRAKES ON BOTH CARS

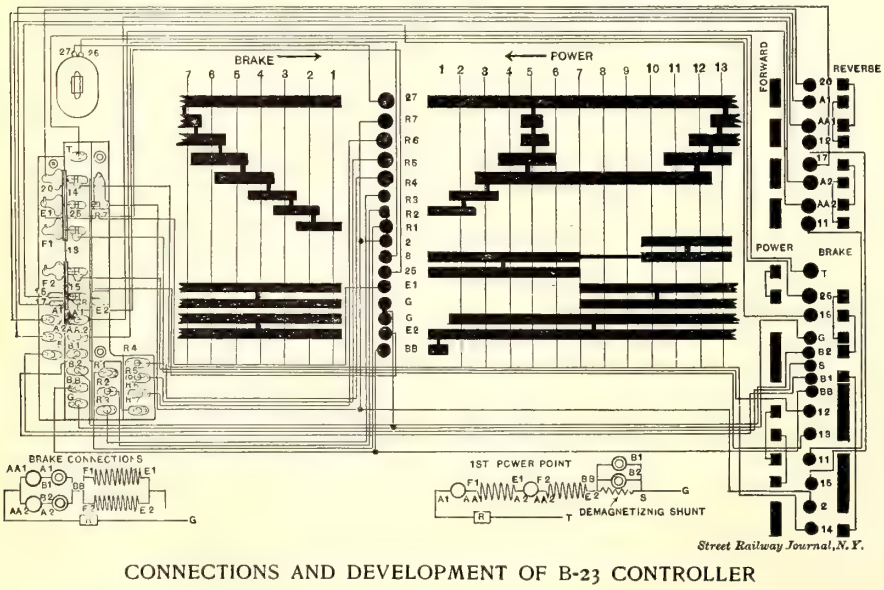
The store room is fitted with stands or racks 6 ft. x 10 ft. and 10 ft. high, which are divided into suitable boxes, bins and shelves for holding the material, one rack being assigned to each class of material. Each rack is labeled on the side toward the track in white letters, and designates the character of material which may be found therein; for instance, one reads, "rope, twine and power house supplies," another "carbon brushes and parts for standard motors," a third, " valves and pipe fittings," still another, "arc lamp supplies," and so on for each of the racks. In addition, there are shelves and drawers along the side walls in which shelf hardware is stored, and there are sliding ladders provided which give ready access to the higher shelves. Every class of articles is known by lot number, and when issued is charged up to the different departments, a most rigid system of accounts being maintained.



B–23 CONTROLLER



CAR WIRING FOR B-23 CONTROLLERS AND TWO MOTORS WITH ELECTRIC BRAKES



CONNECTIONS AND DEVELOPMENT OF B-23 CONTROLLER

ROLLING STOCK

In the matter of rolling stock equipment, the energies of the general manager have been directed to the standardizing of all parts and appliances. All appliances of the same kind are treated as a unit and repairs are made on a specific equipment at stated periods, without reference to the amount of wear they have sustained. The cars are all of the same design, the trucks all of McGuire manufacture, the motors Westinghouse, No. 38, with the exception of 120 new equipments mentioned below. The signal gongs are placed on the hood of the cars, and are sounded by means of a cord that hangs just above the controller handle. Recently a new type of illuminated sign has been adopted. To provide for the hauling of trailers, all the cars are equipped with the Van Dorn couplers.

Each of the 120 cars which the company has recently added to its equipment is provided with two 50 h.p. railway motors and electric brakes, manufactured by the General Electric Company. The motors are what are known as the GE-57 type, and contain all the latest improvements in construction and design. The frames are of cast steel and are fitted with laminated wrought iron pole pieces which are bolted to them. The bearings were designed with special reference to obtaining a large bearing surface and good lubrication. The armature is small and compact, having a diameter of only 14 ins. It is of the standard, iron-clad construction, such as is now universally adopted by manufacturers of this class of apparatus. The winding is of the three-coil per slot type, which has great advantages in the way of armature repairs and the ensuring of a high insulation. The weight of this motor is about 3000 lbs. complete. Each motor is fitted with a cast steel yoke, which is bolted to the frame on the commutator end of the motor. It is provided with two horns which project on each side of the axle and which are designed to support the brake shoe. The latter is of the AJ-11 type and is 26 ins. in diameter.

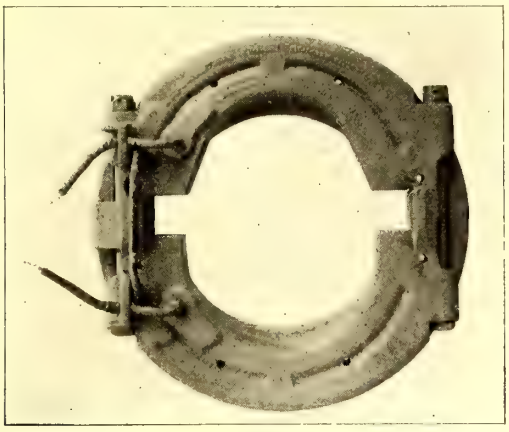
The brake disc which is keyed to the axle is the AK-18 and is, of course, of the same diameter as the shoe. The hub of the disc butts against the end of the motor axle lining, and the end play of the motor is limited by the disc which is provided with a suitable adjustment.

The controller used on these equipments is the B-23, designed for operating two 50 h.p. motors with electric brakes. The braking is accomplished in the usual manner by converting the motors into generators and passing the current thus generated through the brake shoes and regulating resistance. With this method of braking, it is immaterial whether the trolley is "on" or not. The braking effort is due to the "back" torque of the motors (acting as generators) and the friction between shoes and discs.

A good idea of this controller may be obtained from the photo-engraving showing the interior. The controller has a single operating cylinder which is rotated in one direction for power and in the opposite direction for brake.

The various motor and brake connections for power and braking are made by the small commutating cylinder shown on the right hand side of the controller. This cylinder is moved by means of a cam secured to the main cylinder shaft which engages with the lever seen at the bottom of the controller. The reversing cylinder is shown at the top of the controller on the right hand side, and is of the usual construction.

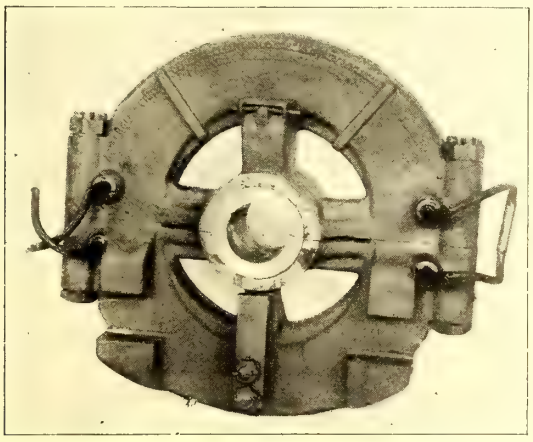
The main cylinder serves to series parallel the motors on



MOTOR CAR BRAKE SHOE (TYPE A J-11)

the "power" side and to regulate the resistance both for power and brake. As the usual interlocking mechanism between cylinders is used, all arcing takes place on the main cylinder where the efficient magnetic blow-out embodied in all controllers of General Electric manufacture, provides for its prompt and complete extinguishment.

This controller differs from some of the earlier types in the arrangement of braking connections and enables the



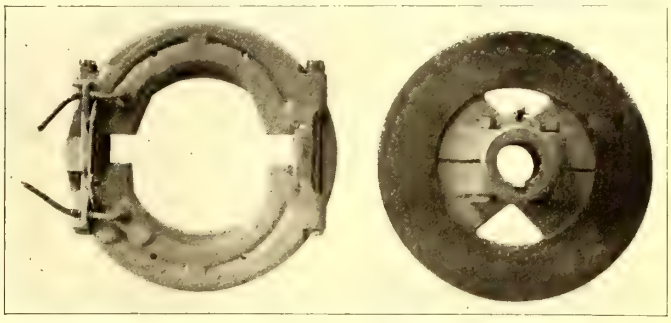
TRAIL CAR BRAKE SHOE (A J-13)

motormen to make a much quicker stop without skidding the wheels than was possible with the other types of controller, or with any form of power brake. The diagram on p. 138 shows the development of the controller and the connections of the apparatus for both power and brake.

It will be observed that the brake shoe on each axle is directly in series with the armature of the motor on the same axle. If either brake tends to lock, due to a too rapid application of the brake, the axle will cease to turn, or, at least, slow down, with the result that the armature in series with the shoe ceases to generate as great a voltage as the armature of the other motor.

The natural result is, that current will pass through the locked shoe in the reverse direction and demagnetize it, allowing it to release. As this action is entirely automatic, it is practically impossible to skid the wheels for more than a foot or two, which is not sufficient to cause a flat wheel. The maximum braking effort that can therefore be applied is dependent solely on the friction between wheels and track.

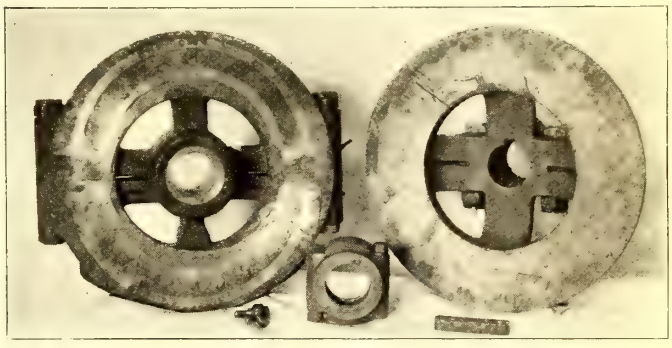
The shoes are demagnetized in the usual manner by



MOTOR CAR BRAKE SHOE AND DISC

shunting a portion of the current on the first power point through them in a reverse direction. This current allows them to release and drop away from the disc.

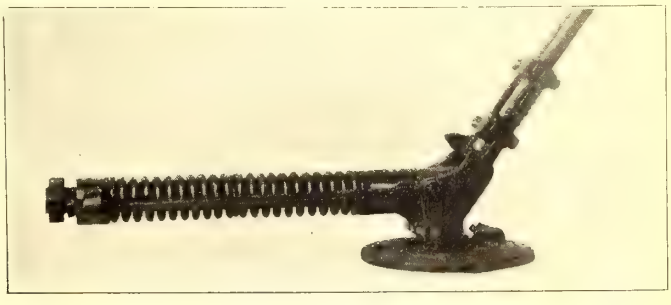
Provisions are also made for the use of electric brakes on the trailer cars. The shoe used is of the axle suspended type, being mounted directly upon the car axle. This shoe is the AJ-13 and is provided with brass axle lining and grease cup. The brake disc is the AK-13. Both shoe and dics are 28 ins. in diameter and they are mounted on each axle of the trail car truck. The shoe is adjusted by an axle collar and an adjusting screw, passing through a U bolt which is screwed into the axle. The shoes are kept from



TRAIL CAR SHOE AND DISC

revolving by means of a bar which passes between the horns shown on the lower half of the shoe.

Connection between motor and trail car is made by means of a special coupler which contains the lighting connection as well as the two brake connections. The



U. S.-6 TROLLEY STAND

sockets are secured to the dashers of the two cars and connections made by means of a flexible lead with a plug at each end. The trail car shoes are connected in series, and when in use are connected between the common lead from

the two motor car brake shoes and the equalizing connection of the motor fields. Referring to diagram of the controller, these shoes are connected in the wire marked BB.

The trolley bases are of the new type recently brought out by the General Electric Company, and known as the U. S.-6 base. The interesting feature of this type of base is the use of a single compression spring which serves the double purpose of a pressure and a buffing spring. A view of this trolley is shown on page 139, from which the action of the base will be readily understood. The buffing collar is seen on the inner end of the spring guide and is forced against the spring by the two lugs on the inside of the swivel head. The stud is very long, insuring an easy swiveling action and allowing the wheel to follow the wire exceptionally well. The inside of the swivel head is fitted with a brass bushing, which reduces the swiveling friction and can be easily replaced when worn out. The minimum height of this base is 6 ins. with the pole in a horizontal position. The cars are provided with circuit breakers connected according to our latest method, the circuit breaker at either end of the car being in circuit only with the controller at the same end. These circuit breakers are of the "MQ" type and contain a magnetic blow-out and other features found in circuit breakers of the General Electric manufacture.

ORGANIZATION

The business affairs of the Consolidated Traction Company are chiefly under the direction of C. L. Magee, president, while the operating department, as well as the electric and mechanical features, are in charge of G. F. Greenwood, with the title of chief engineer and general manager.

CONTRACTORS, ETC.

Some of the contractors and manufacturers of the material required for the erection of the new buildings, and the equipments noted in the accompanying description include the following: The Pennsylvania Iron Works Company of Philadelphia, engines and the auxiliary steam equipment; Babcock & Wilcox Company, boilers; Westinghouse Electric & Manufacturing Company, generators; Jones & Laughlin, Pittsburg, structural steel for roofs and coal bin; Alfred F. Moore, Philadelphia, lead covered cables; John A. Mead & Sons, New York, coal conveyors and automatic weigher; Electric Storage Battery Company, Philadelphia, storage batteries; The U. Baird Machinery Company, Pittsburg, some of the iron working tools; J. A. Fay & Co., Cincinnati, wood-working tools; Marlin & Co., Pittsburg, exhaust steam headers, roofing and ventilators; Pawling & Harnischfeger, Milwaukee, electric traveling cranes; Laclede Car Company, American Car Company, Union Car Company, cars; A. French Spring Company, Pittsburgh, car springs.

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It has been proved that it is usually a waste of time, and very little has been accomplished, by attempting to instruct motormen and conductors other than in the simplest ideas of electrical problems, for while on some roads there may be a number of old motormen who have a fair idea of electrical equipments and whom it would probably be safe to allow to locate existing troubles, it would be difficult to draw the line between the men competent in this direction and those wholly lacking in such knowledge. I know of nothing more distasteful to passengers unwillingly detained than sitting in a car impatiently waiting while a motorman works over some part of the equipment in a vain endeavor to locate some trouble, the very nature of which he has not the faintest idea, and quite likely, at the same time, interfering with the movement of several other cars. From paper at the Boston Convention, 1898.

Interurban Electric Railway in Titusville, Pa.

A 10-mile electric railway has recently been completed in northwestern Pennsylvania, connecting the towns of Pleasantville, East Titusville, Titusville and Hydetown. The road was built and is operated by the Titusville Electric Traction Company, which, in 1897, obtained a 999-year charter from the State. It was opened for business on June 3 of last year, carrying passengers from Pleasantville to Titusville, and in November, the 4 miles to Hydetown were finished. Titusville is the largest of the four towns, and has a population of 10,000. Pleasantville, with its population of 1200, does its shopping and marketing in Titusville, as does East Titusville and Hydetown. The total population of the four towns is about 15,000.

Titusville is famous for having been the center of the great oil excitement of the early sixties. Petroleum was discovered here, and in a few years, what had been a straggling hamlet, became a bustling young city. Gradually the production of oil has lessened in the vicinity of Titusville, and the city has suffered a reaction. Several years ago, however, a Board of Trade was organized, and through its efforts and those of the Industrial Association the city is now enjoying a more wholesome and lasting prosperity. Among its leading industries are several large iron-working establishments; a tannery, which employs several hundred men; oil refineries, and a silk mill.

For a number of years the people of Pleasantville and Titusville have been desirous of having the two towns in closer communication than was afforded by a stage line and George B. Dunham, of Pleasantville, took the initiative and succeeded in interesting R. D. Stoelzing, of that place, M. B. Dunham and A. J. Hazelton, of Warren, Pa., and a corporation was formed with a capital of $100,000. A survey was immediately made and work was begun in July, 1897. Pleasantville is 6 miles from Titusville, and the new company was obliged to purchase the right of way for almost the whole distance from the eastern city limits of Titusville to Pleasantville. Two miles of the road run through a deep gorge along the path of a small but turbulent brook. The engineers at first thought it would be an impossibility to build the road through this gorge, and it was only accomplished after much blasting and bridging were resorted to, and finally the course of the stream was changed near the entrance of the gorge. About 1 mile from the entrance of the gorge the company has leased 60 acres of woodland, which is being converted into a park. The place is one of great natural beauty, and, with the attractions that the company offer, it is expected that it will become a favorite resort, and will do much to increase the road's earnings. Next summer it is proposed to construct, near the park, an artificial lake, in the center of which will be a large electric fountain. The lake will be large enough to afford boating and bathing.

The company's power station is at East Titusville. It is a substantial brick building 74 ft. x 58 ft., of which the engine room occupies 58 ft. x 35.5 ft. and the boiler room 38 ft. x 39 ft. A steel stack 4 ft. in diameter is used. The floor of both rooms is of cement. Since the road has been in operation one engine has been employed. It was built by the Atlas Engine Works, of Indianapolis, and is of the Corliss type, 16 ins. x 32 ins. During the past month a larger engine, 24 ins. x 48 ins., of the same type and make, has been installed and is now running. The smaller engine will be used as auxiliary in case of breakdown or when the load is too heavy for the newer engine. The bed plate is of the girder form, known as the "Corliss bed plate." It is cast in a single piece, unusually massive and rigid, the main shaft-bearing having removable parts with

wedge adjustment. The ends of the cylinder, which contain the valve chambers and the steam and exhaust parts, are cast and finished separately from the cylinder proper, through which the piston traverses. The parts are so constructed and bolted together that the piston travels over no joint, while the clearance remains as low as in the usual form. The advantages afforded by this construction are a more perfect bore free from flaws and shrinkage strains, which the presence of small cored passages is apt to engender, and that, being made to gages on the interchangeable plan, it is possible to renew, without delay and at small cost, a part injured by accident, which otherwise might mean the loss of the entire cylinder. A steel plate lagging, which leaves a space packed with non-conducting material, covers the cylinder. The steam and exhaust valves are of the usual rocking or Corliss type, but are so constructed that they open their ports in two places, thus giving the full opening with half the usual motion.

In the valve gear of the engine a wide departure from the ordinary is seen. The steam valves are operated from the usual wrist plate, driven by an eccentric on the main shaft, but a separate eccentric is used for the operation of the exhaust valves. The cross-head and crank-pins are of steel, and have unusually large wearing surfaces.

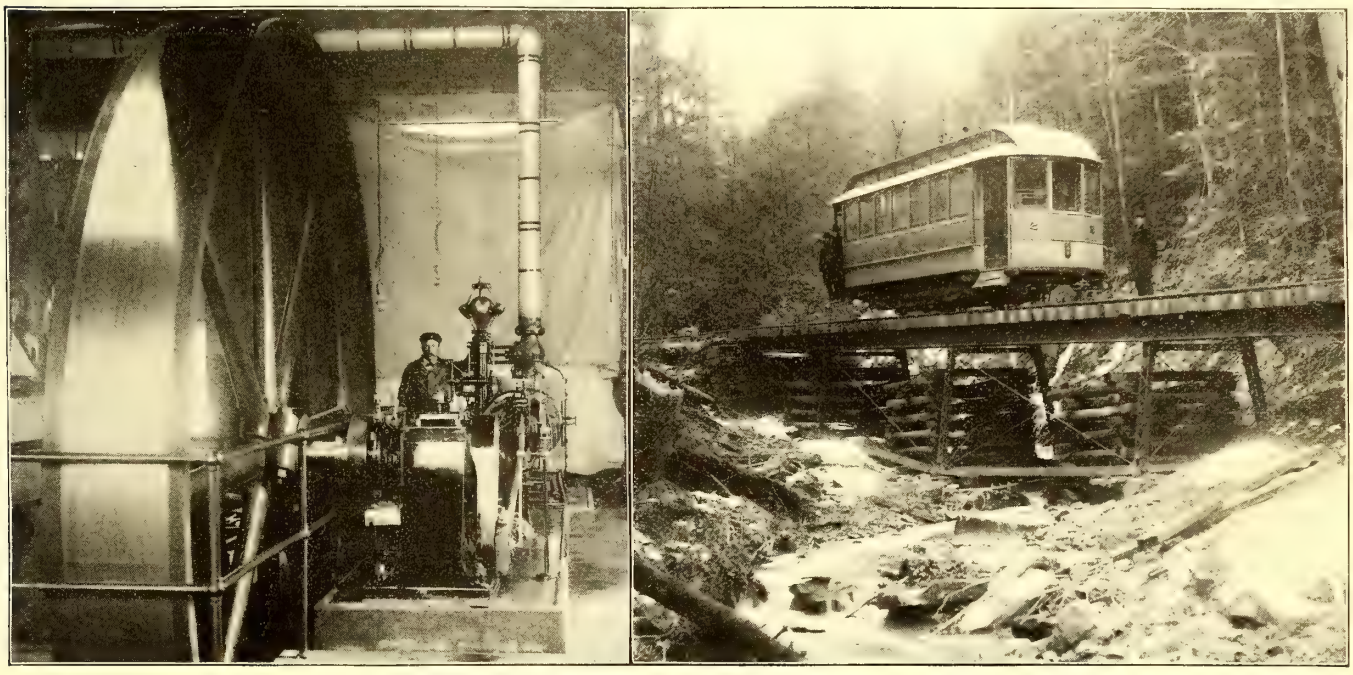
The main shaft is of hammered iron, and the engine is provided throughout with the most improved automatic sight-feed oiling devices and is adapted for continuous working.

Two of the General Electric Company's generators have been installed, and are belted to the engines. The smaller one, a 110 kw., has furnished the current since the completion of the road. The new engine is connected with a 325-kw. generator, which is now in operation, the smaller one being reserved for emergencies. A General Electric Company's switchboard is used, fitted with instruments made by the Weston Electrical Instrument Company.

The fuel used in the three 150-h.p. boilers is natural gas furnished by the Oil City Fuel Supply Company. This is a much cheaper fuel at Titusville than coal would be, costing 10 cents per 1000 cubic feet. The average monthly consumption of gas since the road began operation is 52,000 cubic feet. The steam pressure carried averages 100 lbs. The gas requires but little attention, one man only being in attendance in the boiler room. The feed-water heaters and a 7-in. x 4½-in. x 10-in. pump in the boiler room were made by the Stillwell-Bierce Company.

The trolley wire used was made by Washburn & Moen, and is No. 00. The poles are of chestnut, 50 ft. long, with a 7-in. top, and bracket construction is used almost entirely. The track in the city is laid with 60-lb. girder rails 60 ft. long. Outside the city 70-lb. T rails are employed. Hewn ties, 7 ins. x 7 ins. 8 ft., are used generally in the country. Within the city limits the ties are sawed 6 ins. x 8 ins. x 8 ft. The cost of track construction averaged $10,000 per mile.

A temporary wooden car barn adjoins the power house and accommodates the four cars. The American Car Company made the four closed cars now in service. They are full vestibuled, with 20-ft. bodies, 30 ft. over all. Three of the cars are finished in cherry, the other is in white ash. Extra-heavy extension Peckham trucks are employed, each being equipped with two No. 49 Westinghouse motors. The New Haven registers are used, and the cars are heated by the Johns system. The New York Car Wheel Company's wheel 33 ins. in diameter, with 2¼-in. tread are used. The average life of the wheels on this road is about 20,000 miles.



VIEW IN ENGINE ROOM AND ALONG LINE, TITUSVILLE

The cars travel at a schedule speed of 15 miles per hour, although on some parts of the road over 25 miles is reached.

The maximum grade of the road is 8 per cent, which is reached in the gorge. It is practically an up-grade from Titusville to Pleasantville. The western end of the line is mostly a light grade. Two steel bridges were built in the gorge, one 168 ft. and the other 80 ft. long.

The fare charged in the city of Titusville is 5 cents, and outside averages 2½ cents per mile. Over $6,500 net was earned in the first six months of operation.

The officers of the company are: President, B. D. Dunham; secretary and general manager, G. H. Dunham; chief engineer, A. A. Robertson. The main office of the company is at Pleasantville.

Train Resistance

BY JOHN BALCH BLOOD

I have read with interest the formula for train resistance proposed by John Lundie in the last issue of the Street Railway Journal, but think that investigation will show that the method used by Mr. Lundie for obtaining his formula, i. e., by coasting, is not new. In fact it has now been practically abandoned, as it does not make the test under conditions of service, either as regards the condition of the bearings and the forces acting, or as regards the speeds. All engineers who are acquainted with the subject will know the benefits and disadvantages of this method, and the predisposition would be against it rather than in its favor. It is mentioned that the results indicated in Fig. 1, in the article last month, are obtained directly from 150 or more observations. It would seem that the results should check better within themselves, if such were the case. In the case of the 80-ton train the variation of the tangent of the angle is about 6 per cent.

Train resistance has been a subject which has figured largely in mechanical engineering. A great many men in this country and in Europe have made attempts to formulate it in some convenient manner. Some of these men have been eminent technically, while others have been interested in the subject more from an operating or practical standpoint. Most have desired to make an empirical form of an equation which would best represent the results obtained by experiment, irrespective of the different factors which go to make these results; few appreciated that train resistance was a combination of factors, and therefore if any one factor was pre-eminently above the average, the whole empirical formula would fall. Probably most of the people, who have worked on this subject, appreciated the different factors which go to make up resistance as such, but judging from their formulæ they did not appreciate the function of these factors, and their relative amounts, and also that they were liable to occur in different proportions under different conditions.

There are two methods of measuring this resistance. One, by observing it as a function of the retardation or acceleration, and the other by measurement direct as the resistance pull. The first mentioned was the original method, and the one almost universally used for twenty years. Recently actual measurement by dynamometer or indicator cards on the engine has been more frequent. The first method can be applied in three different ways: First, by bringing the train to a known velocity and measuring the distance to a full stop, then by calculation with averages the train resistance can be computed. After a while it was found that the average should be calculated as an average of the square of the velocity rather than the direct function.

Another method used was to bring the train to a known velocity and measure the loss in velocity at stated intervals until it came to a standstill. Still another method was by calculation from acceleration or retardation in connection with a force of gravity, on an up or down grade. In the second method of determining this resistance, namely, by direct measurement of the pull, this is done in three ways, namely, by use of a dynamometer, by calculation from indicator cards on steam engine, or by calculating from the power curves of an electric motor. The dynamometer and indicator have been used with very good results. The method of calculating from an electric motor has not been used to any great extent, principally from reasons that the speed attained in present installations are not high enough to give reliable points for use in a formula.

The writer made some calculations a few years ago from tests which were conducted quite accurately on the Metropolitan West Side Railway in Chicago. The tests were not conducted for this purpose, and therefore the results are all the more gratifying because they check so accurately. The tests show that between 22 and 26 miles per hour the resistance was from 17 to 18 lbs. per ton.

With regard to the different methods of computing, it can be said that the second general method of measuring absolutely the pull is by far the best, as the conditions are as in practice. The first general method has been practically discarded, because the bearings are not in normal condition on account of the fact that during retardation the force goes from the track and the friction of the bearings is constantly diminishing with the speed, whereas in the case of direct measurement with the speed constant the power is transmitted through the car, and the resistance force is constant at the time of measurement. If the speed is not constant during measurement, allowance must be made for the acceleration or retardation.

Calculations from electric motors seem to me to present the best chance for accuracy.

We will now consider a number of the formulæ in a chronological order:

In 1854, D. K. Clark published a formula based on the experiments of Mr. Gooch, during some previous years. The formulæ given out by him were as follows:

$$R = 8 + \frac{M^2}{171}$$

$$R' = 6 + \frac{M^2}{240}$$

M = Speed in miles per hour.

R = Total resistance of engine tender and train in lbs. per ton of 2240 lbs.

R′ = Resistance of train above in lbs. per ton of 2240 lbs.

The formula now referred to as Clark's formula with tons of 2000 lbs. and giving resistance for train only is

$$R = 7.14 + \frac{M^2}{191.5}$$

Experiments were conducted at low speeds, and condition of the bearings and tracks was not by any means as it is at present. It was soon found that the locomotive had more resistance than the ordinary train.

Rankine proposed a formula which was as follows:

$P = [5.35 + .27 (v - 10)] (T + 2E)$.

P = resistance in pounds.

v = speed in miles.

T = weight of train in tons.

E = weight of engine in tons.

Transposing and using our nomenclature, we have for resistance, exclusive of engine

$$R = 2.6 + .27\ M$$

It will be noted here that he assumed that the locomotive would have just twice the resistance of the rest of the train, a very arbitrary assumption. This formula was based on low speeds.

Searles proposed:

$$P = 4.82\ W + .005\ v^2\ W^2 + .00047\ v^2\ E^2$$

W = weight of train plus locomotive.

E = weight of locomotive.

v = speed.

P = resistance in pounds.

This reduced to the form as follows if we assumed weight of locomotive 35 tons:

$$R = 4.82 + .005\ M^2 + .6\frac{M^2}{T}$$

This formula has been complimented and recommended quite largely. He appreciated that there was a factor in the resistance which was not a direct function of the weight, and also that the locomotive gave more resistance than ordinary cars. The third factor of the formula takes these two facts into account. This formula was developed when low speeds were in vogue:

Welkner in Bavaria as a result of his experiments gave the following formula:

$$W = 3.125 + .00079\ v^2$$

W = kilograms per tonne (1000 kg.)

v = speed of train in kilometers.

Transposed into English units

$$R = 6.25 + .004\ M^2$$

These tests were made with low speeds.

The Eastern Railway of France conducted quite elaborate tests and as a result gave four formulæ as follows:

(1) $W = (1.65 + .05\ v)\ Q$

(2) $W = (1.8 + .08\ v)\ Q + .009\ A\ v^2$

(3) $W = (1.8 + .08\ v)\ Q + .006\ A\ v^2$

(4) $W = (1.8 + .14\ v)\ Q + .004\ A\ v^2$

Q = weight of train in tonnes of 1000 kg.

v = speed of train in km.

A = cross section train square meters.

W = resistance in kg.

Stating that the first for use with freight trains from 12-32 km. per hour; the second for use with mixed freight and passenger trains run from 32-50 km. per hour, the third for passenger trains run from 50-65 km. per hour, and the fourth for express trains running 70-80 km. per hour.

These engineers appreciated that there was a factor due to wind resistance which was independent of the weight of the train, and which varied as the square of velocity multiplied into the cross section of the train.

Transposing, and bringing these formulæ into form for comparison we have as follows:

(1) $R = 3.3 + .161\ M$

(2) $R = 3.6 + .258\ M + .259\ \frac{M^2}{T}$

(3) $R = 3.6 + .258\ M + .173\ \frac{M^2}{T}$

(4) $R = 3.6 + .451\ M + .115\ \frac{M^2}{T}$

R = lbs. per ton.

M = miles per hour.

T = weight of train tons (2000 lbs.)

Cross section of train taken constant as 10 sq. yards.

First for 7.5-20 miles.

Second for 20-31 miles.

Third for 31-40 miles.

Fourth for 43-50 miles.

The formula proposed by Mr. Wellington is as follows:

$$P = 4\ W + .28\ v^2 + .03\ v^2\ C + .005\ v^2\ W$$

Where C = number of cars in train and the rest as before. This reduces to

$$R = 4 + .005\ M^2 + (.28 + .03\ C)\frac{M^2}{T}$$

Or, if we take 6 as the number of cars in average train, we have

$$R = 4 + .005\ M^2 + .46\frac{M^2}{T}$$

The first term of this formula is for friction of the journals between the wheel and the rail, a quantity which is independent of the speed. The second factor is what he terms head resistance, or the resistance of the first car on account of the wind pressure. The third factor is to represent side resistance, or the resistance offered by the atmosphere to the side of the train. The fourth factor he terms oscillating resistance, or increase in journal or rolling friction depending on the speed. When we combine, we have here two factors which are proportional to the weight of the train, and two which are independent of it.

From the "Engineering News," 1893, results are given, which if put into a formula would be as follows:

$$R = 2 + .25\ M$$

D. L. Barnes has given as result of his observations

$$R = 4 + .16\ M$$

These two formulæ have been developed in connection with higher speeds up to 100 miles per hour.

Dodd proposed, STREET RAILWAY JOURNAL, September, 1898:

$$P = (18 + .2v)\ E + (7 + .2v)\ T$$

This is equal to the following if the train only is considered:

$$R = 7 + .20\ M$$

Lundie gives as a proposed formula:

$$R = 4 + S\left(.2 + \frac{14}{35 + T}\right)$$

Or, transposed,

$$R = 4 + .20\ M + \frac{14\ M}{35 + T}$$

Mr. Lundie's formula was gotten from tests with the

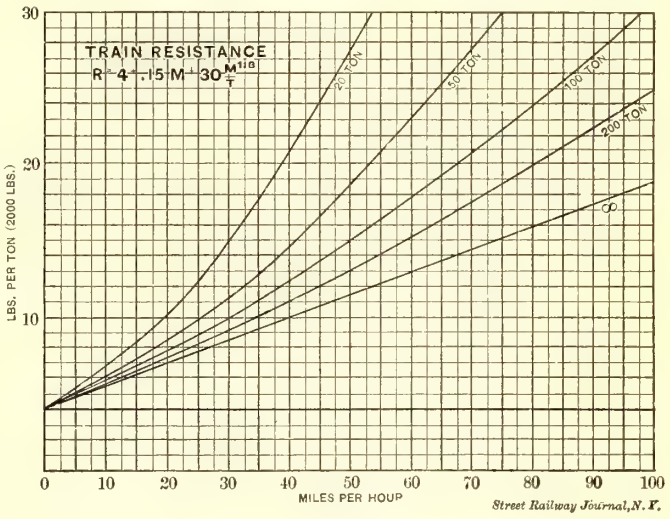


FIG. 1

cars using electric motors. The friction of the electric motor gears and eight extra bearings per car is a considerable factor in the total friction. His formula, therefore, would give too high results.

In ordinary train resistance there are three factors. The journals of the cars, the friction of the wheel on the rail, and the air resistance. In Mr. Lundie's test he should also consider a fourth, namely, the friction of the gears, and the bearings of the motors. All of the cars which he tested had mounted on one of the trucks two 60 h.p. motors. The friction of gears and bearings of these motors when running at 20 miles an hour is about 1400 watts, or 2800 watts per car. This is equivalent to 3.74 h.p., or, reduced to the term of train resistance, would be equivalent to 3.5 lbs. per ton. From Mr. Lundie's curve the train resistance at 20 miles is 12 lbs. per ton, with a 20-ton unit; subtracting this factor of motor friction, we have as an actual train resistance, according to the ordinary understanding, 8.5 lbs. per ton. We therefore see that in this case Mr. Lundie's error by assuming motor friction as nil, is 41 per cent. of the actual train resistance.

Journal friction, according to the laws of friction, should be practically constant in torque at all speeds. The friction of the wheel on the rail varies as first power of the speed. The resistance due to air varies as a higher power than the

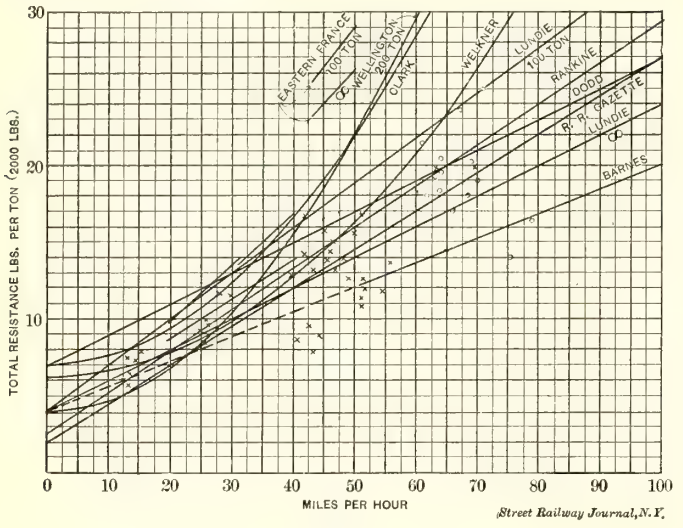


FIG. 2

first of the speed, and is independent of the weight of the train. The resistance due to the motor friction is compound, the motor bearings which would be practically independent of the speed and the gears which would increase with the speed.

From the best information which I have at hand, the calculation for the friction due to the motor would be

$$G = .1\,M + 1.5$$

where G is equal to the motor friction in lbs. per ton, and M is equal to the speed of the car in miles.

For comparison we present all these formulæ in a table:

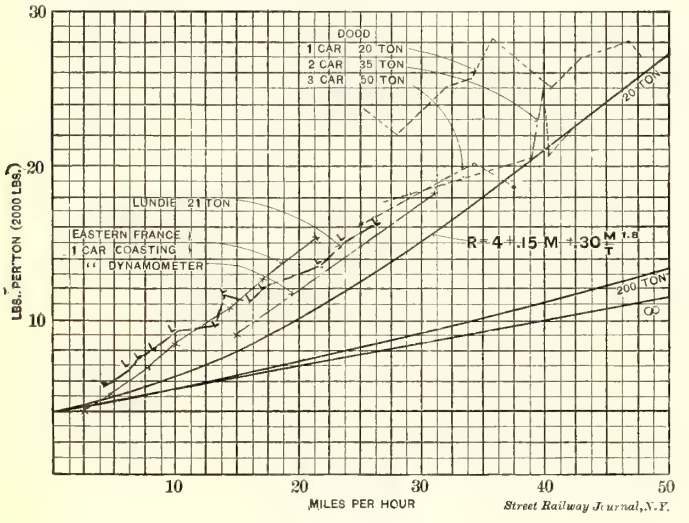


FIG. 3

COMPARISON OF FORMULÆ.

Clark, 1854, $R = 7.14 + .006\,M^2$

Rankine, $R = 2.65 + .27\,M$

Searles, $R = 4.82 + .005\,M^2 + .6\frac{M^2}{T}$

Welkner, $R = 6.25 + .004\,M^2$

Eastern Ry, France, 1885, $R = 3.6 + .258\,M + .29\frac{M^2}{T}$

Wellington, $R = 4 + .005\,M^2 + .46\frac{M^2}{T}$

Engineering News, 1893, $R = 2 + .25\,M$

Barnes, $R = 4 + .16\,M$

Dodd, $R = 7 + .20\,M$

Lundie, $R = 4 + .20\,M + \frac{14\,M}{35+T}$

R = resistance in lbs. per ton (2000 lbs.)
M = miles per hour.
T = weight train in tons (2000 lbs.)

We note that at the start the speed in the second power was used. Rankine, however, used the first power. The errors of experiments were so large that at low speeds it was almost immaterial whether the first or second power was used and the coefficients. Most of these formulæ with the second power were found to give too high results at speeds above 50 miles per hour, therefore a reaction came and new formulæ with a speed as the first power are being recommended. Various modifications have been suggested. The engineers of the Eastern Railway of France had formulæ with both a first and second power of speed as a factor. They apparently appreciated that the second power was too high a power for the wind factor, and therefore have given out formulæ with small coefficients for the higher speeds. These engineers may not have appreciated that the power of the air resistance component should have been between one and two, but they certainly did find that

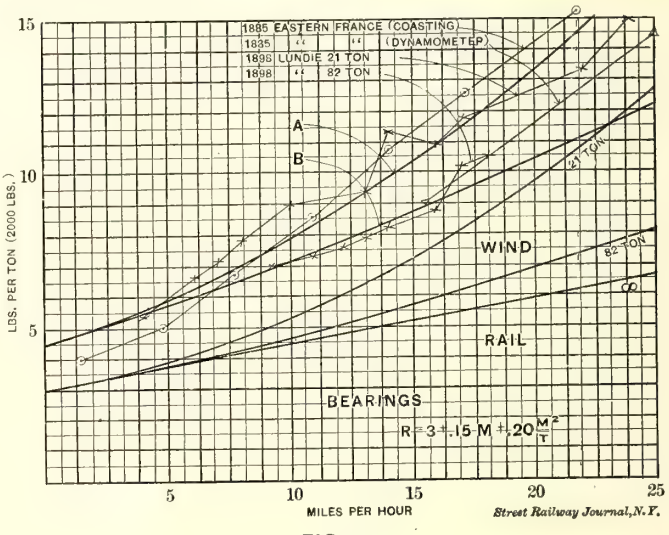


FIG. 4

using the same formulæ for high and low speeds was impracticable.

If we analyze the case we will find that there are three main factors which go to make up this resistance. First, the resistance of the journals, which is approximately constant at all speeds. Second, the friction between the rail and the track which varies approximately with the speed. Third, the wind resistance which is independent of the weight of the train, and which varies as a function of the speed to a power between the first and second.

The general form of the formula would then be as follows:

$$R = B + W\,M + A\frac{M}{T}$$

Where

R = resistance.
M = speed.
T = weight train.

The coefficients

B = journal coefficient.
W = wheel and rail coefficient.
A = air resistance coefficient.
n = exponent of air factor, which should be determined by experiment. It is between 1 and 2.

It is folly to attempt to give a formula which would be universal. We must place a proper coefficient in our for-

mula depending upon the quality of the different pieces of apparatus in connection with the friction. If we have well-worn, nicely made bearings, with low surface pressures, the factor B can be taken from 3 to 4. If the cars are new, bearings not worn, or the pressures abnormal, this factor would have to be taken as 5 or 6. With rails of a proper shape, of sufficient weight, well laid, and a wheel with proper flanges, and perfectly round and the right size, the second factor W would be .15. If these conditions were discounted this factor would increase. In the third term of the right hand member of the equation the factor A would depend upon the cross section of the train, and the exponent n, should be determined by experiment. The exponent n is certainly greater than 1, and in all probability is less than 2. Of course, if we make this exponent anything from an even number it makes the formula hard to use in calculation. At the same time, in high speeds the air resistance becomes of considerable moment, and must be determined accurately.

In Fig. 4, I have attempted to suit this equation to the results of Mr. Lundie, using in the air resistance term the

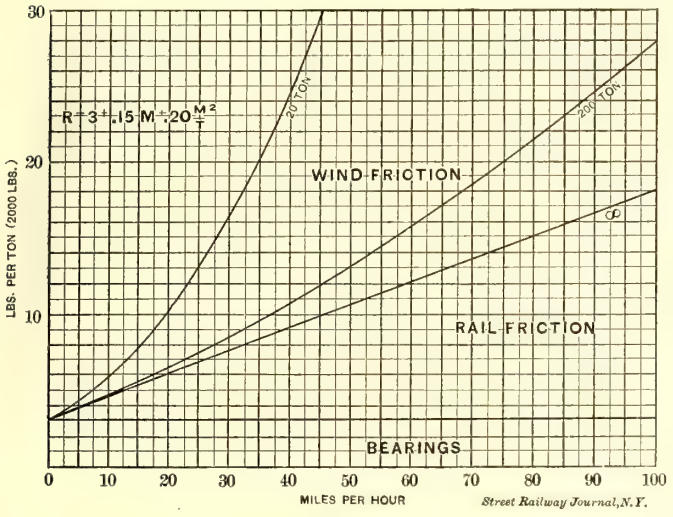


FIG. 5

second power in order to get a simple equation, and I have as a result the following:

$$R = 3 + .15\,M + .20\,\frac{M^2}{T}$$

Fig. 5 shows the equation plotted for all speeds up to 100 miles per hour.

The following table will show the relation of the friction to the different component parts, both with a 21-ton and an 82-ton train:

TRAIN RESISTANCE WITH MOTORS.

			Air.			Total.	
M.P.H.	Bear.	Rail.	21 T.	82 T.	Motor.	21 T.	82 T.
0	3	0	0	0	1.5	4.5	4.5
5	3	.7	.2	.06	2.0	5.9	5.8
10	3	1.5	.9	.2	2.5	7.9	7.2
15	3	2.2	2.1	.5	3.0	10.3	8.7
20	3	3.0	3.8	1.0	3.5	13.3	10.5
25	3	3.7	6.0	1.5	4.0	16.7	12.2

It will be seen that the motor friction is a very important factor throughout the whole range.

To the best of my knowledge in applying the most reliable data which I have at hand, I would say that the formula which would represent good practice would be as follows:

$$R = 4 + .15\,M + .30\,\frac{M^{1.8}}{T}$$

This is given in curves in Fig. 1. Fig. 2 shows how the various formulæ compare, and also shows points from best results which I have at present at hand. This figure will show how the curves compare with the results and with themselves. From this it will be seen that it is immaterial for trains over 200 tons, and running at less than 40 miles an hour, whether the exponent of the speed term in the equation was of the first or second power. The variation from the curves is less than the accuracy of the experiments among themselves. Again, the variation of the proper coefficients would, in all probability, be greater than the variation from the curve itself.

Fig. 3 shows how this formula agrees with tests of trains of light weight. I have plotted here in this figure results of some tests made on the Eastern Railway of France, some ten years or so ago. These were made with single cars; in all probability 6-wheel cars, and of a weight considerably less than 20 tons. I have also plotted results of a test by Mr. Lundie on the Chicago and South Side Elevated Railway. These results contain, beside the usual resistance, an additional resistance of the gears of the motors, and of the bearings of the motors. There are two motors on each car, and this resistance is quite material compared with the total. From calculations from absolute tests at 20 miles, this resistance would amount to 3.5 lbs. per ton. Taking this into account, it will be seen that these results agree quite well with this formula.

I have plotted also, in Fig. 3, results of some tests mentioned by Mr. Dodd in a paper read before the Civil Engineers' Club of Cleveland, published in the STREET RAILWAY JOURNAL for September, 1898. These tests, on account of their variation, would not seem to be very accurate. In all probability, although it is not directly stated, there is a motor friction to be taken from these results.

[For a further discussion of this subject, see pages 149 and 150 of this issue.—Eds.]

A French Account of an English Accident

One of the French electrical papers thus humorously describes a recent accident in one of the underground railways in London:

Even under ordinary circumstances, it is far from reassuring for the timid traveler to traverse tunnels, especially when these tunnels are some 60 ft. below the surface of the earth, but when the box in which he is enclosed stops suddenly with no indication of ever starting again, no passenger ought to be considered a coward if he begins to feel cold chills run up and down his back. The situation is certainly one which does not have many cheerful features in it. This is what happened the other week to a crowd of Londoners who were going to see a procession of the Guards returning from the Soudan. The trains, heavily loaded, were passing slowly through the single tube which extends under the Thames, and were approaching Waterloo station, when, all of a sudden, they came to a stop. Immediately the ventilation in the tunnel, which is secured by the rapid movement of the trains, ceased. The poor passengers began to get suffocated, the lights went out and the darkness added still more to their terror. Finally, half-asphyxiated, they climbed out of the cars in a crowd and on foot traversed the distance through the tunnel to Waterloo station, about half a mile away. The trouble was caused by the electric motors, which, not receiving sufficient current to propel the heavily loaded cars, refused entirely to work. It is fortunate that the accident happened in England, where stolidity is so common and everyone is cold blooded, as otherwise the accident might have had a more serious termination.

In dealing with the inspection of cars in the car house, we believe better results can be obtained by giving to each man some particular branch of the work, rather than assigning to him a certain number of cars and expecting him to do all the work required thereon. From paper at the Boston Convention, 1898.

LETTERS AND HINTS FROM PRACTICAL MEN

Notes on the Standard Rules and Regulations as Reported by the A. S. R. A. Committee

II.

Schenectady Railway Co.,
Schenectady, N. Y., Feb. 18, 1899.

Editors Street Railway Journal:

In an article in the February number of the Street Railway Journal, the qualifications and limitations necessary for a set of "general" rules for street railway employees were outlined, with the intention of judging by them the set of "Standard Rules and Regulations" as submitted by the committee of the A. S. R. A. and published in the December Journal.

In this and succeeding articles this test will be made, and where the rules of the committee do not fulfil the conditions, criticism will be made, changes and amendments suggested and reasons given therefor.

Taking the qualifications and conditions as enumerated in the February Journal and submitting the report to them, we wish to know—

First—Are they all *rules?* Several of them are not, as a whole, and many of them are not in part. General Rules Nos. 1 and 2 are announcements regarding the rules, their place is on the title page or closely following. No. 7 is a notice to the employees of the policy of the employer in regard to promotion, etc. Its place is in an "Introduction" to the rules, or in a "General Notice." No. 8 is not a rule at all, it comes under the head of "unnecessary and axiomatic remarks." Any reasonable being knows that a wilful, repeated or inexcusable act of the kind therein specified should cause his dismissal from *any* position, and especially from a service that deals with the public as a common carrier, where the consequences of such acts are liable to be so serious to the employer. Of a similar character are the third paragraph and the last part of the fourth, under "Depot Masters." For what general reasons are the heads of departments hired except for "properly conducting" their part of the "company's business," looking after the "safety of the property intrusted to their care," and seeing that employees under them are "prompt and efficient in the discharge of their duties?" These are not the peculiar duties of a "depot master," they are the well-known and thoroughly understood principles of duty of *all* heads of departments or sections of departments. They are all the very axioms of duty, and to put such truisms in as rules is to insult the intelligence and common sense of the employee. General rule 15 and rule 13 for conductors and motormen are other similar cases, they contain the stereotyped phrases, "will be held responsible for the care and protection of the property of the company coming into his hands" and "will be held responsible for any damage caused by their neglect or carelessness." Of course they will be; *all* employees are; not only those of street railways, but those of "the butcher, the baker, the candlestick maker!" Care of the employer's property is a necessary qualification of *any* employee and cannot be too carefully fostered, but it must be done in other ways than by repetitions of bald-headed truisms. If it is really the intention or practice of the employer to penalize carelessness or negligence, such practice should be stated in positive terms under a "general notice" or should form one of the "general rules" and should read as follows:

"Any damage done to company or other property, or any loss or expense incurred by the company by reason of neglect or disobedience of these rules will be charged to the account of the employee or employees responsible for the damage, loss or expense, and the amount so charged up will be deducted from their ———." (Pay, deposit or bond, as the case may be.)

Rule 14 for inspectors is not a rule, it is very good advice and might be put into a note at the end of the inspector's rules, or into the "General Notice."

Under rule No. 3 for motormen the words, "and accidents can and must be avoided," and the paragraph following them are not only unnecessary remarks, but they are *not true*. The employer and the employees are both aware that by no amount of human foresight or care and by no use of appliances, can *all* accidents be avoided. Even the law—and coroner's juries—do not go that far; therefore, to make such an unqualified statement, and to put it in capitals, is to make the whole rule ridiculous instead of impressive, as a "safety rule" should be. These paragraphs should be cut out of the rules and only put in the "General Notice" in an amended and truthful form.

The first part of rule 1 for conductors is objectionable in many ways; its intent seems to be that even around the depot—away from passengers—profane and filthy language is not to be used, but the wording of this part is unhappy, as—by inference—it says that other employees may use such language around the depot and—as there is no other rule to the contrary—conductors may swear and use "improper language" in other places. Again, by placing such a rule under "Special Rules for Conductors" and nowhere else, it would be apt to give the impression that either the conductors were the only employees with foul mouths, or that they used the depot as the only available place in which to express their feelings! These remarks have no place in this rule or in this section of rules. If it is thought necessary to touch on this matter, it should be placed in the "General Rules" for all employees, and worded about as follows:

"They will—while on duty or about the premises of the company—*entirely abstain* from profane or indecent language and from improper or ungentlemanly conduct, and they will, in *all* cases, be polite and courteous in their dealings with one another and with everyone with whom they come in contact in the performance of their duties."

Rule No. 15 for conductors is mostly unnecessary remarks. The specific part of it in regard to "waste, etc." should be amplified and elaborated into a rule as will be shown further on, and the "good judgment" part entirely cut out. Good judgment is common sense applied to cases where experience or specific directions are lacking, and in a matter as important as the care of his car, specific directions—either by rule or by oral directions from his depot master or inspector—should *not* be lacking.

Rule 19 is of the same style—only worse. It should not reflect on the other employees by making the conductor the only person who—under the rules—is allowed to use his own judgment! It should be completed and made a "general rule" and should read:

"They (all employees) will—in the absence of officials to whom they may apply for advice, assistance or authority—exercise common sense and discretion in dealing with matters not provided for in the rules."

Finally—as regards their being rules—the first paragraph under "General Requirements"—in fact the whole of this section, and the three paragraphs under "Penalties" (following rule 23 for motormen) are not rules. As they stand, they are recommendations and suggestions by the committee to employ*ers*, and should be put into the report as such, or incorporated into the "General Notice," or put

into shape as rules. As they are placed they are out of place, especially the matter under "Penalties" (about which something will be said further along) and the location of which under "Special Rules for Motormen" might suggest that this generally excellent body of men were the black sheep of the flock!

By a difference of wording and arrangement most of the "General Requirements" would make excellent and necessary general rules. A uniform and generally known and understood set of "requirement rules" for certain employees would be a blessing to all who had the hiring of them. They would make a "standard," and as such would save much trouble with labor organizations, with nepotic directors and with politicians who had a "pull" and needy relations and friends, and they would save the labor of sorting out a lot of "dead-wood." These rules would use the word "must," they come under the "imperative case" spoken of, as they fix a standard. The raw material *must* come under rule and measure—afterward, when it is licked into shape, when it has been tested—flexibility may be allowed, but the "requirement" section of the rules should be absolutely positive.

Second—Are they "general" in the sense of being of universal application within a certain territory—in this instance the United States? Could any road in either Maine or Florida, California or New Jersey, single or double track, urban, suburban or interurban, high-speed or low-speed, big or little; could any one of these roads pick out from these rules a full quota of general rules (those not local) for its use, or for guidance in formulating a code of rules of its own? It is, of course, thoroughly understood that the most complete and perfect set of general rules could not be used as a whole by every road, nor hardly by any one road—snow storm rules would be slightly out of place in Southern California or Florida—but in such a complete set of rules any and every rule not caused by peculiarly local conditions should be found complete, or its spirit and principle should be indicated.

On the ground of passing away, the committee has excluded rules "especially applicable to street railways operated by horse or cable power," and it has also—whether on the same grounds or not, is not stated—excluded rules especially applicable to single track roads, to roads operated by open or closed conduits, by third rail, by storage batteries, compressed air or kinetic motors; while it has included rules especially applicable to roads operated by overhead trolley and on double track. These rules are not general therefore in the sense of being universal, and cannot be so until they can be used as general rules by every street railway in the United States, no matter what its motive power or the character of its track, traffic or equipment. If such cannot be done without bringing in rules especially applicable to some one system of motive power or to some special method of using it, then it would be better to leave out of *these* rules those that relate to such subjects except as they may be applicable to *any* motive power or method of using it, and to put the special rules for each system under separate heads. It is conceded at this present time that the overhead, under-running trolley is largely in the majority, but with the advances made in other methods and motive powers, it is not safe to say that such majority may continue for any great length of time, and it would therefore be wiser in the beginning to avoid in any general set of rules those applying to any special and transitory method, or apparatus.

Third—Are they "general" in the sense of not being local or individual? This is best answered by asking a few questions. Is it general, or, is there a reason, good and sufficient enough to make it general, to exact $10 for a badge or $20 for a uniform? Or to use one tap of the signal bell as a signal for the motorman to stop at the next crossing or trolley station? Or to call a rheostat or resistance coil a "diverter"—a name used by one special manufacturer? Or to charge *5 cents* for every adult passenger or *3 cents* for every child between the ages of three and twelve? Or to permit only five policemen, firemen or employees on a car at the same time? Or to allow smoking on the *three* rear seats of open cars? Or to make an employee send an excuse by *special messenger* if he is absent through sickness? Yet all of these, and some others not noted, are specified in the rules, and all of them are local and individual. If the idea has been in each case to suggest a principle, it should have been done by giving the skeleton of the rule and leaving the specific name, number and amount to be filled by each road according to its local conditions. For instance, it is a wise thing and one of general use to formulate a general rule limiting the number of "dead-heads" that should ordinarily be carried on any one car at one time, but it reduces a general rule to a local one to make such a number fixed and specific, as local conditions would govern that point absolutely.

These rules are stated in the report as being for conductors and motormen, but the committee have included in the report those for "depot masters," "receivers" and "inspectors." Leaving out the receivers, whose duties are dismissed with a curt paragraph, the division of the officials immediately in authority over the conductors and motormen into "depot masters" and "inspectors," and the defining of their duties as such is an arbitrary and local action and not a general one. It is true that there must be some one in direct authority over the conductors and motormen when they are *not* on the cars, and there must also be some one in like authority when they *are* on the cars, and that on a road of any size at all, these officials cannot be one and the same man. It may also be true that the division of these officials into depot masters and inspectors and the arrangement and division of their duties as suggested by the committee is a correct one for certain roads, but it can never be a general one and certainly could never be made a standard one, even within a State, as local conditions would influence the duties and division of duties of these officials so greatly as to prevent any such arrangement as is suggested by the committee being made general even by roads of similar size or number of employees. As a matter of fact, the office of "inspector" is quite different on different roads. Originally they were what their name implies, "inspectors" of men, cars or motive power, but, as street railways have enlarged both in size and aims their duties have been increased, broadened and changed until they are more "supervisors" than "inspectors" on some roads. Even on the same road the duties and authority of one so-called inspector will be totally different from another one bearing the self-same official title. It is, therefore, to be easily seen that any attempt to generalize the title or to divide and specialize the duties of the officials directly in authority over the conductors and motormen, would be at this time an impossible task.

Fourth—Are they comprehensive? Do they cover every point in regard to the general duties of these employees in relation to their superior officers and officials, in relation to one another, to the property they are intrusted with and to the public? On some of these points they are fairly full and complete, on others they are not, and on others they are almost lacking. This may seem a strong statement but—as this head will be more fully treated under No. 11 ("Classification and Arrangement")—a single instance will be given to prove the statement. The property intrusted to the care of the conductor—the car itself—is a valuable

one and the proper care of it by him will be an important item in the maintenance account. The neatness and cleanliness of the inside of the car, the proper adjustment of the ventilation, temperature and lighting, will all tend to increase the comfort of the passengers and, consequently, their satisfaction with the service. Therefore, on both these points, the rules should instruct him and guide him to the fullest extent. In relation to these duties, the rules as reported by the committee are conspicuous by their absence, as they consist of the last sentence of rule 28 for conductors and motormen, and Nos. 15, 25, 31 and 33 for conductors, in all, a matter of a dozen lines on this subject, and of this dozen lines nearly a third are *not* instructions. As a matter of comparison, the following in relation to this point is given as a suggestion of a more complete rule:

SPECIAL RULES FOR CONDUCTORS IN RELATION TO CAR

Rule No. —. CARE OF CAR.—As the conductor will be held solely responsible for the condition of car while in his charge, he will, when taking it from depot, from an inspector or from another conductor, make certain that it is clean; that no parts, such as windows, shades or seats, are broken; that the signal bells and register work properly; that oil lamps (if used) are trimmed and in order; that .... spare incandescent lamps (if used) are in their receptacles, and that all .... (implements or tools used by conductor or in his charge) are in good order and in their proper place. In case the car is dirty or any apparatus, tools or appliances, or parts of car are missing, broken or defective he will at once note the fact on ..... (form or portion of form for that purpose).

He will see that car is properly and thoroughly swept and dusted at least ..... (once, twice or thrice) during his swing or run, or oftener if the weather necessitates it.

(Or) He will thoroughly sweep the car and platform floors and the steps when on stand.

He will take care to adjust the ventilation of the car according to the weather. In closed cars the doors must be kept closed in cold weather as much as possible, and ventilation given when needed by the ventilating sash in roof. In hot, sunny weather the blinds (or shades) should be closed on sunny side of car.

He will not allow the blinds and windows to drop when handling them, but will raise or lower them carefully; he will not slam the doors, and will turn the signs and all reversing seats carefully.

(If used) He will keep the oil lamps turned low when first lighted; will not allow them to smoke, and will relight them AT ONCE if they become extinguished.

He will keep all gloves, overshoes, rubber coats, waste, etc., in their proper lockers, and NO WHERE ELSE.

He will not allow any person to put their feet or dirty articles or bundles on the seats; to put their feet on the dasher or the woodwork of the car; to spit on the floor or platforms or behind the seats; to scratch matches or write on the car; to throw paper, nutshells or other rubbish behind the window-blinds or on the floor, or to in any way UNNECESSARILY damage, disfigure or dirty the car.

He will allow no advertisements, notices, show-cards or circulars to be placed in or on the car without direct order or written permission from his ..... (proper officer for this purpose).

He will not allow newsboys, peddlers or solicitors of any kind to ply their vocation on his car.

Finally: He will, in all other ways, take good care of his car, and do everything possible to preserve it and to keep it neat and clean, and make it comfortable and attractive to passengers.

Fifth—Are they clear and explicit in language? General rule No. 5 says: "No one will be excused for violation of the rules even though not included in those applicable to his department." What is "not included," the employee or the rules? It can be read either way equally well. What is evidently meant is "No employee will be excused for violation of a rule even though such rule is not directly applicable to him or his department." Of the reasonableness of this, something will be said further along.

Rule No. 6, following above, has, in capital letters, "Ignorance is no excuse for neglect of duty." This is probably intended as a paraphrase of the legal maxim, "Ignorance of the law excuseth no man," but it goes wide of its mark in its present form, for ignorance by itself would be an excuse. As nearly as can be guessed from the preceding part of the rule, the intention has been to state that "ignorance of the true meaning of a rule or order will not be received as an excuse for the neglect of it," but that would be highly unreasonable and unjust and would be bettered but little by placing the word "wilful" before "ignorance." As a matter of fact, any and every ordinary and general rule or order should be so plain and explicit that any employee of average common sense and in the class or group of employees for which the rule is intended, should be able to rightly comprehend it. If a rule or order is one that deals with technical or special matters which might be beyond the understanding of the employee, or of a new employee, care should be taken that such rule or order should be diagrammatically or orally or practically explained before being enforced. Given an ordinary or general rule as carefully, plainly and clearly expressed as possible, and the employee who cannot or will not understand it without oral explanation, is not, as a rule, the proper employee to work under that rule.

Paragraph 17, under "Depot Masters," says: "They must arrange to sand the rail when necessary." Rule 16 for inspectors, says: "They should give special attention to sanding the track on hills," etc. In both cases, being officials or in authority, it means that they are to have it done, and the rules should read: "They must arrange to have the rail sanded when necessary" and "they should give special attention to the sanding of the track on hills," etc. Of course, it is understood that in an emergency case, there being no one else to do it, a depot master or inspector would sand the rail himself, but that is not the intent of the rule.

General rule No. 9 for conductors and motormen says: "Under no circumstances must a conductor and motorman be away from a car at the same time unless properly relieved." What is meant is, "Under no circumstances must *both* motorman and conductor be away from *a* car, unless properly relieved."

Rule No. 12 says: "The official badge must never be worn by anyone except to whom it is issued." This was probably intended to have the words "the employee" inserted between "except" and "to." It is even then not complete, the rule in regard to badges should be: "The official badge must be worn in plain sight so as to be readily seen and read at all times. Under no circumstances will employees exchange badges with one another, nor will they lend them to *any*one for *any* purpose. The official badge must never be worn by anyone except the employee to whom it is issued."

Under rule 5 for inspectors, they are required to "keep themselves informed of all instructions issued by the officials of the company and see that they are complied with." This is a "big order" for an "inspector,"—in the first place, to ask them to "keep themselves informed," in the next place, to keep informed "of all instructions issued by officials of the company," and, lastly, to "see that they are complied with!" If this were really the intent of the rule an inspector's life would be like that of the policemen in the "Pirates of Penzance," "*not* a happy one!" As a matter of fact, no official or minor official should have to "keep informed" as to any orders which affect him or his department. Such orders or instructions should reach him directly in writing or printing, should be posted in a place that he is expected to examine regularly for them, or, in case of emergency or of trivial matters, may be given verbally. In no case should he be expected to hunt up orders or instructions, nor should he be expected to be familiar with or responsible for the "compliance with" any orders

or instructions not affecting himself, his department or the employees under his charge. The rule should read: "They will make frequent examination of the bulletin board for orders or instructions affecting themselves, their department or the employees under their authority, they will make themselves fully conversant with them and see that they are complied with."

Under rule 13 for motormen the words, "passing men on the street," should read "passing men *at work* on the street." Under rule 9 for same the word "junction" in second line should be "curve," and the word "the" before "junction" in the third line should be "a."

Some of these may seem like trivial items to criticise and it may be that some of them—together with a lot more which have been criticised—may be due to the "intelligent compositor" or his able coadjutor, the typewriter, but there are many of these items that are evidently not the handiwork of these two, and are therefore subject to the criticism that in matters where a word or sentence misplaced, omitted or wrongly used may alter cases of vital importance and lead to very harmful results, there should be nothing used but the clearest and most explicit language, brevity must be sacrificed to perspecuity in rules, especially in "safety rules." H. S. Cooper.

(*To be Continued.*)

Method of Keeping Accounts

Baltimore, January 23, 1899.

Editors Street Railway Journal:

I have carefully considered the article on "An Ideal System of Street Railway Accounts," in your January issue, and it gives me pleasure to say that it seems to me thorough. Of course, its use involves much work, but without that work some detailed showing would be necessarily omitted. A simple system would give results but omit much desirable analysis. De Courcy W. Thom.

The local conditions should govern the type of double truck used, the bolster type in most cases being preferable for long cars on high speed, suburban service, while for city service, where heavy grades and quick starts demand maximum traction, and short curves make it necessary for the wheel to turn under the sill, the bicycle type must necessarily be used. From paper at the Boston Convention, 1898.

Power Station Records

Trenton Street Railway Co.,
Trenton, N. J., Feb. 17, 1899.

Editors Street Railway Journal:

I enclose the report of our power station for the year ending Dec. 31, 1898. The low cost in fuel consumption in April and October was due to our taking account of stock of coal on hand those months. The cost of power includes the expense of lighting our park and of heating and lighting our cars.

In our station we have one 100 h.p. and two 400 h.p. Watts-Campbell tandem compound condensing engines; six 100 h.p. return tubular boilers; four Short 100 kw. generators, and one G. E. 750 kw. generator. The generators are belted with the engines. Our boiler pressure is 100 lbs. Henry C. Moore, President.

Statement of the Cost of Operation of the Trenton Street Railway Company for the Year 1898.

	Superintendent.	Engineers.	Oilers.	Firemen.	Helpers.	Repairs to Engines.	Repairs to Boilers.	Repairs to Dynamos.	Repairs to Piping.	Repairs to Pumps.	Fuel.	Oil, Waste and Packing.	Light.	Extra Labor.
January	50.87	120.49	86.85	91.93	38.75	170.60	33.67	3.77	....	1.05	836.19	105.45	1.25	6.00
February	46.92	110.80	78.44	83.04	35.00	4.17	25.97	3.09	....	....	849.32	166.77	4.42	15.00
March	50.88	122.67	86.84	91.94	38.75	....	74.73	....	....	18.75	801.96	43.03	....	10.50
April	49.56	118.71	84.04	88.97	37.50	22.50	52.09	....	....	....	639.90	130.22	4.73	19.45
May	50.87	122.68	86.85	91.94	38.75	10.50	5.00	....	....	10.95	703.85	92.00	....	7.79
June	49.56	118.71	84.04	88.97	37.50	2.81	10.94	1.50	....	....	698.57	106.87	4.25	7.50
July	50.88	122.67	86.84	91.94	38.75	10.65	60.80	....	....	....	753.14	76.48	....	17.89
August	50.87	122.67	86.85	91.93	38.75	12.07	17.75	....	33.93	....	727.61	116.16	....	38.64
September	49.56	118.72	84.04	88.98	37.50	49.47	81.10	....	16.57	23.75	927.67	173.68	4.34	68.50
October	50.87	122.67	86.85	91.93	38.75	7.80	178.18	....	....	...	600.61	145.81	2.10	17.89
November	69.57	118.71	84.04	88.97	37.50	59.90	11.17	9.75	....	....	897.20	121.49	4.55	31.50
December	50.00	122.67	86.84	91.94	38.75	30.04	17.02	2.19	17.09	61.73	1,059.61	146.42	3.58	65.13
Total	620.41	1,442.17	1,022.52	1,082.48	456.25	380.51	568.42	20.30	67.59	116.23	9,495.63	1,424.38	29.22	305.79

Total cost, 1897..... $15,301.60
" " 1898..... 17,031.90

Car miles, 1897..... 1,484,885
" " 1898..... 1,612,108

Cost per mile..... $.01
" " " 01.1

A Formula for Train Resistance

Massachusetts Institute of Technology,
Department of Engineering.
Boston, Mass., Feb. 2, 1899.

Editors Street Railway Journal:

I should like to know more with reference to the original data of Mr. Lundie's experiments before I can make up my mind regarding his formula. I am inclined to agree with the remarks from "Locomotive Engineering," which you quote at the beginning of your article. Trains differ very much as regards every element in the problem. With reference to Mr. Lundie's method, of course you are familiar with the tests which were made in connection with the Burlington brake tests, by which trains were allowed to run until they came to a stop, so that Mr. Lundie's work is not new in this respect. I do not think that it is shown very conclusively that these lines *ought* to "intercept each other with surprising accuracy at a single point," since the lines as drawn are plotted from the equation and must, of course, meet at this point. I think the form of Lundie's equation is better than that of Clark's, although S should not appear to the first power or to the second power, but to some intermediate power. The same result might be attained with two terms, one with S and one with S^2. Cannot you publish an article giving all the details of Lundie's experiments, or does he wish to keep them for publication

in some original paper? They would, no doubt, be of much interest, and I should be glad to see them.

Geo. F. Swain, Professor of Civil Engineering.

The Chicago City Railway Company,
Electrical and Engineering Departments.
Chicago, Ill., Feb. 3, 1899.

Editors Street Railway Journal:

I am much interested in Mr. Lundie's formula for train resistance. The figures given by him are much lower than anything we are able to get in street railway practice owing to the difference in the conditions, as you have mentioned. We have in street railway work a rail almost buried in dirt, especially in this city, and you can readily appreciate that there is double, and more, the track resistance on such a rail than there is on a steam railroad rail lying high and dry; and I quite agree with you when you say that it is probable that no formula can be devised for street railway work where the conditions vary so largely.

I remember a few years ago making a test in order to determine when it is time to replace a badly worn rail, and the wide range in differences in draw bar pull per ton may be observed in the following table:

	Average Speed in Miles Per Hour.	Total Weight of Car Tons.	Draw Bar Pull Per Ton.
1. On badly worn rail...	12.9	4 1/3	43.8 lbs.
2. On badly worn rail...	10.	4 1/3	40. lbs.
3. On nearly new rail....	12.	4 1/3	26. lbs.
4. On nearly new rail....	11.4	4 1/3	30. lbs.
5. On badly worn rail...	8.6	4 1/3	37.5 lbs.
6. On nearly new rail....	8.8	4 1/3	24.2 lbs.

The rail was dry and comparatively clean, and the resistance small. In test No. 5, the time consumed in starting and stopping was eight minutes and forty seconds; and in test No. 6, nine minutes and forty seconds. The rate of speed attained in these two tests includes the time consumed in making stops and starts. With "badly worn rail" the flanges of wheels were, in many instances, running on the tram of the rail. In noting the difference in draw bar pull per ton with a new rail and an old one, it can readily be appreciated that it is false economy to try to operate a street rail after it becomes badly worn.

I doubt if it is possible to adopt any given formula; that is, for practical use, for train resistance, no matter how carefully determined, when, in the majority of cases, the joints of steam railroad rails are very poor and irregular in the matter of alignment, and this difference alone would, in my opinion, vary the results very materially, to say nothing of the variations which would be caused by "spongy" sub-grades, etc. As I understand it, Mr. Lundie made all of the observations, from which he worked out his formula, on the Alley "L" or South Side Elevated Railway. He had, of course, in that track, ideal conditions existing in the way of a solid road-bed and well aligned and rigid joints and rails such as are rarely found with surface steam railways.

Mr. Lundie certainly deserves great credit for his efforts and their results in working out this formula, and the method he used gives an accuracy which has not heretofore been obtained.

G. W. Knox,
Electrical Engineer.

New York, Feb. 14, 1899.

Editors Street Railway Journal:

While I have a very limited knowledge of the subject, I would say on general principles, that the formula which does not contain the square of the speed in one of the terms, cannot be true for widely different values. But if, as you say, the practical results within certain limits agree with the values found according to Mr. Lundie's formula, his work will not be the less welcome to engineers.

Nikola Tesla.

Sibley College, Cornell University.
Ithaca, N. Y., Feb. 13, 1899.

Editors Street Railway Journal:

I am very much interested in the question of train resistance, and am entirely convinced that some of the recently proposed formulæ that did not take into consideration a variation of the traction coefficient with the speed were wrong, but did not find it convenient to take up the matter at that time. A comparison of actual acceleration curves and those deduced from other formulæ would indicate that Mr. Lundie's formula is more generally applicable than any yet proposed. S. B. Fortenbaugh.

The Lake Shore & Michigan Southern Railway Co.,
Engineers Department.
Toledo, Ohio, Feb. 15, 1899.

Editors Street Railway Journal:

We have never made any scientific train resistance tests, so far as I know. Mr. Lundie's formula is certainly very interesting. Such an empirical formula, if carefully made from a sufficiently large number of observations, ought to have good results within those limits, and under conditions similar to those under which the observations were made. But it is difficult to pick out the value of the different causes which have contributed to make up the numerical factors of such a formula, or the effect upon these causes when the conditions under which they operate may be changed, so no one can say whether these numerical factors are correct outside the limits of actual observation. Fortunately, however, most cases will come near enough within these limits, and consequently all such formulæ have a value. I hope this one will have a large one.

Samuel Rockwell, Engineer M. S. Division.

University of Wisconsin,
College of Mechanics and Engineering,
Madison, Wis., Feb. 2, 1899.

Editors Street Railway Journal:

Mr. Lundie's formula appears to agree unusually well with experimentally deduced results, and it may rightly be looked upon as a decided improvement upon the older formulæ. The insertion of the train weight as a variable in the formula follows the line of argument set forth, for instance, by Searles, when he premises in his field book that a formula of the kind here considered "must include at least the velocity and weight of the train and engine;" and it is a substantial service to engineering to put a formula of this nature into useful shape. Mr. Lundie is to be congratulated upon deriving a formula of so apparently wide application, but no fixed formula can be fitted to the widely varying conditions met in street car (surface) traction as it now exists. D. C. Jackson, C. E.

From the information before us, we feel sure that we can safely assume twenty-four years as the life of a creosoted tie, and with this assumption we will determine the cost of keeping the different kinds of ties under sections of track for twenty-four years. Creosoted ties will cost 24 cents per lineal foot of track; therefore, 60 cents (36 and 24) will represent the cost of labor and ties per lineal foot in rebuilding. Principal and interest on 60 at 6 per cent for twenty-four years, $1.46—which is the actual cost per lineal foot of keeping ties under this track for twenty-four years.—From paper read at the Montreal Convention, in 1895.

The Next Convention.

The eighteenth annual meeting of the American Street Railway Association and the third annual meeting of the Street Railway Accountants' Association of America will be held in Chicago, Ill., Oct. 17, 18, 19 and 20, 1899, at "Tattersall's," State and Sixteenth Streets. This building contains 50,000 sq. ft. of floor space, without a post or obstruction of any kind.

Friday, Oct. 20, has been set as a day for an examination of the exhibits. No session of the association will be held, so that all may have plenty of time to view the exhibits. The association will especially request that managers have their heads of departments present on that day.

President Charles S. Sergeant, of Boston, Secretary and Treasurer T. C. Penington, of Chicago; Walton H. Holmes, of Kansas City; Albion E. Lang, of Toledo; George A. Yuille, of Chicago; Frank G. Jones, of Memphis; John I. Beggs, of Milwaukee, and Ira A. McCormack, of New York, members of the executive committee of the American Street Railway Association, met in Chicago, Feb. 6 and 7, and completed all the preliminary arrangements for the convention. The hall is well suited to the purposes of the exhibit, having a clear floor space, without columns, of 50,000 sq. ft. The meeting rooms of both associations will be under the same roof as the exhibit, with ample retiring and committee rooms. The last day of the convention will be set apart for the systematic and careful inspection of the exhibits by the delegates, a fact which will be appreciated by all exhibitors. The banquet will be given on the night of the last day of the convention, at which the installation of the newly elected officers will take place. The committee resolved to make unusual efforts to secure the attendance of representatives of the mechanical, operating and auditing departments, which will make the convention of great practical value to those branches of the service; the attendance having been largely confined to delegates from the administrative departments. The hall will be well lighted and heated; the light during the hours of the day leaving nothing to be desired. All the exhibits will be on the same floor, and there will be little choice as to location. All electric power necessary will be furnished. The hall is within 300 ft. of the steam railroad tracks, and a special siding will be laid to the rear door of the hall, so as to bring the heavy exhibits direct to the hall.

The following subjects were selected, upon which papers are to be read at the meeting: "Maintenance of Car Equipment;" "The Modern Street Railway Shop; Its Design, Machinery and Shop Practice;" "Train Service, and Its Practical Application;" "Investment in Street Railways; How Can They Be Made Secure and Remunerative?" "Construction and Maintenance of Railway Track."

The annual banquet will be held Friday evening, when the officers elected will be installed.

The headquarters of the association will be at the Auditorium Annex. The Auditorium is across the street and is under the same management. Chicago is noted for its good hotels, so no trouble will be experienced in securing good accommodations. The rates charged at the hotels mentioned are: Auditorium, American plan, $5 per day each person; Auditorium Annex, European plan, $2 to $4 per day.

All of the leading hotels in Chicago are within a radius of one-half a mile. They include the Victoria, Wellington, Great Northern, Grand Pacific, Palmer, Tremont, Sherman and Clifton, and all are within ten-minutes' ride of the hall.

The executive committee advises all who desire rooms to apply at once. The rooms at the Auditorium will not be assigned until Mar. 15, and will be assigned in the order in which applications are received.

Railroad rates will, in all probability, be as before—one and one-third fare for the round trip, due notice of which will be mailed the members of the association in time.

The representatives of the association who reside in Chicago intend to make the visit of all a pleasant and profitable one, so that no one will regret attending this convention.

The following organization has been effected for the entertainment of the delegates and other attendants:

GENERAL COMMITTEE

Chairman, M. K. Bowen, president, Chicago City Railway.
Secretary and treasurer, Geo. E. Yuille, second vice-president, West Chicago Street Railroad.
J. M. Roach, vice-president and general manager, North & West Chicago Street Railroad Company.
Geo. C. Nagle, superintendent, Chicago City Railway Company.
H. M. Sloan, general manager, Calumet Electric Street Railway Company.
H. H. Windsor, Editor "Street Railway Review."
F. L. Fuller, general superintendent, West Chicago Street Railroad Company.
Jas. R. Chapman, general manager, electrical department, North & West Chicago Street Railroad companies.

ENTERTAINMENT COMMITTEE

J. M. Roach, chairman, vice-president and general manager, North & West Chicago Street Railroad Co.
T. M. Henderson, superintendent, N. C. Street Railroad Company.
A. S. Littlefield, railroad contractor.
Geo. C. Bailey, John A. Roebling's Sons Company, Chicago.
Harry Keegan, assistant superintendent, N. C. Street Railroad Company.
Frank R. Green, secretary, Chicago City Railway Company.
Geo. A. Yuille, second vice-president, W. C. Street Railroad Company.

EXHIBIT COMMITTEE

Jas. R. Chapman, chairman, general manager, electrical department, North and West Chicago Street Railroad companies.
C. E. Moore, master mechanic, Chicago City Railway Company.
John Miller, master mechanic, North Chicago Street Railroad Company.
F. T. C. Brydges, master mechanic, West Chicago Street Railroad Company.
A. C. Heidlberg, assistant superintendent, Chicago City Railway Company.
Geo. W. Knox, chief electrician, Chicago City Railway Company.
W. F. Carr, superintendent, electric and track dept., W. C. St. R. R. Co.
W. A. Harding, master mechanic, Calumet Electric Street Railway Company.
N. C. Noe, engineer, General Electric Company.

TRANSPORTATION COMMITTEE

F. L. Fuller, chairman, general superintendent, W. C. St. R. R. Co.
W. Worth Bean, president and general manager, St. Joseph & Benton Harbor Electric Railway & Light Company, St. Joseph, Mich.
Wm. Walmsley, superintendent, South Chicago City Railway Company.
Wm. J. Cooke, McGuire Manufacturing Company.
T. D. Miles, with West Chicago Street Railroad Company.
J. M. Atkinson, of J. M. Atkinson & Co., of Chicago.
John O'Keefe, with Chicago City Railway Company.

PUBLICITY AND INFORMATION

H. H. Windsor, chairman, Editor "Street Railway Review."
C. S. McMahan, Western manager, STREET RAILWAY JOURNAL.
D. B. Dean, Terre Haute Car Manufacturing Company, Terre Haute, Ind.
J. A. Hanna, Peckham Truck Company, Chicago.
C. J. Riley, chief engineer, Chicago City Railway.
John O'Keefe, Chicago City Railway Company.

HALLS AND HOTELS

Geo. O. Nagle, chairman, superintendent, Chicago City Railway Company.
A. S. Littlefield, railroad contractor.
T. M. Henderson, superintendent, North Chicago Street Railroad Company.
Maurice Coster, Westinghouse Electric & Manufacturing Company.
T. C. Penington, treasurer, Chicago City Railway Company.

BANQUET COMMITTEE

M. L. Bowen, chairman, president, Chicago City Railway Company.
D. G. Hamilton, Chicago City Railway Company.
M. B. Starring, assistant general counsel, Chicago City Railway Company.
B. E. Sunny, General Electric Company.
H. H. Windsor, Editor "Street Railway Review."
C. S. McMahon, Western manager STREET RAILWAY JOURNAL.
Geo. C. Bailey, John A. Roebling's Sons Company, Chicago.

LADIES' COMMITTEE.

H. M. Sloan, chairman, general manager, Calumet Electric St. Ry. Co.
Theo. P. Bailey, General Electric Company.
Joseph Leiter, Chicago City Railway Company.
Frank R. Green, secretary, Chicago City Railway Company.
F. L. Fuller, general superintendent, West Chicago Street Railroad Company.
M. K. Bowen, president, Chicago City Railway Company.
C. K. Knickerbocker, Griffin Wheel Company, Chicago.
L. S. Owsley, secretary and treasurer, North Chicago Street Railroad Co.
J. Chas. Moore, secretary and treasurer, North Chicago Street Railroad Co.

FINANCE COMMITTEE

Geo. A. Yuille, chairman, second vice-president, West Chicago St. R. R. Co.
C. R. Penington, with Chicago City Railway Company.
J. Chas. Moore, secretary and treasurer, North Chicago Street Railroad Co.
W. S. Bell, assistant secretary and treasurer, West Chicago Street R. R. Co.
H. B. White, secretary and treasurer, Calumet Electric Street Ry. Co.

Mr. John M. Roach, representing the local street railway interests, entertained the committee during their stay in Chicago. On Monday night, at 6 o'clock, there was a dinner at the Union Club, at which the following gentlemen were present: F. L. Fuller, William Walmsley, T. A. Henderson, Albion E. Lang, John I. Beggs, H. M. Sloan, John M. Roach, Frank R. Greene, T. E. Crossman, H. H. Windsor, Ira A. McCormack, W. Worth Bean, A. L. Plimpton, H. F. Grant, Walton H. Holmes, T. C. Penington, Chas. S. Sergeant, Frank G. Jones, George A. Yuille, George O. Nagle and J. R. Chapman. After the dinner the party attended the performance at Powers' Theatre. On Tuesday afternoon, upon the conclusion of the work of the committee, a visit was made to the office of the North Chicago Street Railway Company, where President Yerkes received the gentlemen. Subsequently a visit was made to the Western Avenue power station and other points of interest connected with the company.

The Brown Hoisting & Conveying Machine Company, of New York and Cleveland, Ohio, has just been awarded a contract by the Navy Department for coal handling machinery for the coaling station at Mare Island Navy Yard, California. This is the sixth coaling station for the United States navy to be equipped with the Brown Company's machinery, and constitutes all the stations so far awarded. The Brown Hoisting & Conveying Machine Company has also been awarded a contract for a 100-ton steel floating crane for the Brooklyn Navy Yard. This crane will weigh over 1000 tons.

STREET RAILWAY JOURNAL

MARCH, 1899

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, HAVEMEYER BUILDING, 26 CORTLANDT STREET.

BRANCH OFFICES:

CHICAGO.....Monadnock Block.
PHILADELPHIA.....931 Chestnut Street.
LONDON.....39 Victoria Street, Westminster.
PARIS.....50 Boulevard Haussman.
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Long Distance Telephone, "New York, 2664 Cortlandt,"
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / 25l / 31 fr
Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

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Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, accounting, finance and invention.

Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

Address all communications to

The Street Railway Publishing Co.,
Havemeyer Building, 26 Cortlandt St., New York.

The power stations of practically all of the large street railway systems of this country, and of most of the smaller ones, have been in operation now for at least two years, and many of them for a considerably longer period. During this time many improvements in the economical generation of current have been made, so that the question as to what extent reconstruction should be engaged in is an important one. In many cases the need is intensified by a radical change in location of the "center of gravity," or center of the distribution circuit, caused by the construction of new lines or consolidation with old ones, which has often put the existing power station far away from the most economical point for distribution. Whether, when the station becomes thus antiquated, either in equipment or location, it is better to reconstruct or to continue the old equipment is a special problem of each situation. The best way is to carefully calculate the cost of operation in each case, including that of depreciation and loss of power, and compare the possible saving with the interest on the cost of new investment required. The operating expenses of modern power-house machinery are now so well known to engineers that, if the expenses of the existing plan have been carefully kept, this comparison ought not to be a difficult one. In some cases the economy will be considerable, as in that of the Consolidated Traction Company of Pittsburgh, mentioned elsewhere, where it was found a saving in cost of generating power of 56 per cent could be made by the substitution of one modern station for several older ones.

The advantages of the "loop" idea in terminal arrangements, long well known and appreciated in street railroad practices, are about to be demonstrated in steam railroad suburban service on a large scale. Hitherto the loop has not been used to any extent, if at all, in railroad city termini, because of the impossibility of getting the necessarily large radii of curvature within the limits of the terminal station, but in the enormous South Terminal station, just completed in Boston—the largest station in the world—sufficient room is found to use loop, instead of stub tracks, for suburban trains, and, as a consequence, the ultimate train handling capacity of the entire station is more than 2000 trains per day, of which the twenty-four stub tracks will handle 750 trains, while the two-track route will handle 1250 or more. This is a quite unprecedented capacity. The effect of this terminal arrangement on the traffic conditions in Eastern Massachusetts is far reaching—much more so than might at first appear on the surface, for there is now no doubt that it is the intention of the two great railroad systems which will use this terminus to run their suburban trains by electricity, and to give a frequent service at regular short-time intervals. With the advantage which comes with ownership of right of way and with possibility of high speeds, based upon the complete abolition of grade crossings, which is now rapidly going on in Massachusetts under compulsory legislation, it is much to be feared—or hoped, according to the point of view,—that the keenest kind of competition will come between the railroad and street railway services in the same territory, and the result will quite probably be the usual one, namely, that the public as a whole will ride much more freely and frequently than ever before, the street railways will get the short-distance travel, and the railroads the longer hauls.

The consolidation of properties in the same lines of business seems to be the order of the day, not only in industrial enterprises, but also in those engaged in transportation. The economies obtained in consolidating steam railroad properties have attracted capitalists interested in street railway companies, and press dispatches announcing the union of interests in some new city have been almost a matter of daily occurrence during the last two months. Among the most important events of this kind which have been consummated or announced during

the last month are the street railways around Buffalo, in Jersey City, Baltimore, Lexington, Ky., and the two principal railway systems of Brooklyn, while there are rumors of important consolidations in other cities, including Washington and New York City. While a large system cannot receive the same personal oversight from the acting manager as a small one, there is such a large possibility for saving in many directions that these usually far more than counterbalance the few economical drawbacks, and this is especially true in electric railway systems, where the replacing of several power stations by a single large one is an obvious economy of magnitude. A street railway system of a city, like its water, gas and telephone systems, is a natural monopoly, and is recognized as such by all students of political science, independent of ideas which they may hold as to whether such a monopoly should be owned and operated by the municipality or by a private corporation. It is, therefore, not improbable to expect the final union in most cities of certainly the competing street railway lines. It has been a noticeable fact that in such cases the public has been directly benefited by the pooling of interests in this way. As a usual thing, more transfers are given by the consolidated system than by the individual companies, a result which amounts to a reduction in fare. We do not anticipate, however, that combinations of this kind will materially lessen for any length of time the total number of electric railway companies in any particular section or in the entire country. The consolidations are usually made by the help of outside capital, which necessarily releases a considerable amount of money belonging to those owners whose properties have become absorbed. These persons, whose life has been spent in railroading, will naturally tend to remain in that field, and we think in most cases will turn to interurban electric railroading, which is as yet practically undeveloped, for an investment of their capital. We have referred in previous issues to the possibilities of this field, and to the fact that many of those who have previously made a success with street railway properties are now paying considerable attention to its development. The proposition, taken as a whole, is an exceedingly attractive one, especially since the improvements in three-phase machinery, which have made the cheap distribution of power over long distances an easy task.

The blizzard of Feb. 13 severely tested the capabilities of all the electric railways in the Eastern States in keeping their tracks clear of the snow and cars running. The storm was admitted by all to have been the most severe of any experienced since the famous blizzard of 1888, and it differed from that in being more general and in being accompanied by a low temperature, which added greatly to the inconveniences of the men in removing the snow from the tracks. All of the cities on the Atlantic seaboard, from Portland as far south as Washington, and even Richmond, were practically snowed in for several days, and traffic on most of the steam railroads in this section was brought to a standstill. As may be expected, the street railways were also affected most seriously. Being the furthest north of any of the large cities on the coast, Boston probably suffered more than any city, but in spite of this fact the Boston Elevated Railway Company had clear on Tuesday, Feb. 14, 320 of its 325 miles of electric track. The railway company in Boston has to cart away the snow which it clears from its tracks, and a good idea of the immense facilities which this company has for removing snow is shown by the fact that it had 175 snowplows in use on Monday night, together with 400 sleds and carts of its own for removing snow, with 600 others engaged for the purpose. According to General Bancroft, it was a test in which as much pluck and endurance were required to win as were ever seen in a football game, but the record made forms an excellent commentary upon the vigilance of the officials and men, and the foresight of the company in being prepared for emergencies of this kind. In New York the underground system received its third severe winter test. The new equipment of plows, which were purchased the first part of the winter, came into good use, and, although the traffic on the electric lines was discontinued for nearly twenty-four hours, the company did not suffer any more in this respect than the neighboring trolley lines. The trouble, as stated by Mr. Vreeland, president of the Metropolitan Street Railway Company, was due to track causes, and not to any interference with the electrical part of the equipment. The snow was light and dry and the wind blew it upon the tracks in drifts immediately after the passage of a plow or sweeper, so that the wheels of the electric cars could not obtain traction. It is interesting to note in this connection that the cable cars on Broadway, which do not depend upon the contact between the wheels and the rails for their ability to move, made a showing much better than the electric lines, and for this comparative immunity to snow which the cable system possesses it should receive due credit. Philadelphia, like the other cities, suffered a more or less complete blockade, but with the aid of some rotary snowplows recently secured and a large number of ordinary plows and sweepers the company succeeded in keeping some of its lines in continuous operation. Washington also suffered severely by the storm, but by constant and energetic work the tracks were kept comparatively clear and cars running. It is a remarkable fact that comparatively little damage is reported from the breakage of wires during the storm, even of those of telegraph and telephone companies, which, falling on a railway wire, often create as much, or more, trouble than the breakage of the trolley wire itself. Absence of trouble of this kind is attributed to the intense cold which prevailed, and to the consequent dry condition of the snow, which, as a result, did not remain on the wires. The past season has been remarkably prolific of heavy storms, and if coming seasons are to be as severe in this respect, the snow-fighting equipment of an electric railway company in our Northern cities will necessarily have to be as complete and elaborate as that of a steam railroad company. As a matter of fact, however, the average fall will be considerably below that which we have experienced during the present winter. Snowstorms are expensive, both in actual outlay and in the diminished traffic which results from them, and their expense to a street railway company soon runs into a large sum.

A good example of the way in which unreasonable prejudice is excited against electric railway companies by false and misleading statements was furnished last month by a circular issued by the National Board of Fire Underwriters upon the subject of electrolysis of water mains by

the electric railway current. Strange as it may seem, this report was afterward printed without comment or criticism by one of the best-known engineering papers of New York City, and was there credited to the engineer of the National Board of Fire Underwriters, although we understand that the author of the report does not occupy that position. The subject of the report, which was made by Fremont Wilson, was the bursting of a 4-ft. water main in Brooklyn, caused, it was alleged, by the effect of the return current on the pipe, and some idea of the writer's qualifications to pass judgment upon the subject is shown by the following extract:

> Intelligent expert engineers have proved beyond peradventure that 1.5 volts difference in potential between the water pipe and rail is dangerous; and here we have a railroad company deliberately transmitting an enormous current at a voltage anywhere from 250 to 400. If they were simply transmitting a current with a difference of potential of 15 or 20 volts, enough facts have been presented to prove that this amount of voltage carries with it a current that would, of necessity, under the natural laws, cause enormous destruction. And in proof of this, permit me to call your attention to another exhibit and complete report recently published by the trustees of the Dayton, Ohio, waterworks. I will quote from that report for your information: "At 4.5 volts it has been shown that 6-in. pipe can certainly become useless in five years." Query: What is now the condition of the 6-in. water pipes in Brooklyn, if what the employee has said is true, that a 6-in. pipe has been used as a return feeder with from 200 to 300 volts pressure upon it?

This is utter nonsense, from an engineering standpoint. The arguments as to the danger to the public sound familiarly like those employed when overhead wires were first installed, and which predicted tremendous loss of life to pedestrians who should happen to be in the way of falling wires. We make the following quotations:

> The undersigned begs to state that a careful inquiry made among the employees of the water board of Brooklyn brought to light the fact that they (the employees) were fully aware of the conditions as they existed and do exist at the present time, as they have been knocked down by the current while working upon water mains and, in some cases, severely injured, and in other cases badly burnt; and yet in this community such a state of affairs is permitted to exist, and, as far the records show, no effort has been made on the part of the insurance authorities to prevent it. And yet it could have been prevented, and if I may be permitted to say so, must be stopped now or the community at large will inevitably meet with nothing less than a conflagration when the conditions for such an event happen; and when they do happen the events will be coincident, and it may not only be a large loss of property by fire, but it may mean the loss of a great number of lives.
>
> Let us suppose, for instance, a case that can be readily imagined. What would have happened if a fire had occurred in Brooklyn among the frame buildings in the neighborhood of the break in the 4-ft. water main? This particular locality, as far as the buildings are concerned, would have been completely wiped out of existence, and lives would certainly have been lost in the general panic. This statement is not made by the undersigned for the purpose of appearing as an alarmist, but simply as an actual state of affairs as they exist to-day, only in far worse condition in other parts of Brooklyn.

The rest of the report is about on a par with the portion quoted. It is made up, as shown, for the most part of hearsay evidence as ridiculous as that contained in the paragraph given, together with opinions of the writer, based presumably upon this class of testimony. Nowhere in the report, so far as we can discover, has any attempt been made to determine the actual cause of the deterioration, or defect, in the pipe in question, the only point in which either the railway or the water company is really interested. If any injury had been done by the railway current, a thing which we very much doubt, what is wanted are *facts*, not opinions or hearsay, and such facts constitute the only evidence which merits consideration or would be admitted in a court of law.

There seems to be a lamentable effort on the part of interested persons to prejudice the position of the railway companies on this question in the minds of the public, and to create a feeling of anxiety by giving wide publicity to statements of this kind, without a word of comment. For instance, the report of Mr. Wilson, as published in the engineering paper already mentioned, has recently been widely circulated by some anonymous person or persons. On the back of the sheet containing the report is a scare photo-engraving of the break in Brooklyn. This throws no light on the *cause* of the disaster, but, coupled with the report, is undoubtedly intended to create popular distrust of the safety of the use of rails as return conductors, which is entirely unwarranted by the actual facts in the case.

Electrical World and Electrical Engineer

On and after March 11, "The Electrical World" and "The Electrical Engineer" will be merged together in a single publication under the name of the "Electrical World and Electrical Engineer." The "Electrical World" dates from 1874, and has just finished its first quarter century of life, during all of which time it has been owned and managed by W. J. Johnston. The "Electrical Engineer" dates from 1882, and was purchased from its former owners in 1890 by T. Commerford Martin and Joseph Wetzler, formerly editors of the "Electrical World." Mr. Johnston retires from the field of electrical journalism, and Mr. Wetzler will hereafter devote his energies to the building up of the Electrical Engineer Institute of Correspondence Instruction, organized a short time ago under the auspices of the "Electrical Engineer."

The editorial management of the "Electrical World and Electrical Engineer" will be in the hands of W. D. Weaver, until now editor of the "American Electrician," and T. Commerford Martin, editor of the "Electrical Engineer," both of long experience in electrical journalism, and with world-wide friendships and connections.

The business interests of the new paper will be in charge of J. M. Wakeman, long and favorably known in connection with the "American Machinist," while A. C. Shaw, until now business manager of the "Electrical Engineer," will be associated with Mr. Wakeman in the work of the paper in New England.

The "Electrical World and Electrical Engineer" will be built on broad lines and to high standards, and it is believed that it will easily take rank among the great technical and engineering periodicals of the world. The field of electrical engineering is constantly widening, and it is generally conceded that in the practical application of electrical science to utilitarian purposes America is in the lead among the nations of the world. It is intended that the best practice in all departments of electrical science shall be reflected in the columns of the new paper, and, with the concentration of editorial effort, until now divided between the two constituent periodicals, it is believed that the union of interests will be obviously advantageous to readers and advertisers.

The purchase of these two properties and their consolidation has been brought about by James H. McGraw and his associates of the Street Railway Journal, and among others who will be largely interested in the "Electrical World and Electrical Engineer" will be Messrs. Wakeman, Martin and Weaver and Shaw.

Three-Phase Transmission for Electric Railway Work in Maine

The growing number of interurban electric railways in which the power for operating the cars has to be transmitted over considerable distances has made the subject of high potentials an extremely important one. While no road in this country has yet attempted the use of three-phase motors on its cars, the high economy of distributing power by the three-phase system has led to its careful investigation by a number of companies. Among these is the Lewiston, Brunswick & Bath Street Railway, which has recently put in operation a line 30 miles in length, from Lewiston to Bath, Maine, with urban branches at both ends, making a total of 60 miles of track. The entire system is supplied with power from one hydraulic power station in Brunswick, and contains a number of novel features, including the distribution in Brunswick from one type of generator only.

The Lewiston, Brunswick & Bath Street Railway Company was formed July 1, 1898, by the consolidation of the Lewiston & Auburn Horse Railway, the Bath Street Railway and the Brunswick Electric Railway companies, and is capitalized for $500,000. It has a bonded indebtedness of $1,000,000 in 5 per cent bonds, of which $300,000 are held in the treasury for future construction and purchases. Among the chief members of the syndicate which organized and built the road are I. C. Libby and A. F. Gerald, both of whom are prominent in electric railway interests in Maine. The power for operating the line is obtained from a fall in the Androscoggin River, owned by the Cabot Company, and largely used for industrial purposes. From this company the railroad leases 1000 h.p. at the rate of $10 per h.p. per annum.

The power station at Brunswick is a small brick building near the mills, and contains four Victor wheels, all mounted on the same shaft and operating under a 17-ft. head. These wheels are controlled by Lombard governors, and, by means of a rope drive, operate the main countershaft, to which the three main generators are belted. The generators, illustrated in Fig. 2, are double-current machines, designed to deliver from one winding both alternating and direct currents, being the first machines in the country to be used in this way. Each generator is of 250 kw. capacity, the whole of which may be delivered from the commutator at one end of the armature, from the collector rings at the other, or in any proportion through the two simultaneously. They were built by the Westinghouse Electric & Manufacturing Company, have twelve poles, and run at 1600 r.p.m., delivering alternating current therefore at sixty cycles per second. The direct current voltage is 500 to 550, and the alternating three-phase voltage runs from 300 to 330 volts, as it comes from exactly the same windings.

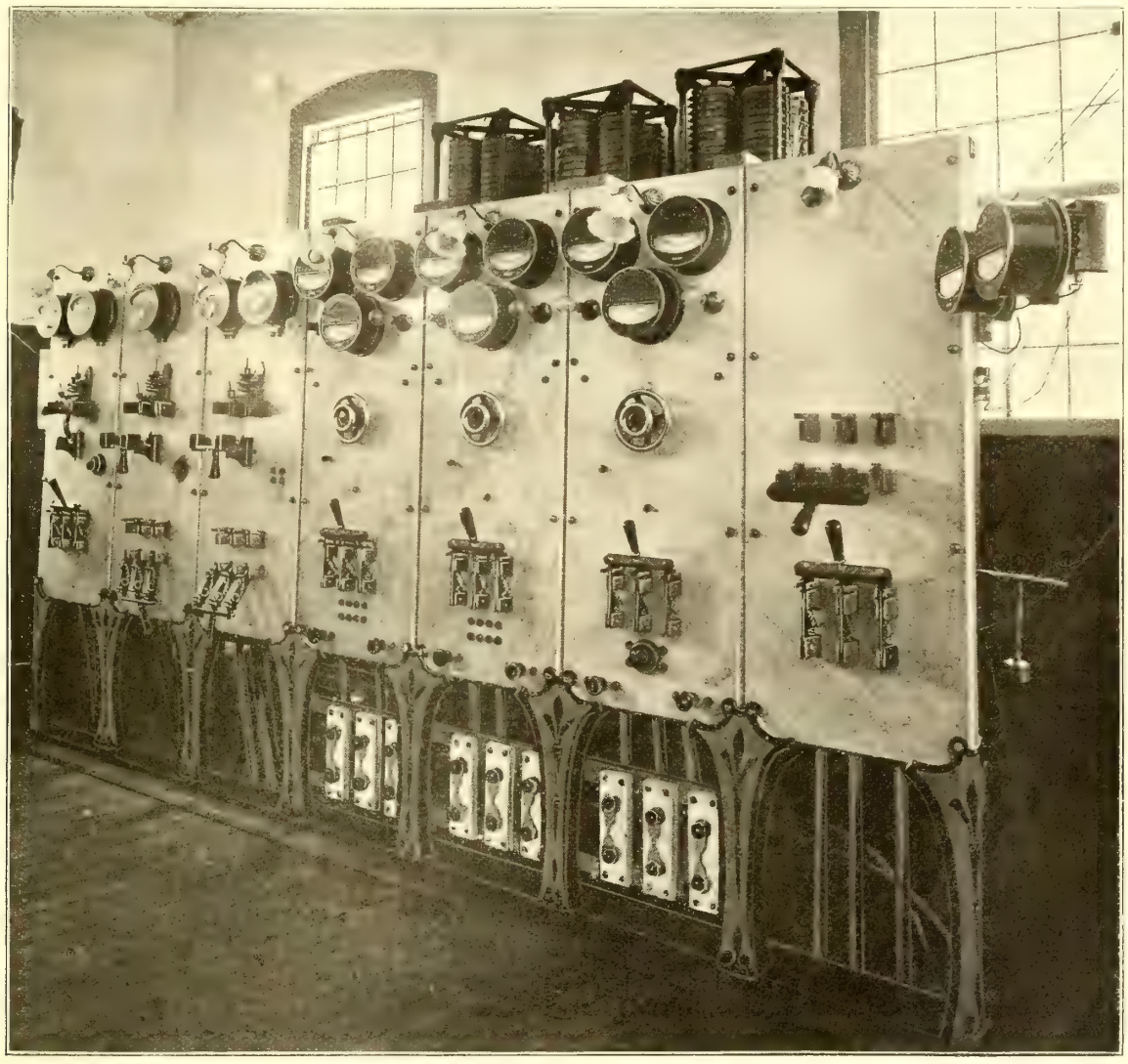


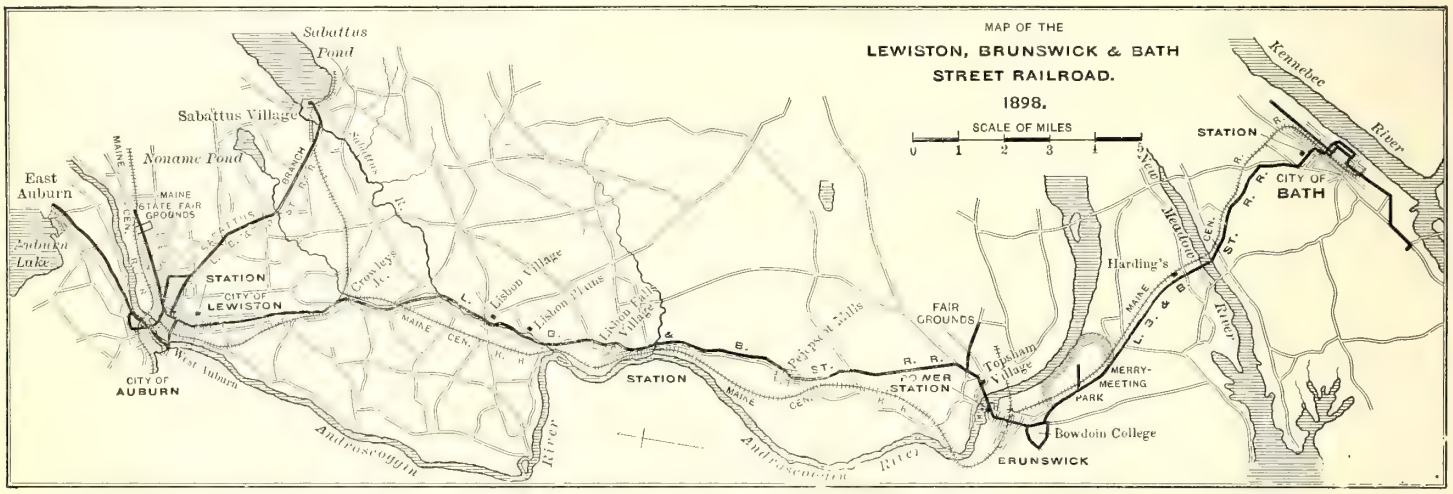
FIG. 1.—SWITCHBOARD AT MAIN GENERATING STATION

The switchboard, which is illustrated in Fig. 1, is made up of two types of panels, one closely resembling standard

railroad generator panels, and the other standard alternating panels. There are three of the former, located at the left end, as shown in the accompanying illustration, each equipped with circuit breaker, ammeter, pilot lamps, voltmeter receptacle and triple-pole, quick-break main switch, but with no field rheostats. Each of the alternating panels, of which there are three, carries three alternating ammeters, one for each phase; a triple-pole, single-throw main switch, for throwing the machine on to the one set of three-phase bus bars, the field plugs and field rheostat.

the latter of No. 1 wire as far as Lisbon Falls, where there is a rotary substation, and No. 3 copper wire for the balance of the distance. The wires are carried on porcelain insulators, mounted on the same poles which carry the brackets for supporting the trolley wires.

There are three substations, one at Lewiston, having two 200 kw. rotary converters, fed by three 150 kw. transformers; and one each at Lewiston and Lisbon Falls, each containing one 200 kw. rotary converter fed by three 75 kw. transformers. The latter are of the oil-insulated, self-



There are, of course, no ground detectors on these panels, as the winding is grounded through the direct current end.

The transformer house for the alternating current is located about 45 ft. from the station, on account of insurance requirements. It is a two-story brick building, about

cooling type, and, like the generators, are connecting in the star or Y grouping. The rotary converters are ten-pole machines, running at 720 r.p.m., and are similar in winding and details to the generators. Overhanging the bearing at one end of the shaft is a small three-phase induction motor for starting, and overhanging the bearing at the other end is a pulley by which the machine can be driven

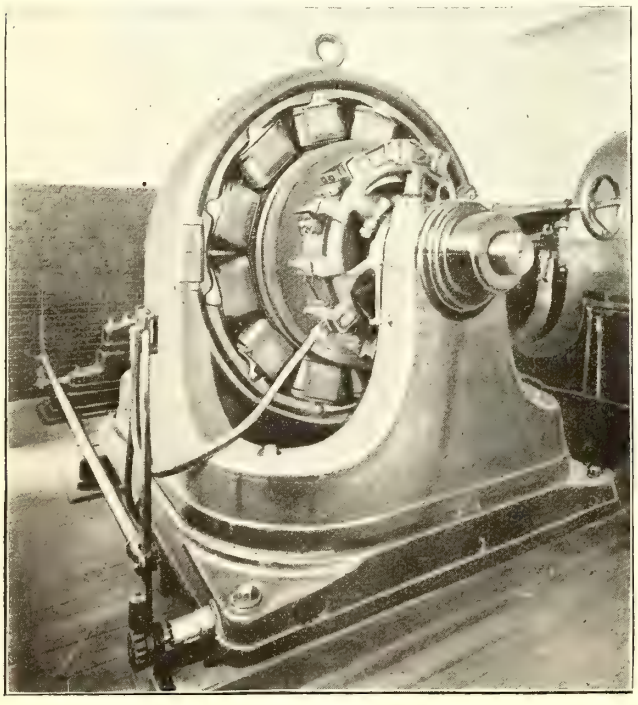


FIG. 2.—A. C. D. C. GENERATOR AT MAIN POWER HOUSE.

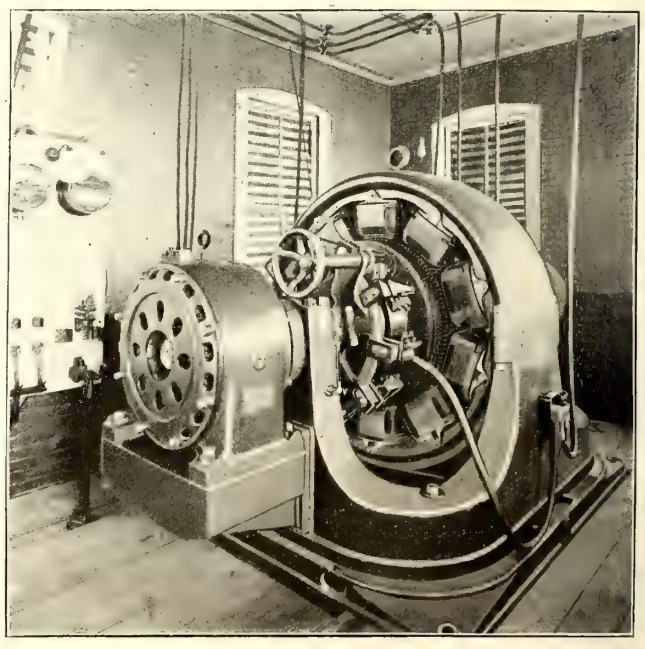


FIG. 3.—ROTARY CONVERTOR AT BATH

18 ft. x 24 ft., and the current is carried to it by lead-covered cables. The step-up transformers are six in number, of the Westinghouse oil-insulated, self-cooling type, of 125 kw. capacity each, and raise the current to a line pressure of about 10,000 volts. From this transformer house two high tension lines are run, one to the city of Bath, 10 miles distant, and the other 20 miles, to the city of Lewiston. The former consists of No. 6 wire, and

by steam engine, which will be installed later for emergency work.

The 30 miles of main line consists of a single track laid with 60-lb. T rails in 60-ft. lengths. About 7 miles is on private right of way 33 ft. in width, the balance following the side of the highway. The country is quite hilly, and the track follows the contour, its maximum grades being about 10 per cent. The cost of

the track, exclusive of right of way and inclusive of the overhead work, was about $10,000 per mile. The overhead line is thoroughly put up on 30-ft. poles with 7-in. tops, placed 115 ft. apart. At the top they carry four-pin cross arms supporting the high tension line, another similar line below carrying the 500-volt feeders, which are of bare copper wire, all copper in the system, including trolley, feeders and 10,000-volt lines, being uninsulated. The trolley wires are two in number, one for the up and the other for the down cars, of No. 0 copper, supported in special hangers consisting of one rigid piece, carrying the caps and cones for both trolley wires. One No. 0000 feeder is carried the whole length of the line, constituting a short distributing main or side feed. The section breaks are short-circuited through switches on the poles, thus tying all 500-volt copper together.

The main line traffic is carried by nine cars, giving a half-hour service, the run of 30 miles being scheduled at $2\frac{1}{4}$ hours. The cars are mounted on single trucks, with two Westinghouse No. 49 motors, and fitted with extra wide bodies and cross seats. Each car makes four round trips, aggregating 264 miles per day, with a change of crew each round trip. A dozen cars more run on the local lines in Lewiston and Bath. The through line has been running since the middle of August, and doing a very satisfactory winter business. For summer service it is equipped with ten fourteen-bench open cars, on Peckham double trucks, fitted with two Westinghouse 50-h.p. motors geared for medium speed. Ten more such cars will be added before the summer season begins. During the winter season these motors are used for snow plows, of which there is naturally considerable need in the wintry climate of the State of Maine. Besides six Taunton-nose plows, there are two Ruggles rotaries, each fitted with two 50 h.p. driving motors and one 50-h.p. motor to run the centrifugal fans. The latter are very powerful, fitted with cutting blades to draw in the snow and centrifugal paddles to throw it to one side, both being 88 ins. in diameter.

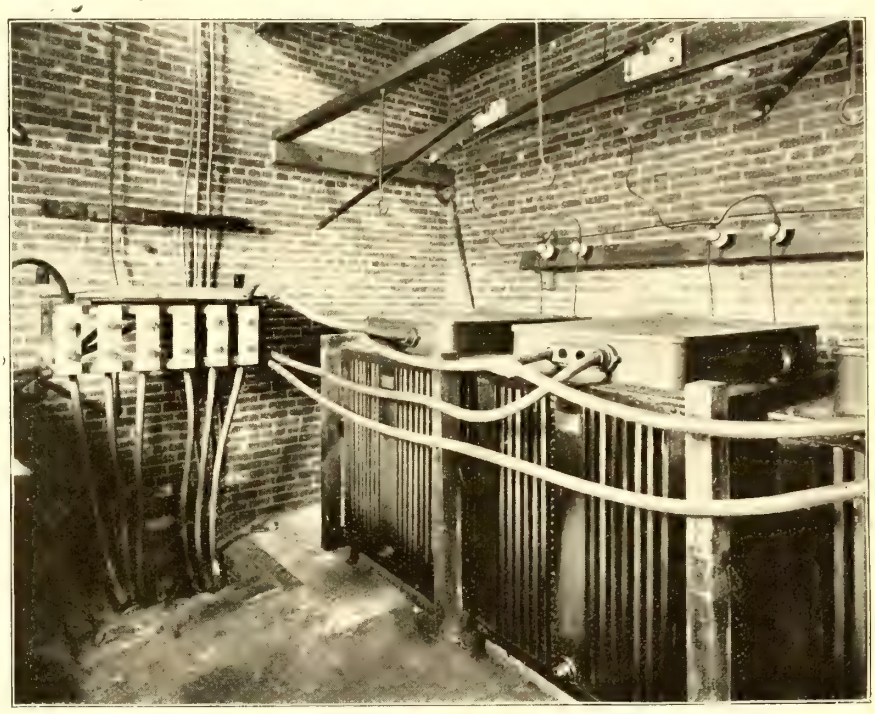


FIG. 4.—STEP UP TRANSFORMERS AT TRANSFORMER HOUSE



FIG. 5.—INTERIOR OF CONVERTOR STATION AT LISBON FALLS

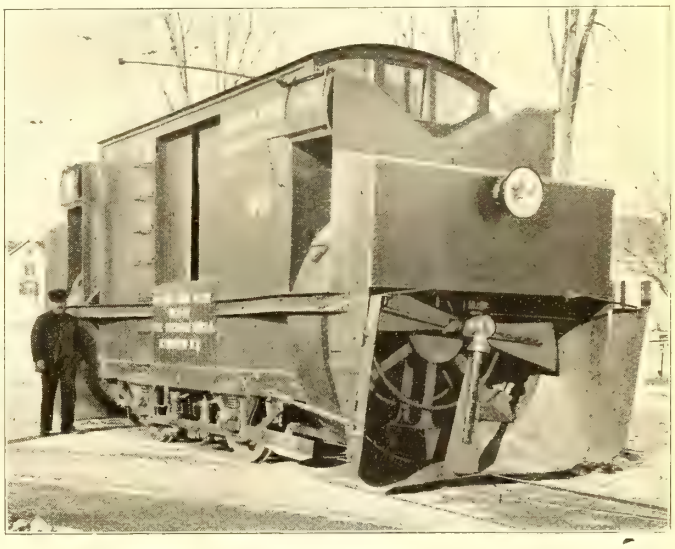


FIG. 6.—ROTARY SNOW PLOW

The through fare for the 30 miles is 35 cts., the route being divided into seven sections, with fare of 5 cts. per section. The road shows gross earnings during the winter months of from $350 to $700 per day, its cost of operation and interest on the bonds being $350 per day. It is expected that the daily earnings will run up to $5,000 per day in the summer months, when the pleasure travel is at its maximum. The company owns a large park on Merry-Meeting Bay, which will attract considerable travel. It has also entered into an agreement with the Kennebec Steamboat Line, running from Bath to Boston, to carry through passengers, freight and express matter,

and will put on special cars for the carriage of baggage and other inanimate traffic.

The officers connected with the line are: President, A. H. Shaw, treasurer, I. C. Libby; general manager, A. F. Gerald, and general superintendent, I. L. Meloon, to whom thanks are due for the information given above.

The electrical apparatus was installed under the general

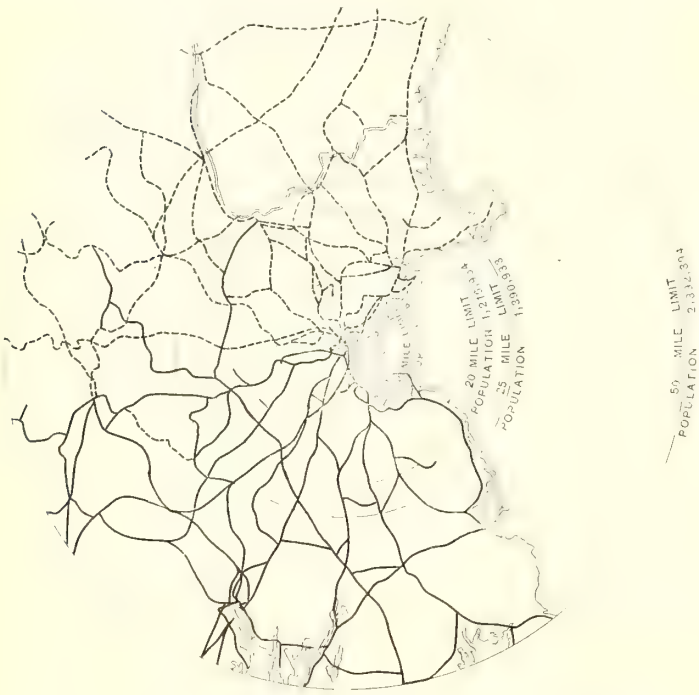


FIG. 1.—MAP SHOWING SUBURBAN (STEAM) RAILROAD LINES AROUND BOSTON

—— Lines Entering Southern Union Station
------ Lines Entering Northern Union Station

direction of E. Chesrown, representing the Westinghouse Company, who lately left to take a position with the Snoqualmie Transmission plant in the State of Washington. His successor is W. G. McConnan.

New York City Quarterly Reports

The trend of traffic in New York City is indicated by the following reports of the Metropolitan (surface) and Manhattan (elevated) companies for the quarters ending Dec. 31, 1897-8:

METROPOLITAN STREET RAILWAY COMPANY

Quarter ending Dec. 31,	1897.	1898.
Receipts from passengers	$2,383,458	$3,092,756
Receipts from other sources	150,919	175,190
Receipts, total,	2,534,377	3,267,946
Operating expenses	1,208,770	1,467,580
Earnings from operation	1,325,607	1,800,366
Deduction from earnings—		
Interest on bonds	107,500	263,750
Taxes	130,431	159,617
Rentals	551,075	649,690
Net income	536,601	727,310

MANHATTAN RAILWAY COMPANY

Quarter ending Dec. 31,	1897.	1898.
Receipts from passengers	$2,597,186	$2,356,896
Receipts from other sources	45,625	47,500
Receipts, total,	2,642,811	2,404,396
Operating expenses	1,358,085	1,341,090
Earnings from operation	1,284,726	1,063,306
Fixed charges	774,855	731,784
Net Income	509,871	331,522

The New South Terminal Station in Boston and its Effect on Traffic Conditions in Eastern Massachusetts

It appears that the New York, New Haven & Hartford and the Boston & Albany Railroads are determined to regain the rich suburban traffic in and out of Boston, which they have been steadily losing to the electric street railways of Eastern Massachusetts during the past few years, and that they mean to fight the enemy with its own weapons, so far as may be possible. No other interpretation can be put upon the building, at great expense, of the new Southern Terminal Station in Boston, at a point more convenient of access to the heart of the business section for the large majority of the users of the railroad systems than are the present stations; upon the elimination of grade crossings in the suburban district, and an increased number of suburban stations; and upon certain peculiar features found in the plan of the new South Terminal Station in Boston, by which its train-handling capacity is enormously increased. Literally, as well as figuratively, one may look below the surface of things at the new terminal and find food for reflection and for predictions as to the future. A brief description of this new station, with its peculiarities, and a discussion of its certain influence on the transportation conditions of Eastern Massachusetts will reveal some things of the greatest interest and importance to railroad and street railway managers and engineers, and to the general public.

A few years ago there were four railroads serving Southeastern and Western Massachusetts, entering Boston from the southern side. These railroads were the Boston & Albany, the New York & New England, the Boston & Provi-



FIG. 2.—MAP OF BUSINESS SECTION OF BOSTON, SHOWING NEW SOUTH TERMINAL AND ITS APPROACHES

------ Abandoned lines

dence, and the Old Colony. Now, the three latter have been purchased and practically consolidated with the New York, New Haven & Hartford Railroad, which has three stations—the Providence Station, located at Park Square; the Old Colony Station, on Kneeland Street, and the New England Station, at the foot of Summer Street. The Boston & Albany Station was also on Kneeland Street, near the Old Colony Station. The locations of these stations are shown in Fig. 2. The lines of the Old Colony, Providence and New England Railroads parallel each other to a certain extent in Southeastern Massachusetts, the Old Col-

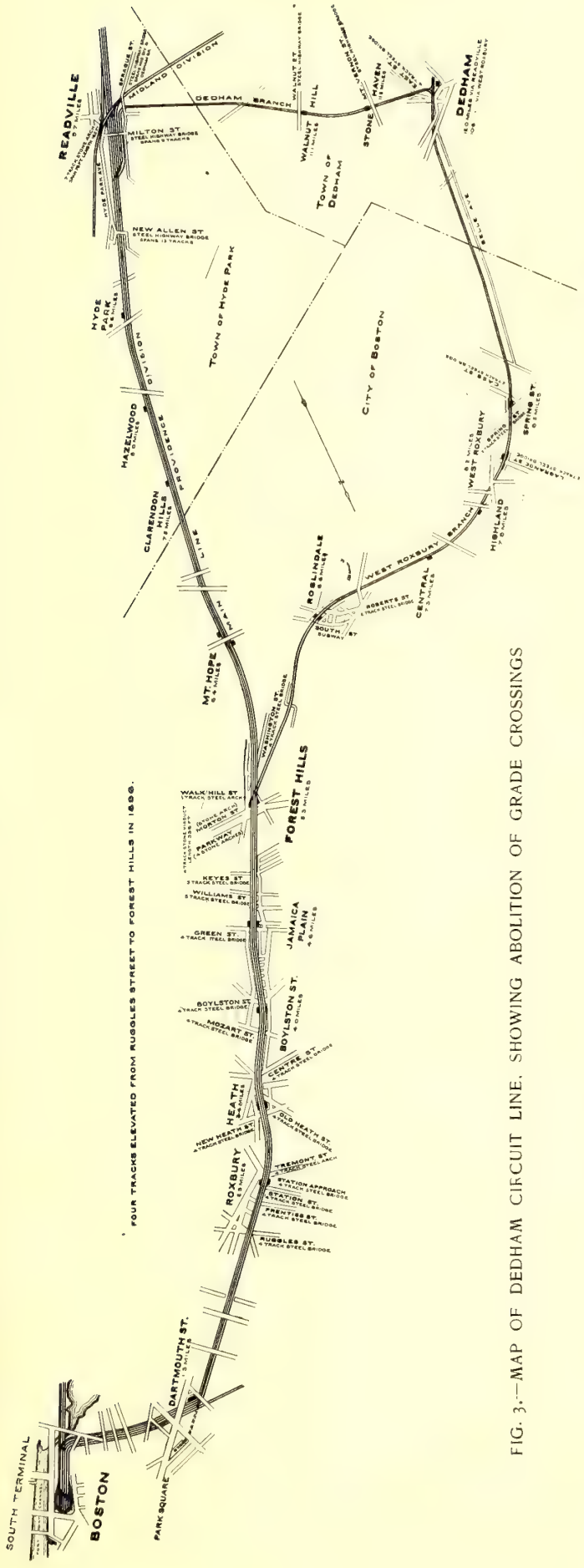
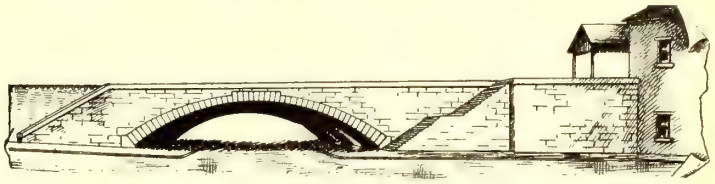


FIG. 3.—MAP OF DEDHAM CIRCUIT LINE, SHOWING ABOLITION OF GRADE CROSSINGS

ony, however, serving many portions not reached by the other two.

These four stations are all to be given up, and a new terminal station, constructed on the site of the former New England terminus, with additions, will replace them. The station is now completed, and the Old Colony and New England trains are using it, the Albany and Providence trains still running into their old stations. The new station location and the changes in the lines leading there-



ARCH CROSSING AT HYDE PARK AVENUE, DEDHAM CIRCUIT

to are noted in Fig. 2. The new station is nearer the financial, business and shopping districts of the city than the old stations, and it will be within quicker reach of the Northern Union Station and the northern ferry lines. When the new elevated structure is built, and with additional surface railway accommodations, the terminal facilities as a whole, including the new and large outlying station at Dartmouth Street, will inevitably be far more convenient to the mass of suburban residents doing business in Boston proper than are the present stations.

The map, Fig. 1, shows the network of railroad lines in Eastern Massachusetts which will use this new station, and gives an indication of the number of people resident in the district within 50 miles of Boston. The world is too apt to consider Boston as a fourth or fifth rate city, forgetting that in addition to the half million people contained within the city limits proper there are from sixty to seventy cities and towns in the immediate neighborhood which swell the population of the metropolitan district to about 1,250,000, while there are nearly 2,500,000 people within a 50-mile radius of the Statehouse. It will easily be seen from this map how intimate is the relationship between the railroads and the townships of Eastern Massachusetts, scarcely one of these towns being without good railroad connection to Boston. It must be equally evident that if the railroads adopt what may be called modern methods in the conduct of their suburban business they will be dangerous competitors indeed to the street railway companies. These modern methods include cars or trains run at regular and frequent intervals throughout the day, so that a would-be passenger may always know, without looking at a time-table, when an inbound or an outbound train is due; higher average speeds than are possible with present steam locomotive service; the doing away with the smoke, cinder, gas and noise nuisances incident to steam railroad operation; the cultivation of pleasure travel; a reduction of fares, made possible by greatly increased business; and uniformity of fares with zone limits, so far as this desirable feature can be introduced.

In other words, modern methods mean primarily electricity as a motive power, and electricity is surely going to be the motive power of the suburban railroad system of Eastern Massachusetts. The physical conditions are all favorable, especially since the passage of the grade-crossing bill in Massachusetts, under which the State, the different cities affected, and the railroads are joining hands for the abolition of the grade crossing evil. The increasing competition of the electric street railway lines compels it, and the railroad companies have realized the situation and taken steps accordingly, as will presently be seen.

Glancing again at the map, Fig. 1, it will be seen that

there are numerous loop lines already established in this suburban area, adapted to a service of the kind just spoken of. Loop lines are a decided advantage in that trains can be kept constantly in motion, without delays and lost time for switching and other purposes, and a regular short interval schedule can easily be kept up. The line which will probably be the first around Boston to be equipped by electricity is that known as the Dedham circuit, one branch of which is made up of the four-track main line of the Providence division, New York, New Haven & Hartford Railroad, between the new Southern Terminal Station in Boston, and Readville, while the loop leaves the main line at Forest Hills and passes through a succession of pleasant residential settlements to Dedham, joining the main line again at Readville. A plan of this line is given in Fig. 3, from which it will be seen that grade crossings have been entirely eliminated from it, and it is now "cleared for action," as it were, ready for electric traction. On this Dedham Circuit line trains run, at present, at hourly intervals, though with greater frequency during the rush hours. Under the new conditions it is quite probable, though no decision has yet been made, that a regular train service at ten or fifteen minute intervals will be kept up throughout the day, using single cars or two-car trains only during the lighter hours, while three, four, or five car trains may be run at other hours, according to the demands of traffic. Another line on which a service of this general character can be put, to the advantage of the steam railroad companies and the people, would be the Newton Circuit line of the Boston & Albany Railroad, which passes through the richest suburban territory in the vicinity of Boston. Several other loop lines could be made along the South Shore, and the Nantasket Beach electric line, if extended to Boston, would, it is hardly necessary to say, be highly popular, and probably far more profitable than is the present mixed steam and electric service.

All these plans for reorganizing suburban transportation methods necessarily involve terminal facilities far greater than can be ordinarily obtained by a stub-track system, where switching of locomotives and delays of one kind and another are inevitable. As a consequence, the new South Terminal in Boston has adopted a plan unique in the annals of steam railroading. It is planned that all suburban trains shall eventually enter the terminal and pass down depressed tracks into a subway loop, where, at properly located platforms of large area and length, they will discharge and receive loads, and will thence pass up out of the subway on inclined tracks to the surface again, on their return journey. By this simple plan the total train capacity of the South Terminal Station is increased from some 750 trains per day, which is all that the twenty-eight stub-tracks entering the terminal could handle with safety, to over 2000 trains a day—a station capacity larger by far than that of any railway terminus in the world.

A plan of the Southern Terminal is seen in Fig. 4, and a section in Fig. 6. From these the location of the loop can be readily understood, and it will be seen also from the curvature of the outer loop (262-ft. radius) that it is only in a station of such enormous size that a scheme of this kind is feasible. The platform capacity of the two-track loop in the subway is sixty cars, each 40 ft. in length, a capacity greater than will probably be called for for some years to come; and the inner loop will be used only if the traffic should eventually exceed the capacity of the outer. Passengers will enter the main station and pass down stairways to the loading platform, which is that between the two tracks, and which will accommodate 25,000 people at a time. Here will be gates and penstocks, from which the trains for given lines will depart, and these penstocks can be filled before the arrival of the train. The unload-

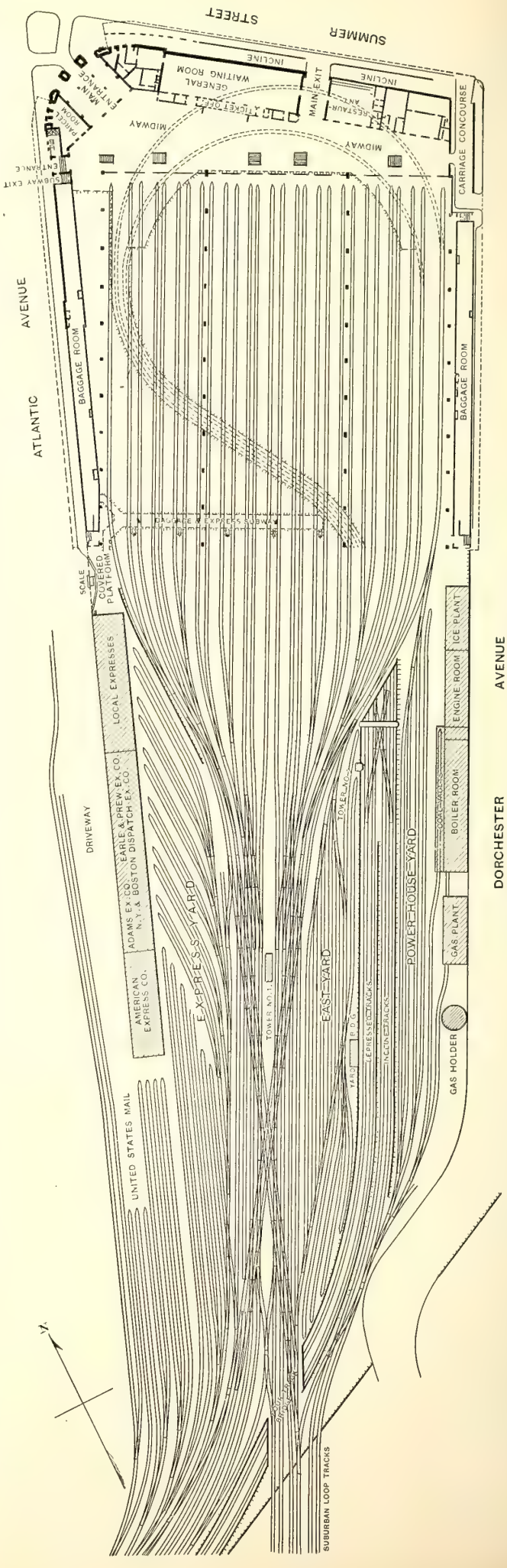


FIG. 4.—TRACK AND STATION PLAN OF THE NEW SOUTH TERMINAL, BOSTON

ing platforms will be on the outside of the loop, and from it passengers will find an exit directly to the street, with little obstruction to the outward flow. When the inner track of the loop is used it will, of course, be necessary to make the innermost platform an unloading one also, and from it passengers will have to find an exit to the midway above, or over stairways and bridges to the outer unloading platform. This plan is, of course, less desirable than the first, but is a necessity of the situation. The inter-

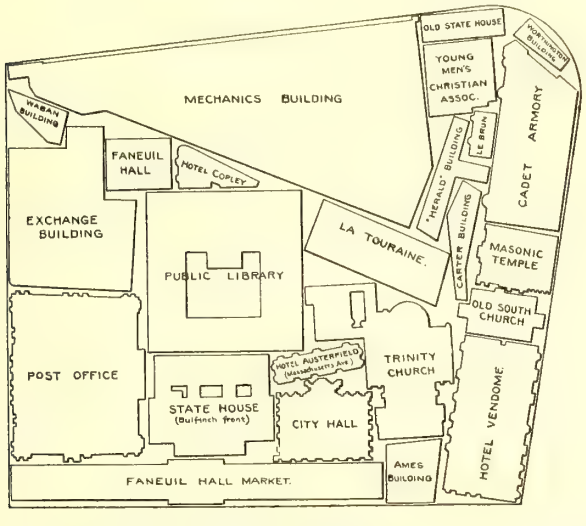


FIG 5.—DIAGRAM SHOWING SIZE OF HEAD HOUSE, NEW SOUTH TERMINAL

locking switching arrangements in the yard above are such that a train can be passed out of the subway every sixty seconds, and as there is platform space for four trains on each track, there is thus provided ample time for loading and unloading.

The terminal building itself is a magnificent and imposing structure, particularly when seen from above in a "bird's-eye view." It is difficult to form a conception of the immense area covered by the building itself unless in some such way as that shown in Fig. 5, where it is seen that no less than twenty-four large Boston buildings could be contained within the limits of this single one. The building alone, exclusive of the yards, extends south along Atlantic Avenue 792 ft., and east on Sumner Street 672 ft., while the frontage on Dorchester Avenue is 725 ft. The train shed is 602 ft. long x 570 ft. wide, and contains twenty-eight tracks having an aggregate length under roof of 4 miles. These tracks are arranged in pairs, with a passenger platform between each pair, and between the pairs are seven platforms devoted exclusively to the trucking of baggage and express matter. The baggage is handled by elevators, which pass up and down from the baggage platforms to a subway below, whence they are trucked to and from the baggage rooms.

The midway at the end of the train shed is a magnificent stretch of platform space, containing 60,000 sq. ft., extending the entire Summer Street length of the building and reached from the street by broad inclined walks, and from the waiting rooms through many doors. Eleven windows of the central ticket office open toward the midway, and sixteen windows open into the waiting room. The station accessories in the matter of waiting rooms, lavatories, restaurant, barber shops, telegraph and telephone offices, electric elevators, etc., are well planned for the comfort and convenience of passengers, and little is left to be asked for by the traveling public. The inward baggage rooms are on the east side, and the outward on the west side.

Never before has a great railroad station been provided with such extensive and elaborate equipment requiring the use of power, and as a consequence never before has a station power plant been so interesting. Much time has been spent in the study of other terminal stations at home and abroad for the purpose of introducing the best features found therein, but in addition to these, others entirely unique are met with here for the first time. There is an elaborate system of interlocking switching and signaling apparatus for the yards and train shed, all worked by compressed air, and requiring, therefore, a suitable compressed air plant; steam for heating and for various other purposes; electricity for elevators, the ventilating system, fans, and a half-hundred other purposes; an ice plant for the manufacture of ice used in the cars, restaurants, etc.; a refrigerating plant for cooling the provision boxes and storage rooms in the headhouse; a plant for filtering and cooling drinking water for the public and for use in the offices; mains for heating cars when standing in the train shed and yards when locomotives are detached; charging apparatus for air-brake appliances; a fire protection service for the terminal buildings; a pumping plant for disposing of water which may find its way into the portions of the terminal situated below tide water;—all these depend upon the general power plant, which is located on the Dorchester Avenue side of the building. The building devoted to this purpose is 460 ft. long and 40 ft. wide.

A general contract for practically the entire engineering and power equipment of the terminal was placed by the Terminal Company with Westinghouse, Church, Kerr & Co., who have in turn sublet contracts for all the detail appliances not manufactured by themselves. The entire equipment is as follows:

There are ten horizontal tubular boilers, built by Edw. Kendall & Sons, of Cambridgeport, Mass., each 72 ins. in diameter x 18 ft. long, with 130 3-in. tubes. Each boiler is equipped with Roney mechanical stokers operated by two standard Westinghouse engines.

There are two economizers of the Westinghouse steam

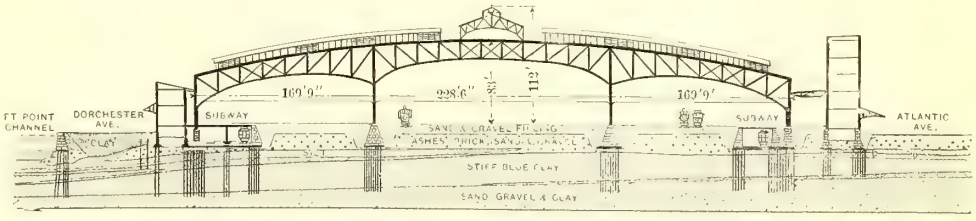


FIG. 6.—TRANVERSE SECTION, NEW SOUTH TERMINAL

circulating pattern, manufactured by the Fuel Economizer Company, of Matteawan, N. Y.

There is no chimney to the plant, but forced draft is used and is supplied by two blast wheels 14 ft. in diameter x 7 ins. wide, designed by Westinghouse, Church, Kerr & Co.

In the engine room are four 375-h.p. Westinghouse automatic compound condensing engines, each direct connected to a Westinghouse 8-pole, 220-volt direct current dynamo of a peculiar type, each dynamo being capable of generating a 220-volt current for power purposes and a 110-volt current for arc and incandescent lighting, both currents being deliverable in any desired proportion from the same machine.

The heating of cars waiting in the train shed in cold weather when the locomotive is detached is provided for by a complete system of steam mains leading to the ends

of the stub tracks, steam at boiler pressure being passed through a reducing valve which supplies the mains with steam at 70 lbs. pressure.

A thirteen-panel switchboard is another feature of the power plant.

The air compressors were made by the Ingersoll-Sergeant Drill Company, and have 12-in. steam and 10-in. air cylinders with 24-in. stroke. A constant pressure of 100 lbs. is kept in the pneumatic signaling apparatus and interlocking system.

A positive hot-water circulating system is used for heating the station.

The ice and refrigerating plant was designed by Westinghouse, Church, Kerr & Co., and is especially complete and interesting.

The Sprague Electric Company has furnished four electric passenger elevators of its Z type, two freight elevators of the Q type, and twelve baggage lifts of type P, the last named operating between platforms in the train shed and the baggage subway below.

The electric pneumatic interlocking system was furnished by the Union Switch & Crossing Company, a Westinghouse corporation.

A complete gas plant for supplying compressed illuminating gas on the "Pintsch" system has been installed in a separate brick building at the south end of the power house. Its capacity is 120,000 cu. ft. per day.

The exceptional completeness of the equipment of the South Terminal Station and the perfection of the plans in every detail is due, of course, to the combined intelligent effort of many men on the magnificent staffs of the Boston & Albany and New Haven Companies, but among those especially to be mentioned as bearing the final responsibilities are President Charles P. Clark, of the New Haven system and the Boston Terminal Company; General Manager John C. Sanborn and Resident Engineer George B. Francis, of the Terminal Company, and Chief Engineer Curtis, of the New Haven Company. The advantages of making a bulk contract for the entire engineering equipment have been well exemplified in the care and celerity with which the work has been carried out by Westinghouse, Church, Kerr & Co.



LOADING PLATFORM ON LOOP IN SUBWAY

Consolidation in Buffalo

On Feb. 27 it was announced that all the electric railways in Buffalo and vicinity had been purchased by a syndicate, and would be consolidated into one company having a capital stock of $25,000,000. The roads purchased are the Buffalo Railway Company, the Buffalo Traction Company, the Buffalo & Niagara Falls Electric Railway Company, the Buffalo & Lockport Electric Railway Company, the Buffalo, Bellevue & Lancaster Railway Company and the Niagara Falls Park & River Railway Company, of Niagara Falls, Ont. In addition to the purchase of the electric railways the syndicate gains control of two bridges crossing the Niagara River below the falls, one of them being the upper steel arch bridge, and the other the new suspension bridge now being erected over the river at Lewiston.



SOUTH TERMINAL STATION, BOSTON

A verdict for $400 has been given to a gentleman in Brooklyn, N. Y., who was ejected from a car by a conductor. The gentleman received a transfer from one line to another, but as the cars of the second line were crowded he decided to wait until he could secure a seat. A car containing empty seats did not pass for half an hour, and when the gentleman presented the transfer on this car it was refused on the ground that the time limit had expired. He was ejected from the car, and brought suit, with the above result.

A decision has been handed down by the full bench of the Massachusetts Supreme Court in the suit against the Warren, Brookfield & Spencer Street Railway Company, holding that a landowner cannot recover damages for injuries caused by the construction of an electric railway in front of it. The court holds that the law granting damages is not applicable to street railway companies, but only to companies organized for the production of electricity for power or lighting.

The Brooklyn (N. Y.) Rapid Transit Company reports passenger earnings for February, 1899, as $370,544.

Park Amusements

BY HENRY PINCUS

The entire success or failure of a park is almost entirely dependent upon the proper selection of attractions, and yet many park owners look upon this as a mere secondary consideration. I have known large corporations to invest many thousands of dollars in park property, and, after months of preparation for a season's business, never give their amusements a thought or consult an amusement manager until the last moment, and oftentimes not at all. In their opinion, the amusement manager does not count for much—he is only a "showman"—and what are his suggestions and advice worth, compared with those of the engineer, architect, landscape gardener, and such persons?

Why is an amusement manager so necessary, particularly at the start? What does he know about the details of laying out a park? These are the questions I propose to answer.

A man who understands the business of park amusements should have a general knowledge of the entire subject. By this I mean that he should see at a glance where to locate this or that attraction with a view to getting the best results, make it easy for the people to see and hear, and, at the same time, make it easy for them to spend their money. This is a science, and an expert amusement manager knows all the tricks that go to accomplish this end. The park is designed for amusement and should be built upon amusement principles, and the larger and more pretentious the park, the greater the need of an experienced man. Why? Because in all enterprises, everything revolves around one pivotal point, that for which it was organized. For instance, who would think of exploiting a mining scheme without a mining expert? Just imagine a large department store without a competent buyer for the various departments. All the magnificent buildings, handsome decorations and perfect surroundings would amount to very little, if the right kind of goods were not there. So it is with amusement parks—beautiful grounds, fine structures, and unlimited capital to operate them, do not make successes—the "attraction" is the thing, that magnetic "something" which you must depend upon to draw the people.

Strange as it may seem, the park proposition differs from almost every other form of amusement enterprise. Let me explain. In a theater, for instance, the entire audience are really all in and seated when the performance begins. Their admission fee, which is all the revenue the owner expects to get from them, has been paid. It is now the desire of the proprietor to entertain the patrons to the best of his ability for the entire evening and give them the worth of their money. If the attraction is strong enough to draw the people, it certainly must be interesting enough to hold their attention for the entire length of performance. This is what is wanted. It is not so with parks, however. In out-door amusements, the successful manager must keep his patrons "on the go" all the time. The entertainment must be of such a character as to be sufficiently strong to draw the people, and, at the same time, to keep them entertained *at intervals only*. Why? Because they must be kept moving. The "show" is only the "bait" to catch the crowd, it is the expensive end from which the owner receives no revenue, or very little.

What are the profitable sources of income? The merry-go-round, the toboggan, the thousand and one catch-penny amusements; they are the money earners. The candy, ice cream and soda water stands and such must get their share also. They are scattered all over the grounds. What chance have they to do business if the people are all seated in the amusement pavilion and kept there for the entire evening? Yet there they will stay, afraid to leave their seats for fear of losing them. That is the objection in parks to comic operas, plays and similar attractions—they hold the attention of the audience from beginning to the end. In other words, it is a "story" which they are interested in hearing all through.

The park owner will naturally ask then, "What on earth should I give them?" That depends entirely upon the originality of the manager, style of place he is managing and class of people he is catering to. To illustrate, in a general way, if you have a large place, where crowds are to be amused, and, at the same time, separated from their money, I would suggest the following: In the pavilion put a first-class band of music (I mean one of reputation with drawing power) with occasional solos and novelties interspersed. In another part of the grounds, say some fireworks—elsewhere, maybe, a balloon ascension (illuminated) or other sensational act. This will keep the crowd moving and, at the same time, enable the park owner to catch the nimble nickel. Take, for instance, Washington Park on the Delaware, that I have been managing for several seasons; a matter of the greatest concern was how to entertain the crowds, and, at the same time, get their money. It is hard to do both. For instance, our park covers many acres of ground—we have two carousels, two toboggan slides, a shoot the chutes, Ferris wheel, maze, electrical building, refreshment stands and many other sources of profitable income. Now, to get the people distributed among these points, while the non-profitabe counter attractions are so great with only a few hours to get their money, is a problem. In the evening, it is after 8 o'clock before the people can get to Washington Park from their homes and suppers, and by 11 o'clock they commence to go home. This makes the time very limited. We have two bands, electric fountain, fireworks, etc., all of which are free. After considerable experimenting, we settled on the following method:

At 8 o'clock the big band commenced their concert, which lasted until 8:40 (introducing special features). At 8:50 sharp (ten minutes later to give the people time to get there) commenced the electric fountain display, with its wealth of spectacular effects, living pictures and dances, in the midst of the falling waters. At the conclusion of this entertainment was a display of fireworks. This entire exhibition was all over at 9:20, just one half hour. One hour's show crowded into half that time and why? To keep the people from going home, as 9:20 was comparatively early, while at 10 o'clock they would make a rush for the cars or boats. Immediately at the finish of the fireworks display, the big band in the pavilion would strike up some lively march to attract the attention of those who had been watching the fireworks; this would have the effect of moving the crowd in that direction. Then there would be another concert with some novelty introduced, and the other band would play in the lower pavilion, which, together with the many other attractions distributed all over the park, would keep up the excitement until the end of the evening.

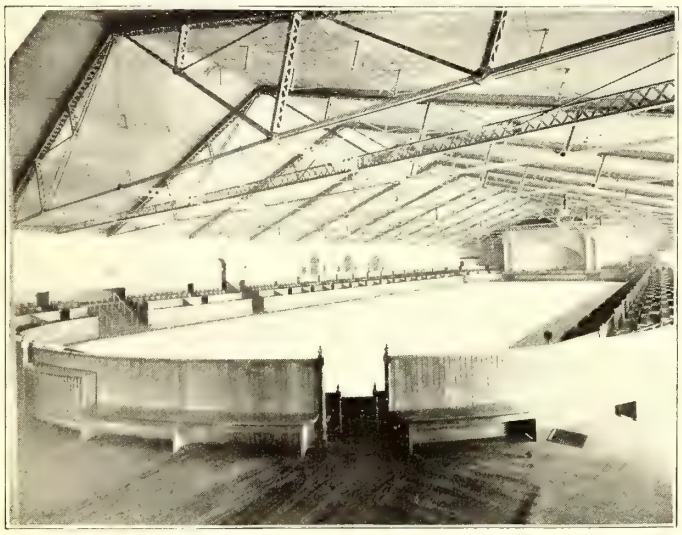
I have tried operas, concerts, vaudeville, big spectacles and water shows, as well as balloon ascensions, by day and night, in fact, almost every kind of attraction, all with the same result; *give it to them at intervals*. It is better to give operettas or selections from operas, with concert selections between, than one continuous show.

Remember I am speaking only of large parks covering great area. If you have a small park with nothing but a stage with seats in front of it, as the *only* attraction, as many of the small trolley parks do, then it is a very different proposition. In such cases a vaudeville, operatic or any other continuous evening's entertainment is just what is wanted.

Transformation of a Street Railway Repair Shop into a Skating Rink

As mentioned elsewhere the Consolidated Traction Company of Pittsburgh, has recently built extensive new repair shops, and this has allowed the company to remodel its former shops and to lease them as an ice skating rink. The building, which is of brick, has a ground dimension of 400 x 136 ft., and the ice surface utilized for skating aggregates 26,000 sq. ft. The skating floor is oval in shape, and is provided on three sides with rows of opera chairs and boxes. One end is fitted up with a stage or a band stand, and at the entrance or front end there are a large soda fountain, cloak rooms, parlors and smoking roms, as well as check rooms for skates.

The building is brilliantly lighted with arc and incandescent lamps, the latter being installed in great numbers along the steel arches which support the roof, there being



TRANSFORMED CAR HOUSE

but a single span. There are also artistic designs in incandescent lamps, and all the auxiliary equipments usually found in a rink of this character. The power for operating the ammonia compressors is derived from two 200 h.p. motors, which are converted generators, formerly employed in one of the power stations. These each drive a 150 h.p. compressor by means of individual rope belts. There is the usual tank and cooling apparatus through which the brine circulates, and the steam pump by which the brine is pumped through the tubes in the floor of the rink. The brine is returned through two large pipes located in the basement under the rows of seats on each side of the building. A portion of the basement is also occupied by one of the 248-cell storage battery stations of the chloride accumulator type, which are employed as auxiliary to the main power station. This battery is connected with the lighting circuit of the rink, so that the lamps burn very uniformly indeed. The switchboard for controlling the lights and power is also in the basement, the whole equipment being very liberally designed.

Every employee of a street railway should be considered as an agent with possibilities of harm to his employer. It is not enough that he be intelligent, sober and industrious. He should be of good judgment and sound thinking; and neither communistic, socialistic or anarchistic in his views; not discontented and at cross-purposes with the whole social order, but of cheerful disposition and content to make the best of life as he finds it.—From a paper read at the St. Louis Convention, 1896.

Woodside Park, Philadelphia

The Fairmount Park Transportation Company owns one of the most elaborate pleasure resorts to be found in this country. This is located a short distance from Fairmount Park in the city of Philadelphia, and nearly a half-million dollars have been judiciously expended in making it one of the most charming spots that can be imagined. The natural beauties of the place have been carefully pre-



SCENIC RAILWAY AT WOODSIDE PARK

served, and have been enhanced by artificial means wherever possible. The place is known as Woodside Park.

Among the many attractions are a Dentzel merry-go-round, a revolving tower, a large casino, from whose balconies magnificent views of Fairmount Park and the city can be secured, a well-managed theater, scenic railway, owned and operated by the L. A. Thompson Scenic Railway Company of New York, etc. These are only made adjuncts, however, to the natural beauties of the place, which consist of attractive woodland and groves, a very beautiful lake, numerous walks and drives, etc. Thousands of seats and tables have been scattered through the woods for the use of picnic parties, and these are always well patronized on pleasant days.

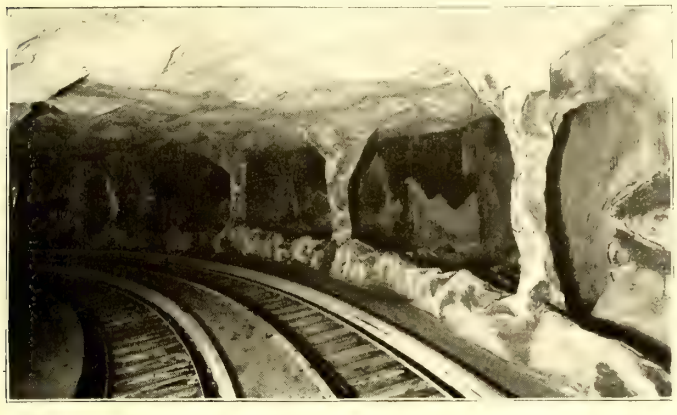
The scenic railway was the first attraction to be installed at this place, and was, in fact, nearly completed before any



LOOP BUILDING FOR RAILWAY

other improvements in the neighborhood had been undertaken. The railway is supplied with a power plant, which can be either steam or electric motor. The structure is built on the four-track plan, with loops at each end. The length of the structure is about 800 ft., 24 ft. wide, except at the loops, which are 62 ft. to 70 ft. across at the widest points. Each car travels four times the length of the structure, making a ride of about 3500 ft. Sidewalls are built along the structure the entire length of the track, making derailment impossible. The force used for the

greater length of the line is gravity. There is also a cable section centrally located in the structural roadway, where short sections of ¾-in. steel rope are driven up the main elevations by the application of steam or electric power. These running sections of cable pick up the cars while in motion by the use of an automatic grip attached to the bottom of the truck of the car, and the cars are carried up and over the elevations without the slightest jar or jerk, and automatically released at the top, so that the motion



GROTTO IN SCENIC RAILWAY

of the car is not checked. Here gravitation and momentum alternately supply the necessary force that propels the car over the roadway to the next cable section. At one terminal of the railway is a large pavilion, and at the other a circular building, through which the cars pass. Here,



GROTTO IN SCENIC RAILWAY

by means of painted canvas, etc., a number of very beautiful scenic effects are secured. These vary in character, from representations of distant views of mountains, hills and water effects to tunnels, from the roofs and walls of which depend imitations of coral, stalactites and grotesque formations of various kinds. The sensation, while passing through these tunnels and bits of scenery in the rapidly-moving cars, is novel and pleasing.

L. A. Thompson, the inventor of the attraction, was one of the first to study the question of developing the possibilities of gravity railways, and he has devoted fifteen years of his life to the problem. The company of which he is the head now operates over $200,000 worth of scenic railway plants in the United States, and is constantly increasing this amount. It is also receiving numerous inquiries from foreign countries, and has just sent two shiploads of material for scenic railways, one to Europe and one to South America. The company is now negotiating for a new site at Coney Island, where it expects to build the largest and finest gravity railway ever erected.

Electricity on the Manhattan Elevated Railway

George J. Gould, president of the Manhattan Elevated Railway Company, of New York, has issued to the stockholders of the company a circular, of which the following is an abstract:

"Pursuant to the request of the board of directors of the Manhattan Railway Company, I have been conducting during the past year a most exhaustive investigation relative to a change of motive power on the railways of this company.

"These investigations have embraced the generation, distribution and use of electric power on both elevated and surface railways by every important plant in this country, particularly those in New York, Brooklyn and Chicago. They represent, therefore, the combined experience of the largest producers and consumers of electricity in the world. The most conservative estimates made by experts show a saving of 2½ cents per car-mile on the entire car-mileage of the elevated roads. As we are now running over 40,000,000 car-miles annually, the saving in operating expenses alone will be over $1,000,000 a year, which, with other economies possible, is sufficient to pay 5 per cent on the $18,000,000 capital which it is proposed to put into the elevated roads, and 1 per cent additional on the present capital.

"This result will be effected merely by the decrease in expenses of operation, even if the effect of the change of motive power and other improvements connected therewith should not add one additional passenger to the present traffic. An equally strong reason, in my judgment, for the change of motive power is afforded by the increase in traffic, which will result as a consequence of the proposed change. When the change has been made, we should be able to run 20 per cent more cars to a train, the speed of the trains will be increased from 16 to 18 per cent, and the number of trains that can be sent out in any given time will likewise be largely increased, thus enabling the company to handle more traffic, and handle it more expeditiously and better than at present. During those hours of the day when the traffic is light our trains now run on some of the lines on a six-minute headway; when the proposed change is made we will be enabled to run cars without any additional expense on a headway of a minute and a half, thereby enabling persons who will not now risk waiting for four or five minutes for a train to travel by our road, induced thereto by rapid and expeditious service."

The circular mentions as additional advantages to be derived from the equipment of the elevated roads with electricity, the ease with which cars can be handled at terminal points, the better lighting of cars and stations, the operation of passenger elevators at the principal stations and the running of open cars in summer.

The circular continues in substance: "I repeat that after careful and deliberate consideration, the board of directors and executive officers concur in the opinion that the proposed change, by reason of the decreased operating expenses, the increased carrying capacity of the road, and the comfort and convenience of passengers, is one which ought not to be longer delayed

"In order to provide the means for making the change, the directors have concluded, as the best method, to create and issue $18,000,000 par value of additional stock, first to be offered to the stockholders at par.

"This will be issued, in order to provide for the necessary new plant and equipment and to modernize all facilities for the comfort and convenience of the public, thereby increasing the efficiency and economy of the service, as well as the earning capacity of the system.

"Stockholders will be given the right of taking the new stock at par on the basis of 60 per cent of their holdings, concerning which further communication will be made to the stockholders at an early date." (Signed) George J. Gould, President.

It is interesting in connection with the above circular to notice some of the bills introduced into the City Council and the Board of Aldermen within the past few weeks, and which have as their object the regulating or improving of the service on the elevated railways of Greater New York. Among these are two which were passed on Feb. 22, one requiring all elevated roads in Manhattan and Brooklyn to put drip-pans under their entire structures (over 170 miles of single track), and the other compelling the Manhattan Elevated to run at least one train every five minutes, day and night, in the Borough of Manhattan. In addition to these, bills have been introduced compelling the Manhattan to inclose all its station platforms, and to run express trains every fifteen minutes, made up of vestibuled parlor cars with reclining chairs and Welsbach gas lamps, the fare to be three cents, and the penalty for violating the ordinance $1,000; also one prohibiting the storage of cars on elevated structures. In addition to all these, the Park Board has ordered the Manhattan Railway Company to remove its elevated structure from Battery Park.

LEGAL NOTES AND COMMENTS*

Edited by J. Aspinwall Hodge, Jr., and Robert Ernest, of the New York Bar

Liability to Linemen for Accidents

Accidents to linemen and repair crews whose duties call them to the top of poles and ladders must necessarily be frequent, and when they happen the liability of the railroad company as between master and servant is involved. A recent case in New York is typical and suggestive and its facts are closely analogous to facts which must constantly arise. *Gibbons* vs. *Brush E. I. Co.* There an electric light company, after finding that the arc lights on its poles in one or two instances, between Fourteenth and Thirty-fourth Streets, on Broadway, in New York, had become insecure, ordered a new set of fastenings and hoods, and when these were obtained sent out a foreman with the plaintiff as one of his men to set them up.

Upon removing one of the old lights and while acting under the directions of his foreman, the fastenings gave way and he fell from the top of the pole, and was seriously injured. The accident occurred because of the way the plaintiff removed the light, in accordance with the foreman's instructions.

The Appellate Division of the first department held that these facts established the proposition that the accident occurred through the negligence of the foreman, who was acting as a co-employee of the plaintiff, when he gave the order which the plaintiff obeyed, and therefore the defendant was not liable.

The risks assumed by an employee are stated to be not only the risks incurred in the handling of lamps in perfect order, but in handling damaged equipment. This is in accordance with cases where the same rule has been applied to the handling by employees of defective cars where it was necessary to couple them so that they might be removed from the track in use. *Arnold* vs. *Canal Co., 125 N. Y., 15; s. c. 25, N. E. 1064. McCosker* vs. *R.R. Co., 84 N. Y., 77.*

According to the opinion of Appellate Division in this case, where a lineman is employed to assist in repairing electric lines, and in the removal of the lamps, hoods and frames, he is bound to assume that they may be defective and to govern his actions accordingly. H.

CHARTERS, ORDINANCES AND FRANCHISES

ALABAMA.—Injunction Restraining Trespass—Remedy at Law—Electric Railway—Additional Servitude.

1. Where a street railway was not authorized to extend its line on a street the fee of which was owned by another company, such company cannot restrain such proposed extension, since it is merely a threatened private trespass, which may be adequately compensated at law.

2. It is only where a party authorized by law to exercise the right of eminent domain proceeds to take property without compensation that equity will enjoin such act, without reference to the question of irreparable injury or the adequacy of legal remedies.

3. The operation of an electric railway with municipal consent along a public street, conforming to its grade, is not an additional servitude outside the public easement, for which the owner of the fee of the street is entitled to compensation.—(Birmingham Traction Co. *et al.* vs. Birmingham Ry. & Elec. Co., 24 So. Rep., 502.)

ALABAMA.—Street Railroad Corporations—Implied Powers—Eminent Domain—Contest of Corporate Right to Hold Real Property—Contracts—Consideration—Specific Performance.

1. From the naked power to construct a street railroad no authority can be derived to construct a freight belt railroad in and around a city, solely to transfer freight cars to and from factories and other railroads.

2. If any power of condemnation can be implied from the authority to construct a street railroad, it is limited to its right of way and necessary structures incident to its business.

3. A corporation authorized to construct a street railroad has no authority to receive, by condemnation or grant, property for a freight belt railroad which it had no power to construct and operate.

4. Where it has acquired title and possession, a corporation's right to hold real property can in a direct proceeding be questioned by the State only.

5. An interested individual may contest the claim of a corporation where it seeks the necessary aid of equity to perfect title to real property, but not where a deed has been executed and delivered or the consideration paid, or the question involved is not the right of the corporation to hold property of a particular kind or for a particular purpose, but its right to hold property in excess of a definite quantity or value.

6. Where a railroad granted the right to use its right of way to a corporation unauthorized to take such a grant, the grantee's successor, though not incapacitated, could not secure the aid of equity to perfect its title to, or obtain possession of, the property, unless the grantor has acted so as to estop himself from denying the successor's right under the agreement.

7. The performance of acts required by statute to be performed does not constitute a valid consideration for a contract.

8. A railroad company, under the mistaken supposition that a land company was authorized to construct a railroad and condemn a right of way across its tracks, and to prevent the land company's threatened crossing of its tracks at inconvenient points, granted the land company the right to cross at certain other points, and to use a certain part of its right of way. The land company's undisclosed object was to secure a right of way into the railroad company's passenger station, under the mistaken belief that it was legally entitled to enter and use the same, and that it owned and could cross a certain 35-ft. strip of land in doing so. In consideration therefor, the land company was to repair the crossings, pay for erecting and maintaining signals and employing watchmen thereat, and grant to the railroad company the privilege of crossing and building its tracks on the 35-ft. strip of land it was supposed to own. Possession of its grant was never acquired by the land company, or its successor, further than to lay a part of its track, which was subsequently occupied by other railroads for passenger traffic, with the railroad company's permission. This traffic, if the agreement was enforced, would be interrupted, to the great injury of the railroad company and the interests of the public; but neither the land company nor its successor, seeking to enforce the agreement, were legally authorized to construct railroad tracks over the right of way leading to the passenger station, and which the agreement was intended to secure. Held, that specific performance of the agreement would not be enforced.—(South. & N. A. R. Co. vs. Highland Ave. & B. R. Co., 24 So. Rep., 114.)

MICHIGAN.—Location—Jurisdiction.

Where the power to locate the road of a street railway through a township is conferred by statute upon the supervisor and highway commissioner, courts have no power to review their action.—(Silsley *et al.* vs. Lyle, commissioner of highways, 75 N.W. Rep., 886.)

MINNESOTA.—Car Barn—Nuisance.

1. The defendant has for some years maintained and operated by public authority a street-car system, the motive power of which is electricity, in the city of St. Paul. As a necessary incident to such operation it has maintained a car barn in a residence district, for the purpose of storing a part of its cars when not in use on the streets. The barn fronts on Ramsey Street, with its sides abutting on Thompson and Smith Avenues, respectively. It is not authorized to operate its system on these avenues, but it has, without any negligence in the premises, laid tracks and curves thereon, over which it runs, from early in the morning until late at night, its cars to and from the barn. Such operation of its cars over such tracks and curves causes loud and disagreeable noises, whereby the rest and comfort of the plaintiff are disturbed, and the rental value of his real estate abutting on the street and avenues is materially reduced. Held, construing the city ordinances granting to the defendant the right to operate its street-car system, that it is authorized to so lay and operate the tracks and curves on the avenues.

2. Held, further, upon the undisputed evidence, that the location of the barn is not an improper or unreasonable one, and that the acts of the defendant do not constitute a private nuisance for which the plaintiff can recover damages.—(Romer vs. St. Paul City Ry. Co., 77 N. W. Rep., 825.)

* Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

MISSOURI.—Franchises—Public Sale—Construction of Statute—Vagueness—Impossibility to determine Meaning.

1. Act, April 9, 1895, provides that the municipal authorities to whom application may be made for consent to the construction, extension, maintenance, occupation, or use of, inter alia, any street railway or railroad for the transportation of freight, passengers, or mails, must provide, as a condition precedent to the granting of such consent, that the franchise shall be sold at public auction to the responsible bidder who will give the largest percentage yearly of the gross receipts derived from such occupation and use, with adequate security for the payment thereof, and for the prompt construction and completion of the proposed plant, provided that such payment shall in no case be less than 2 per cent of the gross earnings uring the first five years of said occupation and use, and thereafter for each period of five years such percentage shall be increased to correspond with the increase in value of the land thus occupied and used. Held, that the act is void, in that its meaning cannot be determined by any known rules of construction, because, if it means that the company must pay at least 2 per cent of its gross earnings for the first five years to each municipality over whose streets it may build, and to each county whose highways it may cross, the railway company may in many cases be compelled to pay more than its total receipts.

2. It is also void if it means that the percentage should be computed only on the gross receipts of that part of the road located on the streets of the city or across the highways, as the case may be, because there is no method provided by which the actual gross receipts of that particular part of the road can be ascertained.

3. A continued line of railroad cannot be subdivided so as to permit competition for the privilege of constructing and operating separately the portions thereof lying within the municipalities and across the highways on its route.

4. The act cannot be practically enforced, since, in the case of street railroads, there is nothing to show on what gross earnings the percentage is to be computed, the act evidently contemplating that the bid shall be a percentage only of the receipts derived from the use and occupation of the "public" property, and a portion of the earnings being attributable to the capital invested in power stations, machinery, etc.

5. The percentage is to be increased in "each period of five years to correspond with the increase in the value of the land thus occupied and used," but the act gives no intimation by whom or in what manner this increase is to be settled and determined.

6. If the provision for increased payment for the franchise after five years is meaningless, in the case of street railroads, the proviso is practically eliminated, so that it is highly improbable that the Legislature would have passed the act with the clause increasing the percentage in each term of five years omitted.—(State *ex rel.* Crow, Atty.-Gen., vs. West Side St. Ry. Co., 47 So. W. Rep., 959.)

NEW HAMPSHIRE.—Incorporation—General Law—Additional Routes—Public Good.

1. Laws 1895, c. 27, sec. 3, providing for the organization of street railway corporations by general law, and authorizing the court to determine whether the public good requires a proposed street railway corporation to build on a proposed route, does not authorize the courts to determine whether the public good requires a street railway corporation organized by a special law before said chapter was passed to build on a proposed route that is not an extension of its road, which, by the act incorporating it, it was authorized to build.

2. A street railway corporation incorporated under a special law prior to the passage of Laws 1895, c. 27, providing for incorporation by general law, need not procure a reincorporation under the general law; section 1 providing that the specially chartered companies shall continue to exercise the powers granted by their charters except as modified by said chapter.—(*In re* Keen Electric Ry. Co., 41 Atl. Rep., 775.)

NEW YORK.—Greater New York Charter—Street Railway Franchise—Legality of Municipal Grant—Certified Questions.

1. Laws 1897, c. 378, sec. 73 (Greater New York Charter), providing that, "after the approval of this act," no franchise or right to use the streets, avenues, parkways, or highwas shall be granted by the "municipal assembly" for a longer period than twenty-five years, etc., became operative on May 4, 1897, the date of the approval of the act, and applied to the board of aldermen then in office of the city of Brooklyn, notwithstanding its reference to the "municipal assembly," which was not to come into existence until January 1, 1898.

2. A perpetual charter, granted by the authorities of Brooklyn after the approval of the Greater New York Charter, to a street railway, is not valid as a charter for twenty-five years.

3. Where a case is sent to the Court of Appeals on special questions otherwise not reviewable, the questions should be so framed that the answers may determine the particular controversy involved in the appeal, and not merely a part of it.—(Blaschko vs. Wurster, Mayor, *et al.*, 51 N. E. Rep., 303.)

NEW YORK.—Mandamus—Peremptory Writ.

A peremptory writ of mandamus is issued in the first instance only in case of a clear legal right on uncontested facts.—(*In re* Forty-second M. & St. N. Ave. Ry. Co. vs. Collis, 53 N. Y. Suppl., 669.)

NEW YORK.—Construction and Operation—Consent of Abutters.

Laws 1839, chap. 218 (re-enacted as Laws 1890, chap. 565, sec. 78), providing that any railroad corporation may contract with any other railroad corporation for the use of their respective roads and thereafter use the same in such manner and for such time as may be prescribed in the contract, is not in conflict with Const., art. 3, sec. 18, providing that no law shall be enacted permitting street railroads to construct their lines without first obtaining the consent of the owners of one-half in value of the abutting property; or with Laws 1890, chap. 565, sec. 91, as amended by Laws 1896, chap. 855, providing that a street railroad or extensions or branches thereof shall not be built or "operated" unless the consent of abutters is obtained; or with Id., sec. 102, providing that no street-surface railroad shall construct, extend, or operate its tracks in that portion of a street where such a road is already constructed without consent of the other road, but that the two railroads may unite in the use of tracks on the condemnation thereof in the manner prescribed for the benefit of one of the companies. Hence consent need not be obtained by a street railroad company operating under a contract over a portion of another company's tracks.—(Ingersoll vs. Nassau Elec. R. Co., 52 N. E. Rep., 545.)

NEW YORK.—Conversion—Removal of Electric Wires—Damages.

1. Though the erection of wires on housetops, the householders consenting, be illegal, the city is liable for conversion where, without offering the owner a reasonable opportunity for reclaiming them, it cuts down the wires and carries them away.

2. It is no defense that the value of the wire could not be accurately determined where the evidence tended to show the wire to be worth a certain sum per foot.—(Electric Power Co. vs. Mayor, etc., of the City of New York *et al*, 55 N. Y. Suppl., 460.)

NEW YORK. — Construction—Injunction—Abutters—Extension—Validity—Municipal Consent—Retroactive Effect.

1. An abutting owner may enjoin the unauthorized construction of an electric railway in a street without showing that the benefits from the railway will not offset the injuries.

2. A street railroad company, whose articles contemplate a single, connected road, carrying from end to end for a single fare, cannot construct an independent line, not connected with its original line, under extension proceedings.

3. Where an extension of a street railroad was invalid because it was disconnected from the line authorized in the original franchise, a second extension proceeding, providing for a line to connect the extension with the original, does not validate resolutions of municipal authorities authorizing the first extension.—(McLean vs. Westchester Elec. Ry. Co., 55 N. Y. Suppl., 556.)

TEXAS.—Trust Mortgage—Foreclosure.

Where a corporation issues a series of bonds to a trust company, and at the same time executes to it a mortgage conveying to it property to secure the payment of the bonds, and providing that, on default in the payment of the interest, the trustee may declare the entire principal of bonds due, and bring suit to foreclose, bonds of such series transferred to an individual are merged in a judgment, if obtained by the trustee in a suit to foreclose and for personal judgment for the debt evidenced by the bonds, so that such individual owner cannot thereafter maintain a suit on his bonds.—(Laing vs. Queen City Ry. Co., 49 S. W. Rep., 136.)

LIABILITY FOR NEGLIGENCE

ALABAMA.—Electric Cars—Injuries at Crossings—Negligence—Name of Motorman—Pleading—Contributory Negligence—Question for Jury—Instructions.

1. A complaint against a street railroad company to recover damages for injuries to one not an employee need not state the name of the motorman whose negligence is alleged to have caused the injury.

2. Where a driver had the right to drive across an electric railroad track at a certain point, the company is guilty of negligence in running its car at so great a rate of speed as to be unable to avoid running into him.

3. It is not negligence per se for a driver to cross over a railroad track whenever he may have occasion so to do for the pur-

pose of going from one side of the street to the other, whether in the open country or in the limits of a city or village.

4. Where an electric railroad company was negligent in running its car at such a speed that it could not stop it in time to prevent hitting a horse which had balked on the track, assuming that the driver's failure to attempt to back the horse off the track was equivalent to permitting it to remain on the track, it is for the jury whether such act contributed to the injury.

5. An instruction assuming as a fact a matter not proven is erroneous.

6. An act of contributory negligence not charged in the answer cannot be made the basis of an instruction.

7. An instruction that if an ordinarily prudent person would not have tried to pull the horse forward as the plaintiff did, but would have backed him off the street-car track, the verdict must be for defendant, is properly refused, as assuming that an effort to back the horse off the track would have been successful.—(Birmingham Ry. & Elec. Co. vs. City Stable Co., 24 So. Rep., 558.)

CALIFORNIA.—Collision with Street Car—Negligence and Contributory Negligence—Question for Jury—Instructions.

1. Evidence for plaintiff showed that, just before driving his wagon across defendant's street-car track, he looked and listened, but did not see an appraching car until he was nearly on the track. The car was then about 50 yds. away, and he could have crossed, if those in charge, after he called to them, and after they saw him, had lessened its speed, as they could have done. Owing to obstructions he could not see the car, or be seen by those in charge of it, until he reached the street from an adjoining lot. Held, that the question of contributory negligence was for the jury.

2. Evidence showed that the defendant's street car was traveling faster than the prescribed limit, and there was evidence that those in charge, after they discovered plaintiff on the track with a wagon, could, with ordinary diligence, have stopped the car before it reached him; and plaintiff testified that the car was 50 yds distant from the crossing at the time he was discovered by those in charge of the car. Held, that the question of defendant's negligence was for the jury.

3. An instruction, in an action for injury to a person crossing the track, that a street railroad has only an equal right with the traveling public to the use of the street whereon its track is built, was not improper because omitting some few exceptions not material in the case, such as that when an ordinary vehicle meets a car on its track it must give way to the car.

4. There is no error in refusing an instruction sufficiently included in instructions given.—(Clark vs. Bennett, 5 5Pac. Rep., 908.)

INDIANA.—Carriers—Injury to Passenger Riding on Platform—Contributory Negligence—Directions of Conductor—Damages—Pleading—Variance—Questions for Jury—Instructions—Depositions—Appeal.

1. Whether a passenger in a street car is negligent in giving his seat to a woman and riding on the platform, at the general request of the conductor, is for the jury.

2. There is no variance where the evidence fairly tends to prove the substance of the issue.

3. Where the testimony is conflicting, and there is evidence which fairly tends to support the verdict, the judgment entered thereon cannot be disturbed on appeal.

4. A request by a conductor of a street car for a passenger to ride on the platform amounts to a direction to ride there.

5. Under an allegation that plaintiff rode on the platform of a street car at the request of the conductor, and was injured through the negligence of the company's servants, plaintiff may recover without proving that the conductor requested him to ride on the platform.

6. A refusal of an instruction that plaintiff could not recover for fright, suffering, and nervous shock, unless they were the result of the "bodily injuries" received, is not error, where an instruction was given that there could be no recovery for such injuries, unless they were the result of "personal injuries" received.

7. Where instructions, taken as a whole, state the law correctly, and are not misleading, the case will not be reversed for inaccuracies of expression in some of them.

8. Where a witness whose deposition had been taken testified in person, and the opposite party introduced a portion of his deposition to impeach him, the party taking it might introduce the entire deposition, although it did not all bear on the subject matter of the impeachment.—(Terre Haute Elec. Ry. Co. vs. Lauer, 52 N. E. Rep., 703.)

INDIANA.—Pedestrians—Contributory Negligence.

A passenger got off a moving street car before it reached a crossing, and, without stopping to look, walked rapidly behind the car to cross the street and walked against the side of a car coming from the opposite direction, on a track five feet distant from the other. This car had its lights lighted, and could have been readily seen, except as the view was obstructed by the other car. Held, that he was negligent.—(Stowers vs. Citizens St. R. Co., 52 N. E. Rep., 710.)

INDIANA.—Personal Injuries—Action by Administrator—Abatement—Statutes—Appeal.

1. Where the Legislature re-enacts a statute of the State it adopts also the construction given thereto by the courts of the State before the re-enactment.

2. Under Burns' Rev. St., 1894, sec. 283 (Horner's Rev. St., 1897, sec. 282), providing that causes of action arising out of an injury to a person die with the person, except actions given for an injury causing the death of any person, an administrator cannot sue for damages for physical pain and suffering of intestate, since the right of action abates.

3. By failing to discuss an assignment of error appellant waives the error.—(Hilliker vs. Citizens St. R. Co., 52 N. E. Rep., 608.)

KENTUCKY.—Carriers—Injury to Passenger in Alighting from Street Car—Instructions to Jury.

1. In an action to recover damages for injuries to a passenger in alighting from a street car it was error to refuse to instruct the jury that the law made it the duty of defendant's agents and servants operating the cars "to observe the utmost care and skill which a prudent man would exercise under like circumstances in the management and control thereof while she was alighting therefrom, and to afford her reasonable opportunity to alight in safety."

2. It was error to give an instruction requiring the jury to believe, in order to find for plaintiff, that the negligence of defendant caused all the injuries to plaintiff complained of; it being doubtful, from the evidence, whether some of the injuries resulted from defendant's negligence.—(Lutz *et ux.* vs. Louisville Ry. Co., 48 S. W. Rep., 1080.)

LOUISIANA.—Weight of Evidence—Carriers—Injury to Passenger.

1. In case the positive statements of two witnesses are exactly in opposition to those of two other witnesses—said witnesses testifying on different sides of a cause, and all of them being equally entitled to credit—the physical situation of the rest may be treated as having the effect of turning the scale.

2. If a passenger, in alighting from an electric car at point of destination, is thrown to the ground by the suddenness with which same is either stopped or started, and this result is caused or contributed to by those in charge of same, a case of negligence of the railroad company is made out, for which it must respond in damages.—(Bourque vs. New Orleans City & Lake R. Co., 24 So. Rep., 622.)

NEW JERSEY.—Death by Wrongful Act—Elements of Damage—Excessive Verdict.

1. In an action based upon the act entitled "An act to provide for the recovery of damages in cases where the death of a person is caused by wrongful act or neglect," approved March 3, 1848, the plaintiff is entitled to recover nothing but the pecuniary loss sustained by the person for whose benefit, as next of kin, the action is brought.

2. Where the deceased was a boy fifteen years of age, with an earning capacity of about $20 per month, and the cause was tried on the basis that the pecuniary benefit to the father could only continue during the minority of his son, if his life had continued, and the instructions of the trial court were to that effect, held, that a verdict of $3,000 was excessive, and that, as the verdict of the jury was based upon only a misapprehension of the instructions of the court as to the measure of damage, the plaintiff could have the option of accepting the sum of $1,500; otherwise the verdict be set aside and a new trial ordered.—(May vs. West Jersey & S. R. Co. *et al.*, 42 Atl. Rep., 165.)

NEW JERSEY.—Wrongful Death—Elements of Damage—Services of Wife.

1. In an action under the death act (1 Gen. St., p. 1188), where it is contended that the advice and counsel of the deceased to the next of kin is an element of damage, it must be shown by the facts and circumstances that such advice and counsel would relate to the pecuniary affairs of the next of kin, and that such advice and counsel would probably result in a pecuniary benefit, and that by the deprivation of such advice and counsel a pecuniary injury would accrue.

2. The services of a wife in her husband's household in the ordinary work thereof, or in aiding and assisting him in his occupa-

tion is due and belongs to the husband; and her continued services during the life of her husband cannot be a pecuniary benefit to the next of kin, and the deprivation of such services cannot be a pecuniary injury, nor afford ground of recovery of damages under the death act of this State. Whether such services after the death of her husband would be a pecuniary benefit to the next of kin is a question too remote to be considered by the jury as a basis of a verdict of damages under such act.—(May vs. West Jersey & S. R. Co. *et al.*, 42 Atl. Rep., 163.)

NEW JERSEY.—Injury to Passenger—Question for Jury.

A boy twelve years of age was about to take passage on an open electric street car, having a bar across the side next to an adjoining track. Under the conductor's eye, he stepped upon the footboard at the barred side, and, before he was fairly on, the car was started on the conductor's signal, and the boy was thrown down and injured. Held, that the question of the conductor's negligence and of contributory negligence in the boy were for the jury, and that a nonsuit was wrong.—(Kelly vs. Consolidated Traction Co., 41 Atl. Rep., 686.)

NEW JERSEY.—Injury to Person on Track—Contributory Negligence.

The plaintiff, at a little after 9 o'clock on a dark night, was approaching on foot a trolley road having a single track, which he intended to cross. His line of approach was northwesterly, and diagonal to the track. When he had somewhat more than 50 ft. to walk before crossing the track, he saw a car somewhat more than 250 ft. south of the place of crossing. He testified that, when from 4 to 6 ft. distant from the track, he turned his head, looked for the car south along the track 75 or 100 ft., and did not see it; that he was then going diagonally across; that the first thing he knew the car was on him, and knocked him down; and that he was about the middle of the track when he was struck. The track to the south was straight for more than 250 ft. and the view of it was unobstructed. It is to be assumed that the plaintiff moved at the rate of an ordinary walk. Three witnesses observed and testified as to the car's rate of speed. Held, that facts within the plaintiff's knowledge and observation made it probable that the car, coming from a quarter towards which his back was partly turned, would be dangerously near to him before he got across the track; that it was therefore his duty to look for the car before he attempted to cross; that the car, moving at any rate of speed that is attributable to it under the evidence, must have been so near to the plaintiff when he looked for it before going on the track that, if he had not looked carelessly, he would have seen it, and have been warned of imminent danger; that his failure to receive warning was therefore due to his own negligence, and that the nonsuit was properly granted.—(Jewett vs. Patterson Ry. Co., 41 Atl. Rep., 707.)

NEW YORK.—Joint Tort Feasors—Stipulation not to Collect from One.

A stipulation not to collect from one joint feasor who agrees not to exact costs, will not discharge a judgment against a co-defendant. To discharge all joint tort feasors, the instrument must be a technical release under seal.—(Schramm vs. Brooklyn H. R. Co. and Consolidated Ice Company. Appellate Division, second department, Dec. 14, 1898.)

NEW YORK.—Joint Tort Feasors—Dismissal of Action against Co-Defendant—Street Railway Company—Injury to Passenger—Evidence—Question for Jury—Boarding Moving Car—Contributory Negligence—Instructions—Corroboration of Plaintiff by Defendant's Witnesses—Death by Wrongful Act—Damages.

1. A joint tort feasor cannot complain of the dismissal of the complaint as to his co-defendant.

2. Where the evidence on the part of plaintiff tended to show that defendant's car, as it approached a crossing, was brought nearly or quite to a stop to allow plaintiff's intestate to step aboard; that, after he had partially entered, the car, without any notice to him, was suddenly started with a jerk, throwing him to the ground, causing the injuries complained of—it was not error to refuse to dismiss.

3. It is not error to refuse to dismiss where plaintiff's evidence shows that the injuries complained of were caused by negligently starting the car with a jerk after her intestate had boarded the same, and defendant's evidence shows that he fell before reaching the car.

4. Attempting to enter or leave a moving street car is not contributory negligence per se.

5. A request to charge that, if the accident happened as testified to by defendant's witnesses, the verdict should be for defendant, is properly refused, where the testimony of some of such witnesses tends to corroborate plaintiff's witnesses.

6. A verdict of $9,000 is not excessive where deceased, at the time of his death, was forty-three years of age, in good health, received a salary of $1,250 a year, and left five children, who had been dependent upon him for support.—(Wallace vs. Third Av. R. Co. *et al.*, 55 N. Y. Suppl., 132.)

NEW YORK.—Injury to Person on Track.

Plaintiff's intestate, while playing with other boys in a street on which were two street railway tracks, started to run across the street near the middle of a block. He passed in the rear of a car going north, but, seeing a car coming south at a rapid rate on the other track, he stopped between the tracks, then suddenly attempted to cross the other track, and was struck by the southbound car. Held, that there was no proof of negligence on the part of defendant's servants.—(Greenberg vs. Third Ave. R. Co., 55 N. Y. Suppl., 135.)

NEW YORK.—Dismissal—Evidence—Construction—Electric Road—Speed—Testimony—Negligence—Statute—Court and Jury.

1. On an appeal from a dismissal the evidence must be construed on all doubtful questions in favor of the plaintiff.

2. Testimony of a high rate of speed of an electric car may be accepted by the jury where there is nothing in the evidence showing it to be incredible.

3. There is no statutory rate of speed for a car in New York city, and negligence, as a matter of law, can be laid down only in extreme cases.

4. Whether a street car is running at a dangerous speed in any locality, is ordinarily, a question for the jury.—(Fullerton vs Meteropolitan St. Ry. Co., Supreme Court, Appellate Division, First Department, Feb. 10, 1899.)

NEW YORK.—Imputed Negligence—Driver of Vehicle—Collisions—Appeal—Harmless Error—Instructions—Special Damages—Pleading and Proof.

1. The contributory negligence of a driver of a carriage which occasioned a collision with a street car cannot be imputed to a person in the carriage, where the driver was not subject to his direction.

2. A mistaken statement of the court that it had charged that plaintiff might recover if the collision with defendant's street car occurred as described by plaintiff's witnesses is harmless where such charge would have been correct.

3. Where plaintiff alleged that a nervous shock was occasioned by injuries, evidence that she suffered from curvature of the spine is not inadmissible as constituting special damages not pleaded, if there is evidence that such curvature was caused by the nervous shock.—(Kleiner vs. Third Av. R. Co., 55 N. Y. Suppl., 394.)

NEW YORK.—Rights of Pedestrians—Contributory Negligence—Accidents at Crossings—Instructions—Care Required in Operation.

1. A person is not at liberty to take even doubtful chances of being able to cross a street in front of an approaching car, or to assume that the motorman will be able to successfully stop it.

2. In an action for damages for being run into by a street car, an instruction that plaintiff is chargeable with negligence if he saw the approaching car and did not take "proper steps" to avoid it, and that he was not at liberty to take even doubtful chances in attempting to cross the street in front of the car, is not erroneous by reason of the use of the term "proper steps," since, construed as a whole, it only requires reasonable care.

3. The degree of care required in operating a street car is to be reasonably careful, to keep the car under proper control, and to be vigilant in approaching crossings.—(Harvey vs. Nassau Electric R. Co., 55 N. Y. Suppl., 20.)

NEW YORK.—Master and Servant—Personal Injuries—Proximate Cause—Fellow Servants.

1. An injury caused to a carpenter by being knocked down from a ladder by a loose horse and cart striking it was not proximately caused by the absence of a vice principal who was to guard the ladder against passing carts or cars.

2. A driver of a cart removing rubbish from a building under construction is a fellow servant of a carpenter on a ladder, the foot of which was near a door where the cart had to pass.—(Byrnes vs. Brooklyn Heights R. Co., 55 N. Y. Suppl., 269.)

NEW YORK.—Injury to Passenger—Contributory Negligence.

Under a complaint alleging that plaintiff was injured while attempting to board a car which had stopped to receive him and was suddenly started, it was error, where the evidence as to whether the car had stopped or not was conflicting, to refuse an instruction that if the car did not stop, but, while moving, plaintiff attempted to board it, and was injured, the verdict must be for defendant.—(Anderson vs. Third Ave. R. Co., 55 N. Y. Suppl., 290.)

NEW YORK.—Carriers of Passengers—Negligence—Joint Tort Feasors—Appeal—Reversal—Measure of Care and Skill—Appeal — Review — Instructions —Witnesses — Bias — Evidence —Harmless Error—Competency—Physicians—Damages—Materiality—Pleading—Amendment—Discretion.

1. A passenger of a horse car having been injured in a collision between it and a cable car, the horse-car company was not relieved of liability by the fact that its car had the right of way, where the cable car was moving toward the crossing at a rapid rate, and there was no appearance of any disposition to check speed before it reached that point.

2. Where a passenger sued the respective owners of colliding street cars for injuries, neither defendant was entitled to an instruction as to the negligence of the other, further than that each of the persons in control of the cars had a right to assume that the other would not proceed over the crossing negligently.

3. In an action against joint tort feasors, wherein plaintiff recovered, either defendant is entitled to a reversal if the charge was erroneous as to him, though it was given at the request of his co-defendant.

4. A horse-car company is bound to exercise all the care and skill which human foresight can suggest to secure the safety of a passenger at a cable-car crossing.

5. The court will not reverse for technical error in a charge disposing of forty-three requests made by defendants, when the charge as a whole is fair and correctly expounds the law.

6. In an action for personal injuries, wherein plaintiff's father testifies in her behalf, his bias may be shown by evidence that he has sued for loss of her services.

7. Where the testimony in an action for personal injuries showed that witness was plaintiff's father, and the jury were informed that he might sue for loss of her services, error in rejecting evidence of that fact to show witness' bias was harmless.

8. When a patient waives the privilege a physician may be compelled to testify to matters concerning the professional relation.

9. In an action for personal injuries evidence of the cause of peritonitis, from which plaintiff suffered before the accident, is properly rejected, where it does not appear to be material and counsel do not state what they expect its bearing will be.

10. It is in the discretion of the court to permit a complaint for personal injuries to be amended on the trial so as to ask $50,000 instead of $10,000.—(Zimmer vs. Third Ave. R. Co. *et al.*, 55 N. Y. Suppl., 308.)

NEW YORK.—Passengers—Alighting from Moving Car.

A passenger on a street car signaled the conductor to stop the car, and, as it was slowing down, he prepared to get off and was injured by the gripman suddenly increasing the speed of the car. Held, that he could not recover in the absence of proof that the conductor signaled the gripman, since the latter may have slackened the speed in the exercise of reasonable care in the operation of the car.—(Armstrong vs. Metropolitan St. Ry. Co., 55 N. Y. Suppl., 498.)

OHIO.—Damages—Personal Injury to Child—Impairment of Prospects of Marriage—Pleading—Special Damages—Setting Aside Verdict—Excessive Damages—Province of Court and Jury —Railroads—Injury to Person on Track—Trespassers—Presumption as to Rights in Street—Permitting Public to Use Track—Measure of Care Required—Contributory Negligence of Child—Negligent Handling of Cars—Injury to Children.

1. Where a personal injury to a little girl is such as to seriously impair her prospects of marriage when she reaches a marriageable age, such fact may properly be considered by the jury as an element of damages resulting from the injury.

2. While the loss of a particular prospect of marriage by a woman must be specially pleaded to entitle it to be considered as an element of damage, the loss of a general prospect of marriage, in the case of a child by reason of an injury which disfigures her, is a natural, and not a special, consequence of the injury, and may be, and in fact can only be, taken into consideration as an element of general damages, and a special allegation with regard to it is not required.

3. A verdict should not be set aside simply because it is excessive in the mind of the court, but only when the excess is shocking to a sound judgment and a sense of fairness to the defendant. Where there is any margin for a reasonable difference of opinion in the matter, the view of the court should yield to the verdict of the jury, rather than the contrary.

4. Where a railroad occupies a street with its tracks the ordinary presumption is that of a joint use by the public and the railroad company; and although the municipal authorities may, under the statute, have power to grant the exclusive right to the use of the street to the railroad company, in the absence of proof of such grant, or of the exclusive use of the street by the company for such a length of time as to give it the right by prescription, a person injured upon the track in the street cannot be regarded as a trespasser.

5. Even where the track of a railroad is on its private property, if it permits the public, including children, to habitually cross its track at a given point without objection, it is bound in the operation of its trains to exercise care with due regard to such probable use, and to the probable danger to persons so using the crossing.

6. While it is the duty of children to exercise ordinary care to avoid injury, ordinary care for them is that degree of care which children of the same age, of ordinary care and prudence, are accustomed to exercise under similar circumstances.

7. To permit a loaded railroad car to run down a grade alone on a track laid in a street, without the exercise of any care or attention to see that no children are in danger therefrom, constitutes negligence which renders the railroad company liable for the injury of a child too young to take care of itself, which was on the track without the fault or negligence of its parents.—(Smith vs. Pittsburgh & W. Ry. Co., 90 Fed. Rep., 783.)

PENNSYLVANIA.—Accident—Negligence—Evidence.

The questions of negligence and contributory negligence are for the jury; there being evidence that a boy on a street car intended and attempted to get off at a certain street crossing, but was prevented from doing so by the car not stopping long enough, and the evidence being conflicting as to whether he was jolted from the car, or fell off or jumped off; he having in some way got off and under the car between that and the next street.—(Moran vs. Versailles Traction Co., 41 Atl. Rep., 652.)

PENNSYLVANIA.—Trolley Cars—Excessive Speed—Evidence.

Verdict should be directed for defendant in an action against a street railway company by one whose horse was frightened by a trolley car, the negligence alleged being the excessive speed of the car, and his testimony that it was "not less than 15 miles an hour," being a mere guess, and his further testimony that not till the car was alongside the horse did it turn into the gutter, and that it then backed against the car, showing, as testified by defendant's witnesses, that the car was running slowly.—(Smith vs. Holmesburg T. & F. Elec. Ry. Co., 41 Atl. Rep., 479.)

PENNSYLVANIA.—Injury to Passenger—Negligence.

A street railway company is liable to a passenger who, without any contributory negligence, following the invitation and direction of the motorman, leaves the car from the front door, on a dark night, and where the ground was broken, and, after taking a few steps, catches her feet in some way, and falls.—(41 Atl. Rep., 743.)

TENNESSEE.—Injury to Employee—Vice Principal—Contributory Negligence—Assignment of Error.

1. Assignment of error that the verdict is "against the charge" is superfluous, there being one that it is against the evidence.

2. It is not negligence as matter of law for one working under a track foreman to attempt at command of the latter, to board a train, consisting of a flat car and trolley car, while going at the rate of 3 or 4 miles an hour.

3. A track foreman who is at the time running a trolley car and flat car attached, carrying tools and materials to a point on the road, and is controlling the cars, and is in charge of the motor as conductor, is a vice principal as regards his negligence in ordering one of the track hands to board the cars while in motion, or in failing to stop them while such employee is hanging onto the railing, which he caught hold of in his attempt to get on board.—(Chattanooga Elec. Ry. Co. vs. Lawson, 47 So. W. Rep., 489.)

Electric Railway Motor Patent Decision

The Thomson-Houston Electric Company and the General Electric Automobile Company have secured an injunction in the United States Circuit Court, Southern District of Ohio, restraining the Steel Motor Company and the Johnson Company from making or selling any combination of electric railway motors and motor circuits and resistances combined with controllers, like controllers covered by Claims 20, 21, 22, 27, 28 and 30 of Letters Patent No. 393,323. Claims 20 and 31 of this patent are as follows:

"20. The combination of a source of electric energy, the coils of one or more electric motors, a switch for connecting said coils in different ways to vary the motor resistance, one or more resistances, and a switch to put said resistances into or out of the motor-circuit without changing the motor-connections to vary the power of the current flowing through the motors.

"31. The combination of two motors, a source of electric power, a motor-circuit, a switch for coupling the coils of the motors in series or multiple to vary their internal resistance, a resistance, a

switch to insert the resistance when the motor-switch is being shifted, and a connection between said switches to operate both simultaneously."

Patent Decision in the Electric Railway Motor Suspension Case

The Sprague Electric Railway & Motor Company has been granted an injunction in the United States Circuit Court, Eastern District of New York, against the Nassau Electric Railroad Company, restraining that company from infringing Letters Patent No. 324,892, which was granted to Frank J. Sprague on Aug. 25, 1885, for improvements in electric railway motors. The claims of this patent, which the court holds were being infringed are Claims 2 and 6, and read as follows:

"2. The combination of a wheeled vehicle and an electro-dynamic motor mounted upon and propelling the same, the field magnet of said motor being sleeved upon an axle of the vehicle at one end, and supported by flexible connections from the body of the vehicle at the other end, substantially as set forth.

"6. The combination, with a wheeled vehicle, supported upon its axles by springs, of an electro-dynamic motor flexibly supported from such vehicle, and centered upon a driven-axle thereof, substantially as set forth."

This patent is owned by the General Electric Company, which controls the plaintiff company.

Commutator Bars of Tempered Copper

The tempering of copper has long been considered a lost art, but has been recently rediscovered, or, at least, a process has been devised for tempering copper and rendering it especially suitable for making solid castings for commutator bars. The secret of the process is known only to Theodore F. Frank, superintendent of the Mansfield Tempered Copper Company, Mansfield, Ohio, and this company has been engaged for the last four years in casting commutator bars of all descriptions and has now built up a trade which extends to all parts of this country and to foreign countries, shipments being made frequently to the Siemens & Halske Company, of Vienna, Austria. In the process of casting the pure copper is melted in retorts in about the same manner as is the custom in ordinary brass and copper furnaces, and when melted is treated by the secret process, and is poured quite hot into the molds. After being formed the bars are placed under a drop hammer, when they are ready for assembling, and are so accurate to size and gage that when assembled they form a perfect cylinder. The company enjoys the patronage of a large number of the manufacturers of generators and motors throughout this country and Europe, and makes patterns of special designs to suit its customers. It has now in stock patterns of more than 2500 different styles of commutator bars. These are kept in suitable cases and all the different types belonging to any electric company have a special compartment and are labeled with the name of the company. The company not only manufactures bars, but has recently engaged in the manufacture of assembled commutators for street railway motors. These are turned up and finished for any of the standard types of motors, all ready to be put in service.

In the manufacture of commutator bars the works consume about ten tons of copper per month, and the bars are made from all sizes from those so small that it requires thirty-five or more to the pound, up to single bars weighing from 5 lbs. to 6 lbs. each. In the manufacture of the large size bars the groove for the connections is cored out, which saves milling, and when so ordered, bars are cored without extra charge. The works have been enlarged two or three times since they were first established, and now fifteen molders are employed in making bars.

The patterns for these are duplicated and formed in nests of six or more, so that a number of bars are formed at one pouring. The equipment of the foundry is very complete, being up to date in every respect. The company not only manufactures commutator bars, but also makes brass castings of almost every description and babbitt journal bearings. The rapidly increasing trade of the concern is due to the fact that the products, especially the commutator bars, are superior in material and finish, being dense, entirely free from blow-holes, smooth and accurately finished.

Power for operating the drop hammers and emery wheels is derived from an electric motor of the card type, the current for operating the same being derived from the plant of the Card Motor Company, which adjoins that of the Tempered Copper Company.

The affairs of the company are operated under the direction of S. N. Ford, president, and S. Glen Vinson, secretary, while, as noted above, Theodore F. Frank superintends the work in the foundry. Mr. Frank has had twenty-five years' experience in general foundry business, and over ten years in the manufacture of tempered copper, so that he is well fitted for making castings of every description from copper or brass.

NEWS OF THE MONTH

Perhaps one of the most interesting features of the new passenger station of the New York, New Haven & Hartford Railroad at Boston, is the electrical switching apparatus for handling the 750 trains that pass through the station daily. To connect the station sidings with the main track, there are fifty-two single switches, thirty-five double slip switches and thirty-five movable frogs, and any one of these can be thrown by simply pressing a button in the switching tower.

It is stated that the syndicate headed by Alexander Brown & Sons of Baltimore, which has recently secured control of all the street railway properties of the city, has also purchased all the electric lighting companies of Baltimore.

It is expected that 60 miles of electric railway will soon be built in the island of Porto Rico by a Massachusetts concern, known as the International Construction & Power Company. This company will have a capital stock of $5,000,000, and a number of the incorporators are prominent Massachusetts citizens. Among the largest holders of stock in the new venture are the Hon. E. P. Shaw, State treasurer, and his two sons, E. P. Shaw, Jr., and James F. Shaw.

Part II. of the 1899 report of the Board of Railroad Commissioners of Massachusetts has just been issued. The report contains the returns of the street railway companies of that State for the year ending September 30, 1898, and from it the following statistics are taken. The figures for 1897 are also given herewith for the sake of comparison.

	1897.	1898.
Gross receipts	$15,898,839	$18,247,236
Operating expenses	10,904,040	11,692,731
Earnings from operation	4,994,799	6,554,505
Fixed charges	2,401,652	4,020,503
Net income	2,593,147	2,534,002
Dividends	1,965,243	2,076,233
Surplus	627,904	457,769

The annual report of the Board of Railroad Commissioners of New Hampshire, just received, gives the following interesting information regarding the street railways of the State: Total number of roads reporting, 10; total mileage, 93.7; capital stock, $1,222,000; funded debt, $756,000; earnings, $354,304; expenses, including taxes and interest, $330,092. None of the roads paid dividends.

The annual dinner of the Northwestern Alumni Association of the Massachusetts Institute of Technology, which took place on February 3, in Chicago, was made the occasion for a very interesting long distance telephone "occasion," by means of which the Technology Club in Boston, and the New York, Philadelphia, Washington and St. Louis Alumni Associations were put into connection with the Chicago association, so that verbal messages, brief addresses, speeches and the institute cheer were sent over the wires.

A bill has been introduced in the United States Senate providing for a three-cent fare over all the lines of the Capital Traction Company of Washington, D. C., within the hours of 6 and 9 A. M. and 4 and 7 P. M. The bill will be vigorously opposed.

In a recent communication, the Sprague Electric Company calls attention to the remarkable comparison between the cost of operating the South Side Elevated Railroad in November and December, 1897, when that road was operated by steam locomotives, and the same months for 1898, when the Sprague multiple unit system was employed. These months are stated to be the first months in which a comparison can, strictly speaking, be made be-

tween steam and electric operation. In considering the following figures, it should be remembered that each of the elevated railways of Chicago, which run around the Loop, is charged its pro rata proportion of the running expenses of the Loop, including cost of power, of station service, of repairs and of management, and, in addition, a rental charge of 10 per cent of the gross passenger receipts of the road is made. This latter charge is really applicable to interest on the Loop investment, and is not, properly speaking, an operating expense. The first column of the following table gives the ratio of expenses to earnings of the South Side road; the first includes the Loop rental, and the second column when the Loop rental charge is excluded, while the final column gives the actual net earnings in the months under comparison:

	Per Cent. Operating Expenses to Gross Receipts.		
	Including Loop Rental (a)	Excluding Loop Rental (b)	Net Earnings.
November, 1897, steam	87.3	77.7	$10,604
November, 1898, electric	57.3	47.7	39,449
December, 1897, steam	83.6	73.3	14,692
December, 1898, electric	55.0	45.4	45,356

It is stated that large orders for electrical machinery have recently been received by American manufacturers from Manila and the Philippine Islands.

The first arrest in Boston made for the violation of the new law prohibiting expectorating in street cars occurred recently. The arrest was made on the complaint of a conductor of the Boston Elevated Railway Company, who testified that the prisoner continually violated the law in spite of repeated warnings. The prisoner was fined $5.

Charles L. Bonney, vice-president and general counsel of the Chicago General Railway Company, has issued an open circular to the horse and dummy railway companies of Illinois, in which he pledges the support of his company to forty-five independent companies of Illinois to contest in the courts any law the legislature may enact reducing the fares of street railway companies to four or three cents. The circular calls attention to the Seaman decision in the Milwaukee Railway & Light case, in which the court held that a reduction of fares in Milwaukee would amount to confiscation.

The annual reports of the street railways of the District of Columbia for the year 1898 have been submitted to Congress. The reports in the main are satisfactory and show considerable increase over previous years. The receipts of the Capital Traction Company from passengers during the year ending December 31, 1898, were $932,171; receipts from other sources, $61,006; total receipts, $993,177. The total operating expenses of the system were $537,991, and dividends and fixed charges were $411,107, making the surplus for the year $44,079. This is considered to be a very good showing in view of the fact that a number of the company's lines were in process of conversion to the conduit electric system, and have only just been completed. The Metropolitan Railroad Company reports receipts from passengers as $822,439, and from other sources, $14,379, making a total of $836,819. The operating expenses were $471,358, making earnings from operation $365,461. The taxes were $38,566, interest $143,691, and dividends $74,921. The operating expenses include $46,776, which was expended for the construction of the Connecticut Avenue extension and for other improvements. The surplus for the year is $108,285. The Columbia Railway Company reports gross receipts as $171,397, operating expenses, $76,180; earnings from operation, $95,217; taxes, $7,386; interest, $30,000; dividends, $24,000; for real estate purchase, $2,800, and for construction of the Benning Division, $22,121. The surplus for the year was $8,909.

International News Notes

The Perth police commission, in dealing with the request of the Perth & District Tramway Company for permission to use electric traction and for an extension of time before the undertaking can be purchased under the tramways act, has consented to the use of electric traction, but refused to consider any extension of time.

Both at a meeting of ratepayers and of the District Council of Tipton has it been decided to oppose the bill whereby the South Staffordshire Tramways Company seeks to hand over the rights and working of the undertaking to the British Electric Traction Company. The Town Council of Walsall will also oppose.

At a special meeting of the Sunderland Town Council last month it was unanimously resolved to give notice requiring the tramways company to sell the undertaking, pursuant to the tramways act. Further, it was resolved to proceed with a bill to enable the Council to acquire, work, extend, or lease tramways in the borough or neighboring districts, to supply electric current, and extend existing power station.

St. Helens.—The electric supply and tramways committee of the St. Helens Corporation has been busily pushing forward the work of laying down and equipping the tram lines for electric traction. On the Prescot section the work has been stopped at Cropper's Hill for some time, owing to a request being made by the tramways committee that double lines should be laid in order to insure the safety of the cars on this hill. The committee has now resolved to lay double lines. In answer to the tramway company the committee has stated the order in which it will carry out the proposed extension of the tramways provided for by the local act of 1898. The extension to the Rams' Head, Haydock, will be carried out first, and this will be followed by the extensions to Nutgrove, St. Helens Junction, Derbyshire-hill, to the boundary of Prescot and to Windle City.

Nottingham is solving the difficulty of stopping tramcars by having notice labels "Cars stop here" hung up at stated intervals along the routes.

The Lowestoft Town Council has practically decided to permit the East Anglian Light Railway Company to construct a system of electric tramways in the borough. The proposed line will run from Gorleston to Kessingland. The company will take its current from the corporation, which is about to construct works. Powers are to be reserved that the Council may acquire the undertaking at the end of seven, fourteen, or twenty-one years. The company is also required to make various street widenings.

The question as to whether the Lincoln Town Council should take over the tramways when the company's powers terminate in 1902 was discussed at the February meeting of the Council. It was decided to let the question stand over for a while.

The recent expansion of the Leeds tramway system can be gathered from the following figures: When the corporation took over the business there were 22¼ miles of track, or 14 miles of route. Now there are 42 miles of track, or 23 miles of route. The number of cars has increased from 69 to 127, and 50 more will be added during the next six months.

The tramways committee of the Manchester corporation recently reaffirmed its recommendation in favor of the overhead trolley system as the best suited in every way to meet the requirements of the city and district.

Representatives of the governing bodies of Plymouth, Stonehouse and Devonport are still conferring, and are unable to come to a decision on what lines to purchase and work the tramways in the three towns. The company now working the lines offers to lease and work them if they are purchased. Stonehouse District Council proposes to purchase such portions of the lines as are within its boundary if the corporations of Plymouth and Devonport will undertake to lease the lines on certain terms, which, however, were unacceptable. Devonport will probably proceed to purchase its lines, but Plymouth is doubtful.

The Dundee Town Council has rejected the proposal for a cable tramway in the borough, but has recognized the need for traveling facilities in the district—the North End—by deciding to extend its own system on similar lines to those proposed by the cable company.

The Urban Council of Bexhill has given its consent to the British Electric Traction Company to lay tramways from Kewhurst to St. Leonards.

The Barking District Council has decided to apply to the Board of Trade for a provisional order to construct electrical tramways throughout the town. The estimated cost is £73,284, exclusive of buildings.

A movement is completed for a new electric line from Blackpool to Fleetwood, and should the proposed bridge across the Ribble at Lytham be sanctioned by Parliament, cars will be able to run from Morecambe through Heysham, Pilling, Blackpool, South Shore, St. Anne's and Lytham to Southport. There is already through communication between the four towns in the Fylde, and the new line will run along the coast from Knott End to Pilling, past Cockerham Sands to the Rabbit Hills, where it will bend north, cross the river Lune, and so to Heysham and Morecambe. It is expected to be a popular trip for visitors in the summer months.

Bury, Rochdale, Oldham and several smaller towns are combining to municipalize the train system of that section of Lancashire, and will take over the lines at the expiration of the existing leases in 1901 and 1902, and run the cars with the overhead trolley system.

The electric lines to Phœnix Park are finished and now opened for traffic. The horse cars have been withdrawn, and the section amalgamated with the Dollymount line.

Sir Francis Marindin, one of the Board of Trade inspectors, has announced as a result of his recent inquiry that the speed of the electric trams on the Dalkey & Kingstown section of the Dublin United Tramways Company may be increased to 10 miles an hour on wide roads.

As a result of its recent visit and inspection of the electric train system of Glasgow, the tramways committee of the Aberdeen Town Council has expressed a unanimous opinion in favor of the overhead trolley system. The borough surveyor and electrical engineer have been instructed to report as to the cost and method of carrying out the work of converting existing lines. Cars will be purchased similar to the double-decked cars in use in Glasgow.

Since the beginning of the year the "Birmingham Argus" has been conducting a crusade in favor of an improved train service for the great midland city. Nearly every town councillor has been interviewed, and the result is a wonderful unanimity of opinion in favor of municipalization. The public works committee has just issued a report upon the tramways question, which will be considered at a meeting of the City Council on the 7th of March. The document, which includes numerous tables, embodies a report of a subcommittee appointed to obtain information as to the working of tramways in other towns. This subcommittee addressed a series of questions to thirty of the principal towns of the United Kingdom. In those which have a population of 200,000 and upward, the corporations own and work the lines —Bradford, Glasgow, Leeds, Liverpool, Nottingham and Sheffield. At Edinburgh, Hull, Manchester, Newcastle-on-Tyne and Salford the corporations own the lines, but let them to companies to work. At Glasgow there was a net profit last year of £44,434. Liverpool horse trams, with experimental length of electric trolley, have a capital expenditure of £889,711, and there was a profit last year of £9,553. At Sheffield horse tramways are being converted into electric trolley. The capital expenditure has been £159,377, and last year's net profit was £15,183. There has lately, in the towns referred to, been no material alteration of system. As far as Birmingham is concerned, the question of traction does not immediately arise, and before it becomes necessary for the Council to come to a decision on the subject it is possible that new inventions and improvements will be available. Many corporations have constructed, or are about to construct, tramways on the overhead electric trolley system. In York the construction of underground electric conduit is being considerably extended. That additional tramway facilities are urgently needed in Birmingham can be gathered from the report on the vehicular traffic just presented to the watch committee. In 1896 there were 160 tram cars, 199 omnibuses and 535 cabs in the city; in 1898 there were 162 trams, 235 omnibuses and 700 cabs—an increase of 165 cabs and only two tram cars in the last two years.

In consequence of the purchase of the local tramway undertaking, the Derby Town Council has appointed a permanent tramway committee to take charge of the operation of the lines. It consists of the mayor and eleven members.

The Grimsby Corporation has pased plans for an electric lighting and power station. It will oppose the Grimsby Tram Company's bill in Parliament, as this bill gives the company power to generate its own electric power for traction, and the corporation wants to insist on the company obtaining power from its works.

At a recent meeting of the Edinburgh Town Council the lord provost stated that he had every reason to believe that the whole of the system would be opened by June 1.

J. Clifton Robinson, managing director of the Imperial Tramways, who own the Darlington tram system, has recently had an interview with the representatives of the Darlington Corporation, who desire an improved tram service. Mr. Robinson proposed to equip the Darlington lines on the overhead trolley system, and promised if the corporation would give a free hand and come to terms he would have electric cars running as in Middlesborough by Sept. 1. The matter is under consideration by the Town Council.

J. Shaw, electrical engineer, has been promoted to the managership of the electric tramways of the Isle of Man, in place of John Aldworth, who succeeded Mr. Baker at Nottingham.

A new line 4 miles long, running to Outlane, has just been completed by the Huddersfield Corporation, and has been passed by the Board of Trade inspector. The rails have been bonded, so that when electric traction is introduced the line will not have to be relaid.

The extension of the Halifax Corporation Electric Tramways from Commercial Street to Salterhebble has been completed.

The tramway committee of the Glasgow Corporation recently approved the recommendations of the general manager as to the conversion of the whole of the city tramways to electric traction. The route to follow the Springburn, High Street and Govanhill will be the line from Whitenich to Dalmarnock and London Roads. The route will be by Bridgeton Cross, and will put out of service about 800 horses now used on this line. About fifty-six motor cars will be wanted, and it is proposed to erect a car shed at Partick and Dalmarnock. The next extensions will be from Parkhead to Paisley Road, Maryhill to Mount Florida, Dennistown to Kelvinside, Woodlands Road line, and Possilpark to Govan. The corporation has decided upon a superannuation scheme for the employees in the tramway department. The scheme will be worked in connection with the Tramwaymen's Friendly Society, and the members are to contribute at the rate of 3d. per week for those whose wages are under 18s., and 6d. for those over that amount. For each member the tramways committee will pay 1d. a week, which will amount to £400 per annum. The superannuation will only come in force through temporary or permanent disablement, and the allowance is to be 10s. a week for members of fifteen years' standing, ranging up to 20s. for those who have been members of the society for twenty-five years.

The engineer of the Weston Super-Mare, Clevedon & Portishead Tramways Company has prepared the parliamentary estimates of the cost of constructing the proposed light railway extensions for which this company is seeking permission this session. The total length of these extensions will be about 6 miles, and the new line will run from the termination of the company's existing

road at Clevedon to the siding of the Great Western Railway at Portishead. The cost is put down at £20,250. The extensions will be constructed as single lines.

Sheffield.—The following tenders have been accepted: Cole, Marchant & Morley of Bradford, for two engines for the extensions at Kelham Tower Station, at the total sum of £6,796; John Brown & Co. of Sheffield, for four boilers, at the total sum of £6,250. The British Thomson-Houston Co., Ltd., for two tramway generators of 500 kw. capacity, for the total sum of £5,280 12s. 6d. An extended contract has been signed for the construction and erection of extensions to the power sation at Kelham Island, the city engineer estimating the cost at £10,000. The tramways committee is obtaining tenders for the thirty double-deck cars and the twenty single-deck cars authorized to be purchased. Slipper brakes and trailing wedge blocks are to be provided for all cars.

The prize awarded by the Institution of Electrical Engineers to H. F. Parshall for the best paper presented during the session of 1898, consisted of 25 guineas' worth of books suitably bound and inscribed by the institution.

Mr. Wiseman, C. E., of Birmingham, engineer to the promoters, explained a scheme for an electric light railway between Nuneaton, Chilvers Coton, Attleborough, Stockingford, Ansley, Hartshill and Whittleford to the local authorities of the district, which abounds in coal, clay, stone works and manufactories. A resolution that the scheme had the general approval of the authorities interested was carried.

The British Electric Traction Company is negotiating with the Bath corporation with a view to acquiring the right to lay down electric tramways, and has suggested that the current required might be supplied from the corporation power station. It is not unlikely that this proposal will be carried out.

The Ipswich corporation has decided to open negotiations for the purchase of the tramways in the borough. It will oppose the proposed bill of the company, applying for permission to sell the undertaking to the Drake & Gorham Electric Power & Traction Company, Ltd., which desires to introduce electric traction. The corporation has referred the matter to the parliamentary bill committee to negotiate for the purchase of the undertaking by agreement.

La Société Anonyme de Tramways, d'Eclairage et Entreprises Electriques en Hongrie is the title of a new company organized in Brussels to build electric railways and lighting stations in the western part of Hungary. The company has purchased the large central power station at Steingamanger, which supplies the electric lighting in that city and the power for operating the electric tramways there. It also owns the station at Sarvar, and owns a number of important concessions, including that for the tramways of Oedenburg. M. Lacomble, of Brussels, has been appointed electrical engineer of the company.

At a meeting of the Trambahn Gesellschaft of Metz, Ger., held January 7, it was voted to equip the line with electric power.

The Mannheimer Pferdebahn will be changed to electric power during the next two years, and the system considerably extended.

According to statistics published in the "Electro-Techn. Zeitschr.," the electric railways in Germany in operation on September, 1898, had a total length of track of 1939 km., covering 1429.55 km. of street. At that time there were electric railways in 68 cities. On the same date in 1897 there were electric railways in only 61 cities; in 1896, in 44 cities; in 1895, in 32 cities; in 1894, in 19 cities; in 1893, in 11 cities, and in 1892, in 5 cities. The total number of motor cars Sept. 1, 1898, was 3190, and trail cars 2828.

The Waterford (Eng.) Corporation is about to open negotiations for the construction of an electric tramway system within the town limits.

The electrical equipment of the Calcutta (India) Tramways is being prevented by the City Council, who have expressed an unwillingness to grant the necessary permission requested by the tramway company until the latter carries out certain repair work considered necessary by the council.

Part of the new electric railway system of Ghent, Belgium, has been put in operation, and the remainder of the system will be completed soon.

Three of the principal tramway lines in Naples, Italy, are being equipped with the trolley system. One of these, formerly operated by steam, has a length of 5651 m., a gage of 1.435 m., and a maximum grade of 6.8 per cent; the second has a length of about 3050 m. and a maximum grade of 7.9 per cent; and the third has a length of 5500 m. and a maximum grade of 7.2 per cent. The installation is being carried out by a Belgian company.

At the last meeting of the Dessauer Strassenbahn, Ger., it was voted to equip the line with electric power in place of the present gas motors.

The Metropolitan Tramway Company of Buenos Ayres, Argentina, has been authorized to change its system from animal to electric traction.

The Société Generale des Chemins de Fer Economique, the Empain Bank of Brussels, Belgium, and the Société des Tramways, have purchased for 10,000,000 francs the tramways in Salamanca, Spain, which formerly belonged to an English company.

M. Passedoit, representing Rigaud & Co., has petitioned the Municipal Council of Cahors for right to build an electric railway in that place.

The Whitefield (Eng.) Town Council has created a special committe to consider the erection of an electric lighting station and the construction of a tramway system.

A syndicate of capitalists propose to provide a complete system of electric tramways in Antwerp, Belgium. Arrangements have been made with the existing tramway companies to apply for one general concession for the whole of the lines. The same syndicate is aplying for a concession for a new line from the docks to the Gare du Sud.

The Grösser Berliner Strassenbahn, Berlin, Ger., is planning to equip a number of its important lines with electric power during the coming year.

The firm of Siemens & Halske has closed a contract to build an electrical line between Metschiapu and Pekin, China. It is hoped that the line will be ready for operation during the early part of 1899.

The Saxon Ministry of the Interior has granted the Elektricitätswerke and Strassenbahn Gesellschaft of Zurich, Switzerland, franchises for three new lines.

The Municipal Council of Carcassonne, France, is considering a proposition from the tramway company of that city to equip the lines with electricity.

It is reported that the Brussels Cômpagnie Mutuelle des Tramways will secure control of all the tramway companies of Antwerp and will introduce electric traction on the 42 km. of tramway track in that city.

The municipal council of Bordeaux, France, has granted the petition of the Tramway and Omnibus Company of that city to equip the tramway lines with electricity.

The Oberschlesischer Strassenbahn Gesellschaft, of Upper Silesia, Ger., which is equipped with electric power, is proposing to make a number of extensions.

M. Robi, manager of the Société des Tramways de Tiflis, Caucasia, has recently obtained permission from the authorities for the equipment of the line with electricity.

The Westinghouse Electric & Manufacturing Company has been awarded a contract for the electrical equipment of fourteen cars for use in the city of Cairo, Egypt.

Storage Batteries and Railway Power Stations *

BY ROBERT MC A. LLOYD.

The difficulty confronting us is that very few operators of railway power stations have any data showing what they are doing. Electric light managers seem to take more interest in the output of their stations, and in many cases maintain a system of records of work done, but the manager of a trolley road is usually contented with superficial observations of the switchboard and the comforting fact that the cars are running.

We always find these managers greatly surprised when the actual state of affairs is shown to them on paper, and I believe that this institute would be astonished at the results of a thorough research into the load curves of the railway plants of the entire country. You are, of course, prepared for the statement that the average load on a railway power station for a given period is much less than the maximum load occurring during that period and much more than the minimum, but it is not generally understood that the maximum load for the same period is apt to be far below the capacity of the generating plant in operation. As an illustration of this fact I show some data on a typical railway plant when thirty-five cars were running. We have not discovered any railway plant where this is not true and I believe that the data on most of the railway plants of this country will confirm my statement. The first explanation of this would be that such a surplus capacity is necessary for reserve to meet emergencies, but I do not find it to be a useful reserve, and shall refer particularly to the diagram, taking this station because, from the standpoint of the manager, engineers and attendants, it is dangerously overloaded and has no reserve. In fact it was necessary to add to the capacity at once to make it safely operative. (See diagram on next page.)

I obtained these data on the day of heaviest travel in the whole year. It will be noticed that the highest point reached was within the capacity of the main station, and yet it was necessary to start up an auxiliary station. The central solid line shows the average load, and the upper and lower lines show the limits of the fluctuations occurring from moment to moment. The method pursued in getting these curves was to divide the day into half hours, and during the first five minutes of each half hour take the highest and lowest ammeter reading in each minute; these readings are plotted in the upper and lower curves; also to take ammeter readings every five seconds and obtain the average of these readings as the point in the curve of averages. Another convenient method of obtaining the curve of averages is by wattmeter readings. Among some of the interesting features in this diagram may be noticed the fact that the nominal capacity of the generating apparatus was about 400 kw. in excess of its maximum output occurring at about 8 o'clock in the evening, and that the average output at this time was about two-thirds of the maximum. The excess of nominal capacity was not so great at 7 o'clock in the morning, or 2 in the afternoon when other high points occurred, but as it was known that the morning peak would be of short duration the engineer decided to run through it without the auxiliary station, and in the afternoon the load increased more rapidly than was expected, and the auxiliary was not ready to go into operation on short notice, consequently obliging the main station to groan under a dangerous load for an hour or so.

It will doubtless occur to some that this station apparatus has been overrated, or that the engineer was incapable or over cautious, but the fact remains that similar data are obtained in very many stations, and that in many cases the apparatus has been subjected to satisfactory tests before acceptance by the purchasers. It may be possible to build engines which regulate at all conditions of load and at the same time use steam satisfactorily at maximum load, but I do not find such engines commonly in use. Further than this there are many very good engines in use which cannot be safely operated at anything like maximum load if that load is liable to sudden variations. I realize that you may suggest all sorts of schemes for getting a better output from the plant illustrated by this curve, and you may wish to ask some questions about this apparatus, but experience convinces me that the men who are most likely to be consulted about such a station will recommend more generating plant, and the truth is that there are so many good salesmen pushing engines and dynamos that station managers frequently fail to get full duty from the machinery which they are operating already. It is not merely that the storage battery has been neglected, but any of us can see in railway power houses throughout the country, where the managers have been persuaded to increase their generating plant when attention to a few details such as steam piping would have brought their output up to requirements. Assuming, however, a station equipped with the best obtainable apparatus, and operated under the most advanced laws of station practice, in the absence of a storage battery, there would still be much more apparatus running than would appear necessary from the load diagrams.

The generator salesman says in reply to this proposition that his apparatus is cheap and that it is good to have plenty of it, but one generally finds that where there is plenty of apparatus available the engineer is tempted to keep too much of it running, and therefore running at low efficiency.

Of course railway power stations have individual characteristics, and it will not do to assume that they all need storage batteries, but there are certain features of railway power requirement which are common to the problem everywhere, and which invite consideration for the storage battery.

The curve characteristics of electric light supply are well known, and much information about electric lighting has been brought out in the committee reports of the National Electric Light Association for 1896 and 1897 and by Mr. Hammond in his paper before the British Institution of Electrical Engineers in March, 1898, but the possibilities are more varied in railway work, and, as far as I know, there has yet been no systematic research into the economy of railway power stations, the only published data on the subject being contained in the paper read before the Street Railway Convention at Boston last September by R. W. Conant.*

In my endeavor to point out some of the uses for a storage battery I shall take as a typical station that shown in the diagram. It is located in a Pennsylvania town of 50,000 inhabitants. The railways radiate from the center of the town to distances of 3 to 9 miles. There are six branches and the power station is located 2 miles out on the longest branch. It has railroad and water frontage. The small auxiliary power house is the result of a recent consolidation and is close to the main house. There are three distinct ways of using a storage battery with this power plant. Taking up the figure we find first the great fluctuation between night and day load; second by the fluctuations occurring from hour to hour; and lastly the superimposed fluctuations occurring from moment to moment. We shall call a battery of sufficient capacity to level off the night and day fluctuations "large;" a battery for leveling the hour-to-hour fluctuations "medium," and a battery to level the momentary fluctuations "small." It will be seen at a glance that the small battery will reduce the requirements of the generating plant to a capacity sufficient to meet the demands of the average load shown in curve A. The battery must be able to discharge at 650 amps. for momentary periods, but its capacity in amp. hours is unimportant. It will cost less in generating capacity for the same work, and a large part of the excess of capacity over requirements shown in the diagram will be saved. It will save some depreciation on the generating apparatus, and its own depreciation will not cost more than the depreciation of generating apparatus of similar capacity. It will have sufficient storage capacity to run a few night cars and lights when the engines are shut down. If located at a point nearer the center of feeder distribution than the location of the generating station, a saving in copper will be effected. Inasmuch as the investment will not be increased by including such a battery in this railway outfit all the saving in fuel due to a steadier load and the operation of less generating machinery will be clear gain to the credit of the battery.

Line B, at 810 amps., shows the average load for 18 hours of the day, and a "medium" battery to reduce the load to this straight line would have a capacity of 1300 amp. hours. It will cost about twice as much as a "small" battery, but will not add enough to the cost of the installation to bring the investment up to the total now in generating apparatus alone and presumably necessary if no battery is used. This battery will have all the advantages of the small plant with wider limits of operation. The station circuit breakers may be set 650 amps. higher, and there will be greater convenience throughout the station in operating at a fixed load. There will be a marked effect on the efficiency of all departments of the station, and all the apparatus will yield a higher output in proportion to investment and cost of operation.

Line C, at 650 amps., shows the average load for 24 hours and a "large" battery capable of leveling off this load will have a capacity of 3000 amp. hours. It will cost approximately twice as much as the "medium" battery and will have all of its advantages. It will cost as much as the generating machinery displaced by it. It will add largely to the flexibility of the station. This battery could be discharged momentarily at 3000 amps., which will put the circuit breaker limit of the station at about 3600 amps. instead of 2300 with all the present apparatus. It may be discharged at 1500 amps. for one hour, which will be sufficient to cover load peaks that would stall the 1150 kw. generating plant completely.

In cases of extreme necessity the entire system might be carried

* Paper read before the American Institute of Electrical Engineers, Feb. 15, 1899.

* See STREET RAILWAY JOURNAL for October, 1898.

by this battery for several hours. The ability to carry sharp peaks is a distinct addition to the earning power of the system. Such peaks often signify the collection of fares which would be lost if the system were not flexible, and some managers keep up enough station capacity to carry a few holiday crowds while for 99 per cent of the whole year it is earning nothing. Other managers do not attempt to carry special crowds. The large battery will give the manager an opportunity to get all the money that can be made out of such business without feeling that he has made any investment for the purpose. Of course the capacity of the system is limited also by the investment in copper, but in many cases the battery may be located so as to facilitate the distribution of power.

There is no reason why a railway power station of this capacity running night and day at a constant load should not attain a fuel economy as high as that of the well-known Chestnut Hill pumping station at Boston, which would be equivalent in electrical work to 557 watt hours per pound of coal. Curve A shows for one day's work 7,800,000 watt hours which required at the above rate 7 tons of coal, and assuming that the battery would only have 75 per cent efficiency, and that 25 per cent of the entire day's work would go through the battery, ½ ton of coal would be added to this consumption, making 7½ tons of coal per day for this plant, running with a large battery.

The battery efficiency in such service as this has been found in most cases much higher than 75 per cent, and in some cases over 90 per cent, so my estimate is clearly on the safe side.

Table I.—Comparison of First Cost.

	Lay Out With	Cost of Generating Apparatus.	Cost of Storage Battery.	Total Cost of Station Plant.	Cost of Coal per Day.	Cost of Coal per Annum.	Saving in Coal.	Saving in Coal and Saving in Int. 5 p. c.
		$	$	$	$	$	$	$
1	No battery	115,000	------	115,000	30	10,950	----	----
1	Small battery.	60,000	20,000	80,000	25	9,125	1,825	3,575
3	Medium "	50,000	35,000	85,000	20	7,300	3,650	5,150
4	Large "	40,000	70,000	110,000	15	5,475	5,475	5,525

Table II.—Comparison of Operating Expenses.

	Cost of Real Estate and Buildings.	Repairs and Depreciation.	Saving in Labor per Annum.	Saving in Water, Oil, Waste, etc.	Total Saving.	Estimated Addition to Receipts.	Net Advantage in Operation.
			$	$	$	$	$
3	All the Same.	All the Same.	----	100	3,675	----	3,675
4			----	200	5,350	1,000	6,350
1			1,200	300	7,025	5,000	12,025
2							

save anything in the cost of operating the road, but that they could not run without it, and I take the liberty of making the following

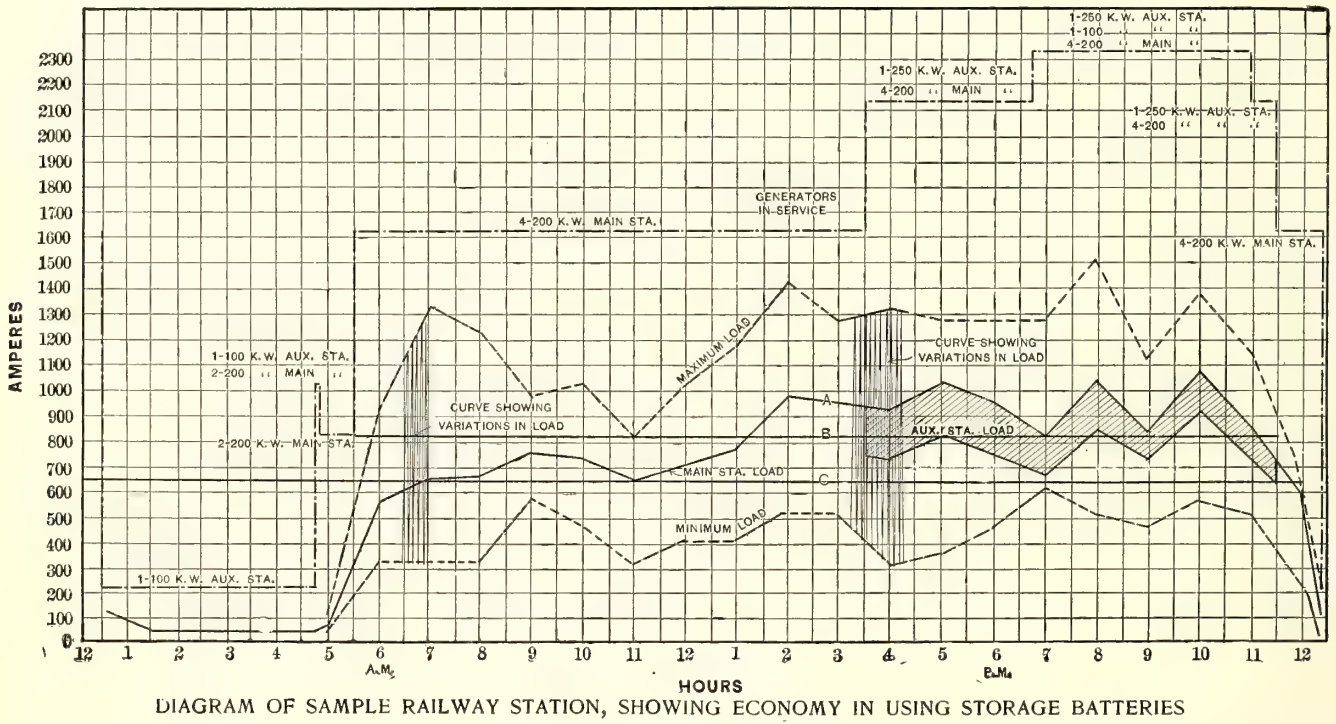


DIAGRAM OF SAMPLE RAILWAY STATION, SHOWING ECONOMY IN USING STORAGE BATTERIES

On the day when these data were obtained 15 tons of coal were burned, or twice as much as would be necessary with the battery outfit. The battery would, therefore, save at $2 a ton, $5,474 per annum in coal alone.

The number of men in the station is now the same night and day, and there would certainly be no increase in the labor item, whereas it is probable that one man on each shift might be dispensed with if the plant were reduced by the battery, in which case there would be another saving of $1,200 per annum. The battery would also save water, oil, waste, etc., and there would be minor advantages such as more constant potential on the line; less annoyance from circuit breakers; no fear of sudden demands on the generating apparatus and the disagreeable possibilities incident thereto.

In the following table some figures are tabulated for the purpose of comparing four different layouts to meet the requirements of the railway system referred to in the diagram:

I have assumed $100 per kw. as the cost of complete station apparatus without batteries. This figure might have seemed high a year ago, but in view of the rising prices of such material I think it is only conservative.

In regard to the "small" battery, there is no doubt of its advantages in many cases, but for new installations it is not always the most economical battery. I understand that Leslie Carter, the president of the South Side Elevated Railroad Company in Chicago, said recently, that, as far as he knew, their battery did not extract from his annual report to the stockholders, which has since been published:

While the amount of current used per car-mile is low, and has produced gratifying results in all tests and comparisons made, the fluctuations of power above the average requirements are large, and the sudden demands on the power-house compelled us to prepare promptly for the heavier business of the winter, which, with increased number of cars in service, heat, and light loads, would have been beyond the capacity of the power-house. Additional Twelfth and Sixty-first Streets, respectively. These batteries have greatly re-engine capacity could not be obtained in the time at our disposal, would have cost more money, and have been expensive to operate. We accordingly installed two batteries of 750-kw. each, equidistant from the power-house, at duced the fluctuations and the maximum load at the power-house. While the output at the power-house is the same, the batteries charge at times of light traffic and discharge at times of heavy traffic, thus equalizing the work at the power-house, and relieving the engines and generators. This is certainly an economy, and it is further claimed, with what correctness I am not yet convinced, that they cheapen the cost of production. But I do know that they keep up the voltage at the ends of the line, enable your road to operate more cars, furnish increased facilities to patrons, and prevent damage to power-house machinery in case of sudden demand for increased power.

That battery was, of course, put in for regulating purposes only, and the load curves give an impression that the battery must certainly be useful. It seems to me hardly worth while in laying out a new station to put in a battery for the purpose of reducing the railway power curve to the characteristics of electric light practice, when by going a few steps further it may be refined to a practice comparable with marine engineering.

It might appear at first thought that a battery of sufficient capacity to insure a full load for the generating units at all times, would save as much fuel as a battery large enough to level off the 24-

hour service, but it is very difficult to follow the power requirements from hour to hour in such a way as to make ideal use of a battery, whereas with a "large" battery it would be possible for the ordinary station engineer to adjust his load so as to operate all of his apparatus to the best advantage all the time.

I have carefully analysed the figures in Mr. Conant's very interesting paper above referred to, and am compelled to differ from him at some points, and refer to them in order to meet in advance any criticism of my paper which may be based on his tables. In the first place he assumes that his standard station can be worked all the year round with a load factor of 33 1/3 per cent, which is entirely too high; 20 per cent or 25 per cent would be more normal. I suspect that Mr. Conant's load factors have been obtained by indicator cards instead of wattmeters. In Mr. Conant's table none of the stations shows a better figure for coal than 3 lbs. per kw. hour, while his standard station is put down for 2.2 lbs., without any intimation of the process for attaining such a good result. The question as to how the cost for repairs and depreciation of the entire plant would be affected by a large battery is particularly debatable ground. Mr. Conant allows 2 per cent for depreciation beyond the normal running repairs. He estimates the entire plant, including buildings, to last 50 years. His statement that the machinery now being installed will last much longer than that with which we have been familiar in the last decade has nothing to back it up except faith in the promises of the builders.

I propose to allow 10 per cent per annum for repairs and depreciation, on the entire station apparatus, including batteries. I have not seen any boilers that are likely to last 50 years, and there is plenty of evidence that all the best engines and boilers in this class of service to-day will go to pieces in a life of from 10 to 20 years. The particularly hard usage to which most of them are subject is not only steadily wearing them out, but producing a state of constant danger and not infrequent accidents. I am sure this is becoming well understood among railway men, and some of the best managers are writing off to depreciation 10 per cent per annum. Moreover, who can say that improvements will not be made in the next 10 years as in the past, and that engines and boilers may be out of date before they are used up.

It is, of course, well known that whatever the rate of depreciation may be without batteries, it will be lowered by giving the generating apparatus a constant load; my belief is, therefore, that the storage battery will not increase the rate of depreciation for the entire plant. If it can be shown that interest and depreciation for a plant of given load dimensions are practically equal with or without a large battery, it is evident that the great saving in fuel alone will determine the superiority of the battery system.

I have so far considered the battery only at the central generating station so that all the advantages due to locating it at proper points in the distribution system are additional arguments in its favor. In many cases the saving in copper may be greater than the sum invested in the battery, and the flexibility of the system improved in places where it would not pay to install sufficient copper to meet the irregular demands of travel.

The reserve qualities of the storage battery are unique. It might be supposed that a mere reservoir which is quickly drained would be of little value compared to a lot of extra generating apparatus standing idle, but experience is demonstrating every day in existing plants that the reserve which is needed most is the reserve which is not only ready for emergencies, but actually alive to any demand without the direction of a human mind.

Most of what has been said of the storage battery as applied to the power station illustrated by the curves is true of its application to railway power stations in general. The use of water power introduces a factor in the problem more variable than fuel, and I shall not attempt the discussion of it. Alternating currents lend themselves readily to the development of storage battery applications on account of the mutually helpful combination of battery and rotary at sub-stations. Up to the present time, each of the large batteries installed for railway work has been obliged to meet different conditions and requirements, but they are all serving their respective purposes well and showing many different fields of usefulness. I shall not refer to these plants, because Mr. Appleton in a recent lecture to the New York Electrical Society has ably described those of most importance.*

Most of us feel that the electric railway and electric lighting interests are destined to get into closer relations, and the generating station of the future may be required to furnish all the electricity used within large areas for every purpose.

Coming finally to a problem which has been the subject of some newspaper discussion of late, I trust you will pardon me for treating of work with which I have no connection. Electricity has so many advantages over any other medium for transmission and storage of energy that I assume its use to be firmly established and cannot conceive of any lasting rivalry by the other contestants now in the same fields. Further than this, without saying anything for or against monopolies, I believe that all the energy supplied by means of electric currents to consumers of every nature in the greater New York should radiate from two or three central stations, and that these should be electrically tied together. The sub-stations would naturally consist of rotaries and storage batteries. It may not be possible to lay out each sub-station so that the rotaries would run at a constant load for 24 hours a day, but it seems to me quite probable that such an arrangement would eventually be reached, and this would, of course, give the generating stations a constant load.

At the present time the load curves of the electric railways are very uncertain, and peaks are likely to occur at almost any time of day, while the addition of the peak due to electric lighting in the early evening would not add in large proportions to the railway peak, but electric lighting is capable of more general application and it is possible that within a few years the distribution in the Borough of Manhattan may reach from 300,000 to 500,000 kw. at the highest part of the lighting curve, which will probably be as great as the railway load when the elevated railway and the underground rapid transit are included. These peaks will often occur at the same time of day, and so there is no possibility of improving the load factor of either system by splicing the two together. It follows, therefore, that what is true of the relation of a storage battery to the economy of the generating station for power or light separately will be true of the resultant of their combination.

The railway and light people recognize the importance of leveling up some portions of their load curves, but I estimate that the greatest saving is to be obtained by operating for a constant load twenty-four hours per day. However high would be the economy of such large stations I am sure it would be higher with large batteries than without. Certainly the economy of the Boston pumping station as to fuel consumption should be surpassed. It must not be assumed that a high load factor for the system is an advantage. It is all right for the generating plant and for the copper feeders, but the kw. hours that bring in the most money may spoil the looks of the load diagrams and kill the load factor. What is required to earn dividends is a *profitable* load factor outside of the stations, whether high or low, and the highest possible load factor at the dynamo terminals. The large storage battery meets these two requirements perfectly. A load factor of 100 per cent may be maintained at the dynamo, and current may be sold to the consummer regardless of the time of day.

With 1,000,000 kw. in view for the Borough of Manhattan it would be necessary to generate an approximately constant force of 300,000 kw. A million kw. in station plant without the battery factor would cost $100,000,000. The same capacity, including the proportion of battery now deemed advantageous by some of the engineers in touch with these problems, would be divided as to cost into $70,000,000 of generating plant and $30,000,000 of battery plant. Finally the same capacity, if divided in the same proportions which seem to me most productive for the investment, would cost $30,000,000 in generating plant and $70,000,000 in battery. This is quite a large battery plant, and as there would be more than two parts battery to one part generator, I am fearful of the jealousy which such a reversal of engineering practice would create.

In conclusion I wish to state that nothing in this paper should be regarded as emanating officially or unofficially from the company with which I am connected.

* See STREET RAILWAY JOURNAL, February, 1899.

Completion of St. Anthony Falls Transmission Plan

The equipment of the power house at the lower dam of the Falls of St. Anthony at Minneapolis, Minn., is about to be completed, and the necessary arrangements have been made by the St. Anthony Falls Power Company with the General Electric Company, which manufactured and installed the plant now in operation.

The hydraulic work and the power house, which were described in the STREET RAILWAY JOURNAL for May, 1898, were finished in the spring of 1898, and five three-phase alternators of 700 kw. each and two direct-current generators of the same capacity, with the necessary rotary converters and static transformers, were installed. The full equipment of this power plant, as originally laid down, contemplated the use of eight alternators and two direct-current machines of the total capacity of 10,000 h.p.

The additional equipment will consist of three 700-kw. three-phase revolving armature alternators, with rotary converter, step-up and step-down air blast transformers, and switchboards for the generators and converter. The installation of this machinery will raise the generating capacity to the 10,000 h.p. originally contemplated.

Some General Observations on Electric Traction*

BY H. F. PARSHALL

It is a natural thing for engineers to reason from experience with electric lighting plants as to how best to design plants for electric traction purposes. Such reasoning, however, is likely to be defective and lead to wrong results. A primary difference between electric lighting and electric traction, so far as the station is concerned, relates to the difference in the nature of the load—one being approximately constant from moment to moment, and the other varying between wide limits, and at such a rate that many engineers liken the strains upon traction apparatus to those upon rolling-mill engines. Another difference of great importance is, that in a plant of a given nominal horse power from three to five times the quantity of electricity would be generated for traction as for lighting purposes; consequently a greater capital investment, greater refinement in the machinery, and greater margins in the individual machines, or in the number of spare machines, are commercially permissible in the case of electric traction. In general, lighting machinery is called upon to work at full load for a few hours in the day, whereas traction machinery is generally called upon to work at approximately full load for many hours in the day.

The steam generating plant for either lighting or traction of the same capacity need not differ in character to be equally efficient. Having reference, however, to the better load factor of the traction plant, and consequently a greater consumption of coal and a lesser ratio of cost of labor to that of material, better arrangements as to coal handling machinery and coal storage are justified. More elaborate arrangements of steam piping are also justified, since the loss due to condensation in steam pipes is determined by the number of hours the pipes are under pressure, rather than by the quantity of steam carried by them.

Steam engines have been the subject of frequent discussions. It has been a much debated point as to whether or not an engine should have a heavy fly-wheel. This question resolves itself into the most economical way, average loads considered, of getting the maximum effort from the steam engine to take care of the temporary overloading incident to traction work. The dimensions of the cylinders of engines for good economy are determined with reference to average loads. For best economy then at good regulation, heavy fly-wheels are necessary to assist during overloads in traction work. The question of governing has also been frequently discussed. I do not understand why this should be, since nobody is of the opinion that an engine that governs closely is at a disadvantage. Such engines do not cost appreciably more, and are now generally manufactured. In reading such discussions I have frequently wondered why the electrical conditions met in parallel running have not been taken into consideration. The necessity of close regulation of steam engines was first demonstrated in the case of generators running in parallel, where the load did not properly divide with rapidly varying loads unless the engines governed with fair accuracy.

Another matter frequently discussed is that in respect to the speed of engines. Here, also, the electrician is entitled to some voice, since experience has clearly demonstrated that each size of dynamo has a range of speed through which its performance either as to efficiency, regulation, or sparking, is best, and dynamos built outside of this range of speed are made at the expense of efficiency, regulation, or commutation.

The speed of the 1500-kw. dynamos which I designed some years ago was limited to 75 r.p.m.. Experience since then has not demonstrated the advisability of increasing the speed beyond this figure for this size of machine. My own experience justifies the statement that the mechanical and electrical conditions, in the case of the larger direct connected generators, generally coincide in the matter of speed.

The system of transmitting mains for distribution, on account of the better load factor in traction installations should be designed, for most economical working, with a greater cross section than in the case of lighting, with its smaller load factor. This is obvious from Lord Kelvin's law, in which the interest that goes on perpetually is balanced against the cost of the energy wasted in the mains. Clearly, then, as the cost of energy does not vary in the simple ratio of load factor, if mains *are* to be utilized three or four times as many hours in the year at rated capacity in one case as in another, a large cross section cable is required, if the cost of wasted energy is to balance the interest account.

Apart from the proper designing of a given system of transmission and distribution, there remains the broad question as to what will be the nature of the transmission, that is, whether continuous currents shall be used, or whether the distribution shall be multiphase with substations. The solution is to be determined in respect to the amount of power and the distance to which it is to be transmitted, and in particular cases to the conditions of distribution. Thus, where a very small voltage drop is permissible in the consumer's circuits, as in the case of earth returns, multiphase transmission, with frequent substations, becomes a necessity, where under less restricted conditions continuous current transmission would be more economical.

For comparison between continuous current high tension transmission and multiphase transmission, see Proceedings Institution Civil Engineers, Vol. CXXXIII, Paper No. 3090. It appears from this that the distance at which multiphase currents become efficient as compared with continuous currents is somewhat less at 500 volts than has been frequently thought.

The fixed losses in a multiphase system for the distribution of power for traction work are determined largely by the maximum momentary load which may come upon the substations. When the ratio of the average to the maximum temporary load is comparatively large, the distance at which continuous currents become more efficient than multiphase currents is increased. In very large traction installations in which the ratio of the average to the maximum approaches unity for average working, the distance beyond which high tension currents are more advantageous is lessened. What method of transmission will be most efficient in a particular case cannot be determined without knowledge as to the nature of the load. In the Dublin installation which I have recently designed for 250 cars, the power station is approximately in the center of the system. The average distance of transmission is about 2½ miles. I have used 500 volts continuous current with so-called "boosting machines," taking the current out of the rails at certain points, so as to restrict the maximum drop in the earth to 2 or 3 volts. For two lines extending some 8 miles from the power station I have, at a distance of about 6 miles, planned to install a rotatry converter station. The multiphase load, however, being such a small fraction of the whole, I have not installed multiphase generating machines in the station, but have used a special design of rotary converter, run from the main machines. Such rotaries have to be very specially designed, since, in the case of the current becoming displaced in phase, they are apt to race dangerously. This is a particular case, designed after determining the average current consumption in any part of the system, when the ratio between the average and the maximum is approximately known from experience, so as to impose the minimum fixed losses, or, in other words, to insure under average conditions maximum efficiency. Were the number of cars doubled I would locate substations approximately at the feeding in points and would use multiphase transmission.

An advantage in the use of rotary converter stations is that at constant speeds such machines will give constant voltage, regardless of the load or the drop in the lines (provided this be limited to an economical amount), or the regulation in the transformers, so that such machines can be made to supply simultaneously and satisfactorily both traction and lighting installations. To justify this statement I instance tests recently made on some 900-kw. rotary converters, from which full load could be thrown on or off from one to the other machine without any perceptible variation of the continuous current voltage.

In the designing of a multiphase system selection has to be made between quarter and three-phase. The three-phase system has the important advantage that but three-quarters of the weight of copper is required as with either single or quarter-phase transmission. Considered, therefore, with the energy factor common in multiphase working, the three-phase system gives better transmission efficiency with the same section of copper in the average case as continuous current.

Another advantage is gained when the transformers are delta connected. Any one of the three can fail, and the other two will deliver triphase currents to the rotaries. There is practically no difference as to efficiency or working between the rotary converters in the two cases. In installations making general use of rotary converters feeding into a network at constant voltage it is necessary to observe some care in selecting the high tension mains, and in securing engines with approximately constant angular velocity. An engine, to be entirely satisfactory, should not produce by variable velocity a phase displacement of more than 5 degrees per half cycle from that of constant velocity. The transmitting mains should be designed with comparatively small drop, so that the rotary converters work properly in parallel in different stations, and so that the rotary converters can generate constant voltage with a varying load without too great phase displacement. If proper precautions are not taken in these matters rotary converters will not operate satisfactorily in parallel, and are likely to give a great amount of trouble from sparking and irregular variation of voltage.

* Paper read before the Northern Society of Engineers Jan. 24, 1899.

For working with rotaries I would also point out the necessity of arranging the mains so that the current in each phase is delivered approximately at the same voltage. I have recently been conducting some tests on rotaries, working on triple concentric mains, and the results were far from satisfactory until a phase equalizing arrangement was used. At first the current in the different phases varied by about 10 per cent, and the rotaries worked unsatisfactorily; when, however, the e.m.fs. were equalized the rotaries worked with entire satisfaction. The conclusion to be drawn from this for three-phase working is that the cables should have equal inductance, equal capacity and equal resistance in each circuit.

In installations which I have designed I have used cables drawn in conduits and with manholes approximately 150 yards apart, so that the cables can be readily replaced or supplemented to meet the demands of the service. Armored cables laid in a common trench are objectionable, in that the burning out of one is quite likely to destroy its neighbor.

By far the most difficult problem to solve at the present moment in large multiphase stations is in conection with the switching apparatus. Circuit breakers have been devised for continuous currents that will open at any current to be met with in practice. In the case of alternating currents the same progress has not been made. I recently examined the plans of a 70,000-h.p. station, and could not but feel that the success of the whole installation was dependent upon the switching arrangements.

In this discussion I have assumed that the distribution in a traction system would be by continuous currents. I have seen nothing that would lead me to believe that any other course will come into general use.

The next point for consideration is as to what form of apparatus should be used for conducting the electricity from the distributing mains to the car; whether it should be the single-wire, overhead trolley system with earth return, the two-wire system with return overhead, or with this last connected up as a three-wire system, with the middle pair of trolley wires acting as a neutral, or whether a conduit system should be used. The valid objection to the single overhead trolley system, neglecting the æsthetic one, is in the use of the earth as a return circuit. Troubles from electrolysis have been frequent in the United States where the e.m.f. drop in the earth return is not limited by legislation. Owing to the stringent regulations of the Board of Trade little trouble has yet been experienced in England or on the continent, where similar regulations are in force. I pointed out in a paper which I read before the Institution of Electrical Engineers,* that with even very little e.m.fs. a certain percentage of the current in all cases leaves the rails. With amounts of copper commercially permissible, either substations at frequent intervals, or boosting machines, such as have already been described by Major Cardew and myself at the Institution of Electrical Engineers, are necessary to bring the e.m.f. drop down to two or three volts, which in most cases of municipal working is the safe limit. If the e.m.f. exceeds this limit trouble from electrolysis would probably occur at some date more or less remote, according to the local conditions as to the location of the earth return in respect to the gas and water pipes and the nature of the soil.

The double overhead trolley system eliminates the possibility of trouble from electrolysis. In the case, however, of most cities where numerous lines converge at certain points, the double overhead construction would be complicated and objectionable in appearance. The same applies to the double overhead three-wire system. This last system has great advantages, however, and when used in connection with rotary converters, which act both as converters and equalizers, it is possible to operate tramways over very long distances from the generating stations. It happens in such cases that the three-wire overhead system is rarely objectionable, since overhead networks are not necessary to meet the traction conditions in outlying districts.

The conduit system has been used in various American and continental cities with a considerable degree of success. The advantage is that it can be a doubly-insulated system, avoiding danger from electrolysis, and that there are no overhead wires. An additional rail at the side, or pair of rails between the tracks, along the slot, has to be set off against the overhead wires on making comparison between the two systems as to appearance in the street.

In general, city corporations are in a better position to install conduit systems than private companies, since the city corporations can borrow money at low rates of interest and have not so great amortization to consider. Further, city corporations frequently having the control of gas and water pipes, can arrange matters so that the conduits can be put in at a less first cost. In some cities I believe the installation of conduits under a dual management would be impracticable, since the conduits would interfere with the gas and water pipes to such an extent that the conduits could not be installed except by such general rearrangement that local arrangements could not be made. Undoubtedly, in the case of heavy storms the conduit system is more troublesome than the overhead system. I had some examples of this in my recent visit to the United States. In New York it has been found necessary to employ an elaborate system of double-throw switches, so that if a part of the positive side of the system goes to earth it can be put on the negative side, and the negative on the positive side.

In conclusion, I would point out that the mistake most frequently made has been in underestimating the amount of power that may ultimately be required in a traction system. Both the size and type of machinery in a generating station should be determined in respect to the maximum output of the station. Having regard to the present regulations of the Board of Trade and to economy in transmission and distribution, the limit for a 500-volt continuous current station is usually reached at 5000 kw. output. Beyond this a multiphase system of transmission, with rotary transformers for continuous current distribution, becomes necessary for most economical working, since experience has fully demonstrated the greater economy of working from a single central power station. The "universal" station is the multiphase station, since it can meet every condition with a single type of generating machinery. As pointed out in the paper, however, the distance of transmission, amount of power, and the nature of the load are the factors determining whether a continuous current or a multiphase system is best in particular cases.

Having regard to lighting experience in the large American cities in which the three-wire system was originally installed, and which is now being replaced by a three-phase system with substations to secure greater economy in working, it would seem wiser in many cases to sacrifice somewhat in electrical efficiency at the beginning, and provide for a plant suitable for practically unlimited growth, either as to amount of power or area of district supplied from a central power station.

* STREET RAILWAY JOURNAL, June, 1898.

The Electrical Inspection of Street Car Equipments*

BY ALBERT B. HERRICK

As electrical machinery is becoming such an important factor in modern civilization, the maintaining of this machinery requires indirect methods in order to make visible, through the means of instruments, the electrical conditions of the apparatus or machinery. Nowhere in the application of electricity is electrical inspection more necessary than in street railway equipments; here the motor is operated with exposure to weather, mechanical jars, heating and severe electrical and mechanical strains, and when the first roads were operated there were many predictions that this system was impractical, and a preposterous engineering proposition. The development of accurate methods for finding these hidden electrical troubles in an equipment has been urged upon me by reason of the high cost of the electrical repairs on street-car equipments. These aggregate many million dollars per annum in the United States, and to bring this forcibly to your minds, in two of the roads which I have examined I have found the cost of the electrical repairs of a 22-ft. car with double equipment to be the same as an 80-ton locomotive running on the Pennsylvania Railroad the same distance and carrying a full train of freight cars.

The wiring of a car, by which the current is conducted through the equipment, is of necessity not a fixed nor rigid system. The resistances which are used to control the flow of current through the equipment, on account of their limited weight and space, will not carry the current continuously, and careless motormen may injure the resistance by improper handling of the controller. The latter, which is practically the nerve center of the equipment, reflects in its depreciation all the latent defects in the equipment. After carefully inspecting, electrically, a large number of equipments, one feels very much like diagnosing the different diseases which are inherent in the various equipments, and also separating from these diseases those which are developed by forcing or the improper handling of the controller, and which are attributable to poor motormen. There is another class of diseases which have their origin in careless inspection and careless maintenance of the equipment.

It is not so much my intention to analyze the diseases to-night as to describe the means by which they are detected and located.

Following out our original anatomical idea, it is easiest to look at the various ramifications of the current flowing through the

* Paper read before the Franklin Institute, Philadelphia, Feb. 14, 1899.

equipment as a circulating system, with the controller as a deflector for these different circuits through the equipment. Fig. 1 shows a very common form of series parallel controller, with the connections it makes with the apparatus on the first notch; with each movement of the controller handle the current is changed in its path. The sequence of changes made by the controller as it passes from the first position to the last, including nine positions in this case, is as follows: The first position starts the current flowing through the electrical circuits of the car, and the car should now move. A large amount of energy is lost now in the resistances R_1, R_2, R_3, R_4, which choke down the initial current on the motors. An advance from the first step to the second cuts out 4½ ohms in a standard equipment of this type; from the second to the third step cuts out 1½ ohms, and from the third to the fourth step cuts out one-half an ohm. The motors are now both in series and across the full potential between the trolley wire and the ground. The rheostat, which is the resistance that has just been cut out by the first three steps of the controller, is usually given very little attention after it has been installed on the car. Its resistance generally increases with age, however, and I have found in many rheostats over four times the resistance they should have had when new. The result of this increase in resistance is that the car will not start on the first step of the controller when the rheostat is hot or the car heavily loaded, for the resistance is so high on this step that the current is cut down below starting value, and when the second step on the controller is reached the car will have what is known as the "kangaroo" start. The result of this defect in the equipment is to increase the temperature of the motors and the strains on them, as well as the current demand on the station, and to give a disagreeable acceleration to the car. This defect is more noticeable on those motors having a large starting torque. The motors which have a small starting torque do not show this defect so much in the start and car acceleration, but struggle along under this excessive condition until they retire to the repair shop damaged.

I have expanded on this point somewhat, because it does not seem to be generally known that this condition is primarily the cause of a large number of breakdowns in equipments, which condition may be caused by burnt-open or high resistance in rheostats. A low resistance on the first step of the rheostat has identically the same effect on the equipment as if the first step is too high and the second step is normal. Where repair accounts have been kept against individual cars in street railway operation I have often found the high cost of repairs on some cars due to just this rheostat trouble, the controller, armature and fields being continually repaired, while the rheostat, which is the real cause of the trouble, is left unmolested.

Rheostats are also much more heavily strained on roads possessing considerable grades, and, consequently, on these roads tend to increase in resistance more rapidly, and thus prevent the most effective operation of the equipment; this condition increases materially the watts per car-mile required on grades where starts are frequent.

In the type of controller under consideration the resistance between the second and third step, R_2 and R_3, being high, is not of much importance in this part of the operation of the controller, provided it is not so high that the car loses acceleration; but if we follow the operation of the controller shown in Fig. 2, it will be noticed that on the sixth notch the motors are connected in multiple, and this second to third step in resistance is again put in series with the two motors in multiple. Here, if the second step is high, the equipment will lose acceleration, and when arriving on the seventh notch the motors will again be subjected to an abnormal flow of current.

It is evident that these conditions can only be determined by the direct measurement of the resistances of these circuits as made by the controller, but the resistances of these circuits possess peculiar features which are not common to a purely metallic circuit. We find contact resistances in the controller, and carbon-brush resistances in the motor. The contacts give extremely variable and unreliable results when measured with a low potential test current. The carbon-brush contact will often appear as an insulator under this condition, and a poor controller contact will give a constantly varying resistance.

In order to bring the contact resistances down to normal it is necessary to pass considerable current through the equipment when testing, and it is most convenient to obtain the current from the railway circuit. But when we use a current varying as the ordinary railway current varies, and yet discover the variation of resistance as low as .005 of an ohm, another difficulty confronts us, and neither a bridge method nor fall of potential method is applicable to this work.

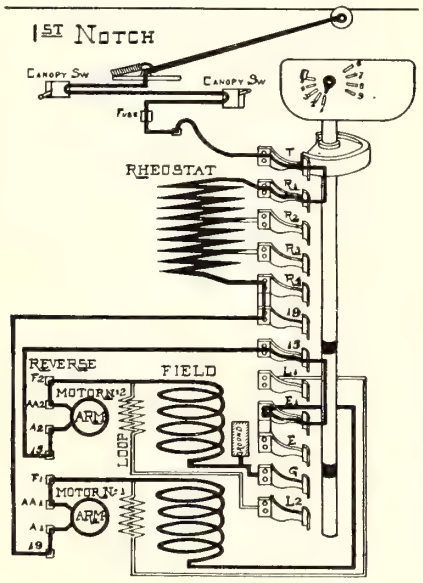


FIG. 1

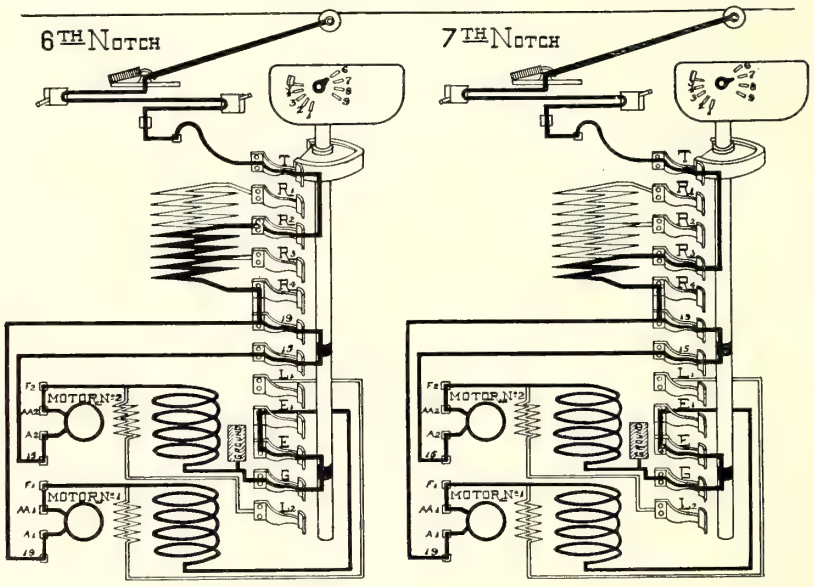


FIG. 2

In any bridge method the measurement of a resistance also includes the contact resistances by which this resistance is placed in the measuring circuit, as at Fig. 3, and due to this varying quantity introduced into the bridge method it is not a reliable instrument under 0.1 ohm, nor at the other extreme can the bridge give quantitative results over 500,000 ohms. For these reasons the method is useless in measuring low resistances with any degree of accuracy which will admit of a definite analysis, especially in those resistances met with in fields and armatures. No multiplying arrangement can increase the accuracy of any measurement external to this instrument.

Thompson's method of measuring resistances, which is applicable to low resistances, is extremely delicate and of general use for this purpose; but there is one very important condition necessary in using this method. That is, there cannot be any appreciable resistance between standard and the resistance under measurement, as at *D* in Fig. 4, for in that condition there would be considerable fall of potential along the measuring lines, which will interfere with the accurate comparisons of the resistances, *A* and *X*, under measurement (and in car inspection it is impossible to have the standard and resistance under measurement adjacent to each other.) The volt-meter and ampere-meter method, where connected as at Fig. 5, will give the resistance sought by dividing the volts read by the amperes flowing. But in measuring an inductive circuit, such as a field or armature of a motor, we find that with the voltage falling the resistance between any inductive terminals is apparently lower than its true resistance, and with the potential rising the resistance will be apparently higher than the true resistance measured. This method is too tedious and unreliable for the purpose of accurately diagnosing equipment troubles, as we have to balance our circuits inductively as well as ohmically in using the trolley circuit in equip-

ment testing; but to make all this practical and of general utility the system must be so devised that the measurements and determinations can be made quickly, and not necessarily by one skilled in the art.

The author, after years of experience, has had to abandon these methods, for they did not produce sufficiently concordant

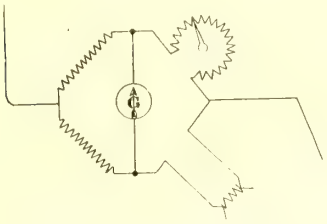


FIG. 3.—BRIDGE METHOD

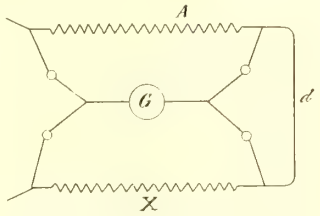


FIG. 4.—THOMPSON'S METHOD

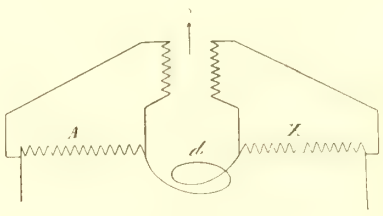


FIG. 6.—DIFFERENTIAL METHOD

results to make the analysis of equipment positive, and he has developed the differential method shown in Fig. 6. This is nothing more than separating the differential coils of Kelvin's method, electrically, so the resistance between A and X would not interfere with the accurate comparison of two resistances.

Another condition necessary in the development of a system is the keeping independent from each other the different tests requiring different connections made to the testing apparatus, so an interlocking system had to be devised by which means the test

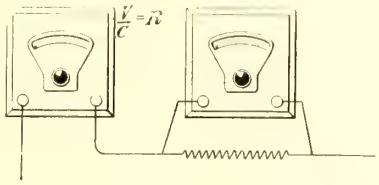


FIG. 5.—VOLT METER AND AMMETER METHOD

under consideration could only be connected up when the dial was turned so the pointer was opposite that test, then the holes for inserting the plugs in this test registered with the proper receptacles, and the plugs could be inserted for this test, and no interconnections could be made which would injure the instruments used in these tests.

The semi-portable apparatus known as form D is shown here, Fig. 7, which combines, besides the inspection tests, all other well-known ampere-meter and volt-meter tests which are required on the line, car operation and electrolysis. The testing set, including only the inspectors' test, is a much more portable affair, and can be readily carried from car to car. It is very easy to make an electrical inspection of an equipment in one minute, when proper arrangements are made to expedite the test, and a testing set can be taken to any part of the road where the cars can be delayed, and this test can be made on each car by holding it for one minute.

The inspection test consists simply of measuring the equipment up on each notch of the controller, and every road fixes its maximum and minimum standard for each type of equipment, there being considerable range at first between the allowable maximum and minimum.

To maintain an equipment means the keeping of the different controller points within standard values, and any part which departs from standard value can immediately be repaired at small cost, before the more serious secondary effects have rendered the equipment a cripple.

I show in Fig. 8 a plotted curve of ten identical equipments which were inspected on a fairly well operated road, and it shows quite a variation in rheostats, and also two burnt-out fields and a poor brush holder. A straight line is drawn through these tests in order to show where the standard should be. It will be noticed that there are high rheostats in several equipments, and it will also be noticed that in equipment No. 2 the high rheostat has resulted in the burning of the field of No. 1 motor. It will cost five times the amount to replace the field that it would to repair the rheostat; and it is only by careful inspection that these primary troubles can be detected in time to prevent a more serious loss.

The ageing effect on the different types of equipments tends to lower in some and to raise in others the resistance of the rheostat. The field resistance will fall slightly, owing to the annealing effect on the wire, but if the resistance falls below 1 per cent it is due to turns being short, or the carbonizing or "baking" of the wire insulation, which allows the current to pass between the adjacent turns through the carbonized cotton insulator instead of around the turn to produce the magnetic effect on the field. The result of this is to make the armature revolve faster in the weakened field, and the armature will become overloaded in its effort to run the car, and also to carry the other motor; in this way if the equipment is operated the result will be an armature burnt out.

In one case where I inspected the cars, the armature winder, who was an excellent worker, had been discharged for the reason that his armatures would not run more than a few hundred miles before being burnt out. I found that defective fields were the cause, and after replacing the bad fields in these equipments the armature winder was reinstated, and there has been no trouble since.

An undiscovered baked field is one of the most prevalent causes of motor troubles. A number of methods of winding and treating fields are now in use, which have for their purpose the preservation

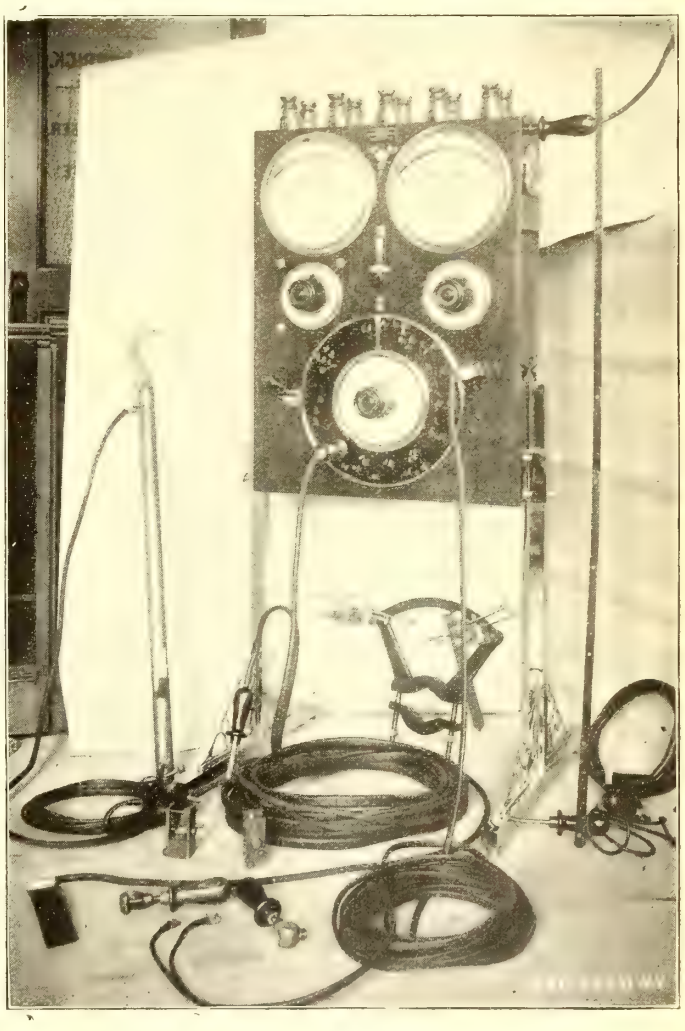


FIG. 7.—TESTING SET

of insulation between adjacent turns of wire, such as winding the wire with asbestos under the cotton. Care must be exercised in using this wire, as some of the forms will not hold the proper number of turns with this increased size, due to the asbestos covering, and if the proper number of turns are put on the form the field spools will not fit in the motor.

Another method used is to slush these coils as they are being wound or to dip them, after they are wound, in a solution made up of chalk, magnesia-oxide and water to the consistency of whitewash. This foreign material, when introduced into the winding

and baked, hardens and forms a mechanical barrier between the adjacent turns and prevents their short circuiting.

Other methods are practiced, such as dipping the field coil into varnish or insulating compounds. These different methods all have for their purpose the introduction between the adjacent turns of wire of a noncarbonizable insulator.

The field coils must be well baked after the application of any of these methods in order that any moisture or alcohol may be driven off before the coils are used. It has been the practice to pass current through these coils and heat and bake them in this way, but when water or alcohol is present internal electrolysis is set up, which forms internally a conducting copper salt, and this destroys the insulating properties of the mediums employed. Another point may be mentioned here in regard to baking where armatures and fields show low resistance to ground after being baked. The baking oven is often completely inclosed, and any moisture excluded from the coil is held in the air; a baking device of this kind, which has no ventilator, is really a steam box, and not a baking oven, and high insulation cannot be obtained unless ventilation to the oven is provided.

The best way to measure the temperature of a motor is to measure its resistance when hot, and for each degree centigrade rise in temperature of the field the resistance will increase 0.38 of 1 per cent. Fig. 9 gives the increase of resistance for each 0.1 of an ohm to 1.5 ohms, and up to 100 degs. centigrade. The drop in volts across one field when the equipment is running is the best method of testing whether the two motors are taking their loads equally when they are connected to a series parallel controller. When the motors are in series they are both taking the same current and the drop across the field should be reduced one-half when the motors are thrown to multiple, and the same current passing in both cases. If, under this condition, the voltage drop is not cut in half the motors must be out of equalization, 8 per cent being the maximum difference in equalization allowable. With the differential method each coil takes the drop off of one field of each motor, and the hand stands at zero in case of equalization. If the hand departs from zero as the speed of the equipment increases the lack of equalization is due to difference in air gaps of the two motors. If there is a constant deflection for all speeds, the non-equalization is due to the unequal resistance of the two motors in multiple.

In the tests on the armature and its commutator, which are the most delicate part of the equipment, the first succumbs to ill usage or lack of proper inspection of the equipment. The different diseases met with in this part of the motor are grounds, short circuits, open coils, broken leads, broken down insulation in the commutator, and especially short circuiting through the commutator ring. Their detection is rendered easy by a bar to bar test on the armature. Fig. 10 shows the method of applying this test to the armature; a brush-holder yoke is clamped to the shaft of the armature, and insulated brushes bear on the bars of the commutator; by moving these brushes around the commutator the indication of the instrument will be constant in all positions of the brushes; but if an armature is wrongly connected there will be a

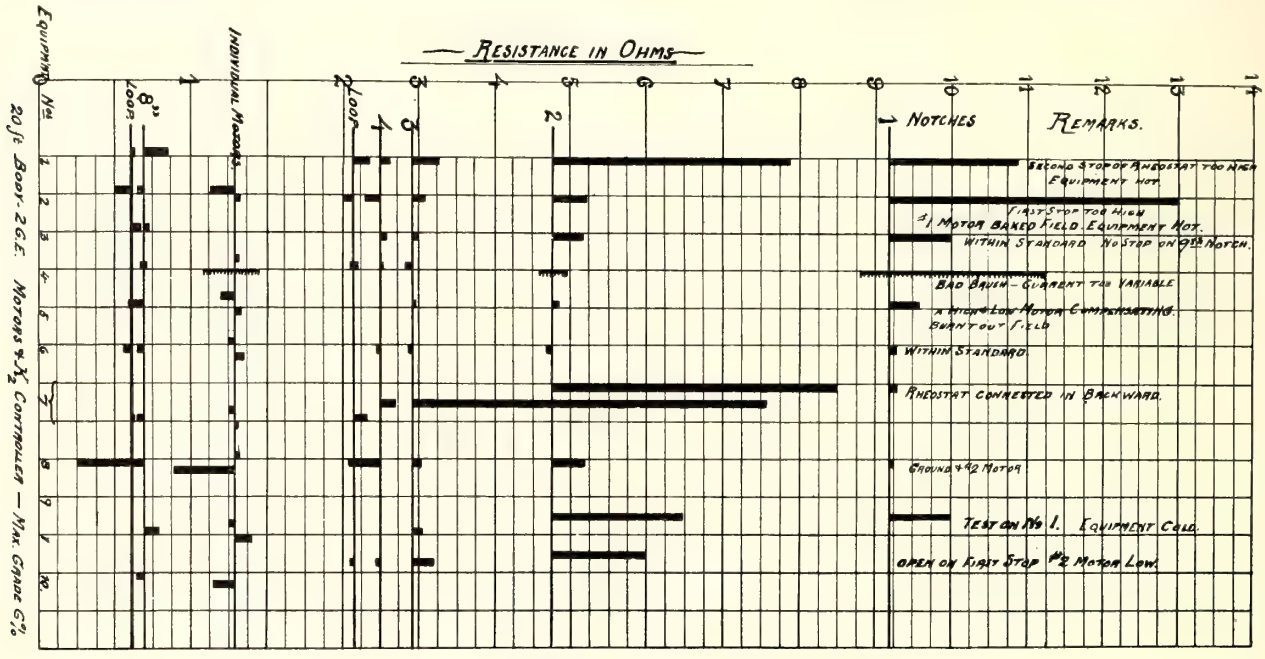


FIG. 8.—RESULT OF TEN DIFFERENT TESTS

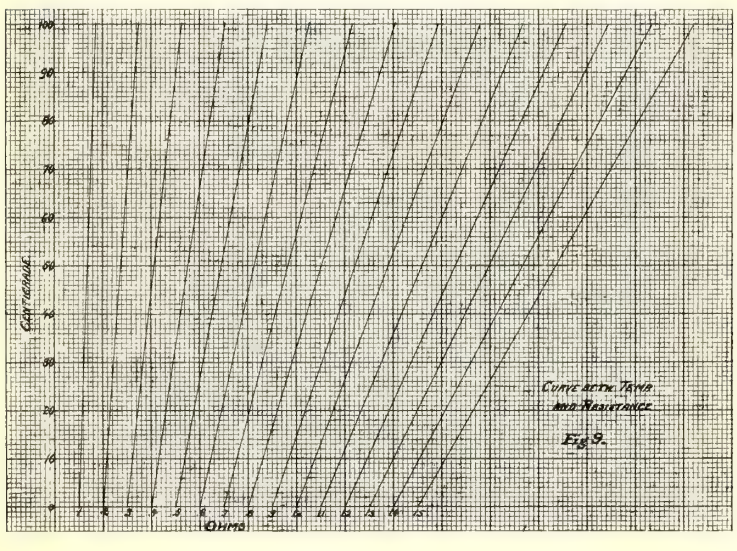


FIG. 9.—TEMPERATURE AND RESISTANCE CURVES

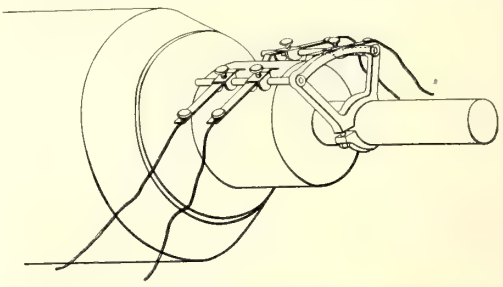


FIG. 10.—METHOD OF TESTING ARMATURE

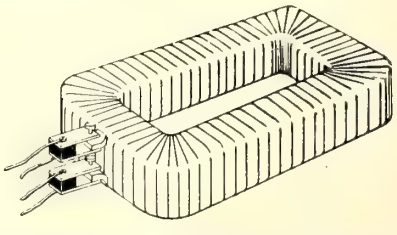


FIG. 11.—METHOD OF CONNECTING TO FIELD COIL

change in values when the brush rests on that commutator bar to which the misplaced lead is connected. Two bars which are short circuited together will give readings lower than normal when they lie between the four testing brushes. A ground on an armature can be located when one of the measuring terminals is connected to the shaft. The grounded coil connects to that commutator bar which gives the lowest reading on the measuring instrument when the measuring contacts are revolved around the commutator. Where the insulation is to be measured the same connections are kept on the armature as for ground, the test plugs are removed, the dial turned to insulation test, and plugs inserted in the exposed receptacles; the insulation is then read directly in megs. on the insulation scale of the instrument. Fig. 11 shows the method of connecting to the field.

The controller has troubles of its own, such as poor contacts of the fingers, short circuits between fingers, grounds, burnt-out segments and misconnections; the insulating partitions between fingers also may become carbonized and cause an arc which destroys the contact fingers. Many imperfections in the controller circuits leave their imprint on the controller. Several of the most prevalent indications will be mentioned, such as the burning of the second resistance contact and an open connection in the first resistance step, indicated by the first resistance contact being bright. A bad flash at either loop contact; where the loop is cut around the field, indicates an open or poor field connection. In this way many things can be observed in connection with the equipment, and it requires that a successful inspector be keenly alive to all the little external evidences of the internal troubles. To aid him I have produced diagrams of connections, divorcing the essential apparatus of the equipment from the intricate wiring system, so that the conditions of cause and effect can be quickly arrived at.

The controller diagrams that we have studied in Figs. 1 and 2 are two of five different types. Placing them historically, we have, first, the rheostat control, which consists of a resistance in series with one or two motors, as the equipment requires. The function of the controller in this case is to close the circuit and vary the resistance in series with the motors, and in this way control the current delivered. The next step in the art of equipment regulation was to first place both motors in series, and also in series with the resistance; after this resistance is cut out the motors are automatically placed in multiple. At this point there is a divergence in connection, one type, such as the *K* controller, places part of the resistance in series with both motors in multiple. The type known as *G* controller, in passing to the multiple position, places one motor directly across the line potential, and the full resistance in series with the other motor, which is cut out in the succeeding notches of the controller, until both motors are directly across the line. The type known as No. 14 controller has a separate resistance step in series with each motor; when the motor is in series these resistances are cut out alternately, both in the series and multiple positions of the controller. Type *C* controller comprehends somewhat the same general arrangement, the relation of the parts only differing in reference to the controller contacts. Each of these controllers has its peculiarities, but to go into them in detail would require too lengthy a discussion.

The wire for car wiring has not been selected large enough in those circuits which lead directly from the motor to the controller. Due to the circuitous route that the current takes in a two-motor equipment with a 20-ft. car body, the length of this circuit is 217 ft., which of No. 6 wire gave under the condition of equipment tested 12 volts drop in this circuit only. This drop occurs under the conditions when the motor requires the maximum potential delivery at its terminals, and a few additional dollars spent in the internal wiring of a car would accomplish the same results as hundreds of dollars spent on the line.

The application of electrical inspection of equipments brings out some very queer conditions caused by the car wiremen not fully comprehending the wiring diagrams furnished. In one case I found a number of equipments with both loop boxes connected in series around the fields of one motor. In another case I found all the rheostat boxes connected in backwards; that is the low resistance step connected to the first step and the high resistance step cut out just before the motors were put across the line. In another case of No. 14 controller I found that one resistance had always been short circuited by a misconnection, and the equipments had been working under this connection for several years.

Briefly summing up my experience of the testing of over a thousand equipments, including nearly all types extant, I find the principal weak points are, first, the two-way connecters are responsible for a great deal more than their share of trouble, and that every break in the continuity of the conductor system reduces their liability of the equipment for continuous operation. Second, that a motor is not any better than its field. Third, that careless brush inspection is responsible for more burnt-out armatures than those caused by poor motormen. Fourth, that the maintenance of an equipment is much more economical and satisfactory than trusting to Providence and awaiting the time until it breaks down; in other words, it is far better for a street railway manager to operate a sanitarium for his equipments than a hospital.

The vitality of an equipment rests entirely upon the excellence of its insulation, and the trend of recent improvements in the equipment is to abandon those insulators which in time either oxydize or carbonize and become conductors.

One final point I would like to mention in regard to high potential alternating insulation tests for railway apparatus. This is generally considered a satisfactory method, because it shows so many faults not indicated by other tests, but the application of this high potential method, with depleted insulation, usually develops the fault which it detects, and curtails the natural life of armatures and fields.

A Large Suburban Car

The Pennsylvania Traction Company of Lancaster, Pa., is one of the largest suburban roads in the State outside of the Philadelphia interurban lines. The practice of the company is especially interesting, because it has tried many different kinds of cars, with a view to finding out which will accommodate its heavy traffic to the best advantage. It is also interesting as showing the general direction or tendency of electric railways in the matter of car construction and design. The car is 28 ft. long and 38 ft. 8 ins. over all, built by J. G. Brill Company. It has curved sides, and is 7 ft. 5 ins. wide at the sill, and 8 ft. wide at the posts. The platforms are 4 ft. 6 ins. long, and the height to the sill from the head of the rail is 30 ins. The step is 17 ins. from the head of the rail, and has a 12-in. riser to the platform.



LONG CAR—LANCASTER, PA.

Each end of the car is provided with a stationary round-end vestibule, with doors folding against the vestibule. This is a complete inclosure, and there is no entrance to the car until it has stopped. The completely inclosed vestibule incidentally increases the profits of the road by encouraging riding through the winter weather by making it perfectly comfortable.

The car is mounted on Brill Eureka maximum traction trucks. The wheel base is 4 ft. and the wheels are 33 ins. and 20 ins in diameter. There are two Westinghouse No. 38 motors. The gage is 5 ft. 2½ ins. The car is furnished with twenty reversible-back seats, covered with spring rattan. This gives a seating capacity for forty persons. The inside finish is of cherry with bird's-eye maple headlining. The trimmings are of bronze throughout. There are two electric headlights and two Brill sand boxes. The buffers are of the Brill angle-iron type. The weight of the car without motors is 20,500 lbs. The trucks weigh 3500 lbs. each.

Testing of Apparatus at Purdue

The engineering laboratories of Purdue University have recently been augmented by the addition of a new room, measuring 50 ft. x 100 ft., in which is installed an experimental equipment of considerable importance. The apparatus is, for the most part, devoted to railroad testing in some of its numerous branches. One of the larger pieces of apparatus is the Master Car Builders' brake shoe testing machine, shown in Fig. 1. This machine was built in 1893 at Wilmerding, Pa., for the M. C. B. Association, and has recently been deposited at Purdue, where the future work on brake shoe testing will be done. Several notable series of tests have already been carried out on the machine by committees of the M. C. B. Association, the results of which tests have been published in its proceedings. The machine consists in its elements of a standard car wheel mounted on a shaft to which is keyed a large fly wheel, designed so as to possess at any speed a kinetic energy of one-eighth of a loaded 60,000-lb. freight car. The shoe to be tested is applied to the car wheel by means of a series of levers, so arranged as to produce between the shoe and the wheel the different pressures actually employed in service and emergency applications. Attached to the head which holds the shoe is a recording dynamometer, arranged to give a continuous record of the tangential pull of the shoe on the wheel. The recording mechanism is also provided with means for registering the speed of the periphery of the wheel, and connection is made with a chronometer for taking the time record. In making tests the double engine, shown in the illustration, is connected with the fly wheel by means of a clutch, and the wheel brought to the desired speed. The clutch is then thrown out and the levers connected with the brake shoe are tripped, thus bringing the shoe in contact with the wheel. The wheel is thus brought to rest in precisely the same manner as the car would be stopped on the road. The data derived from the machine serve to determine the relative coefficients of friction of different shoes under different speeds and pressures of application.

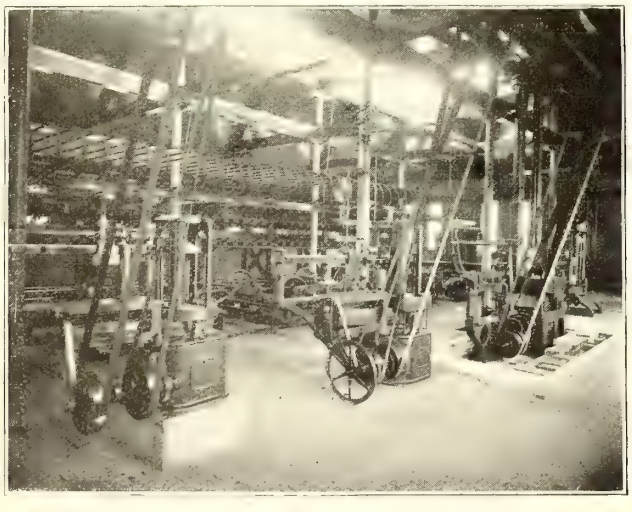
Another unique piece of apparatus is the air brake testing rack, also belonging to the Master Car Builders' Association. This rack, shown in Figs. 2 and 4, was until recently located at Altoona, Pa., and is the one upon which the notable tests conducted by the M. C. B. Association were made. This rack has been deposited at Purdue, and future shop tests of air brakes will be made at that institution. The rack consists of a complete equipment for a fifty-car train. The triples, reservoirs and cylinders are in duplicate. Referring to Fig. 4, the hose pipe shown in the illustration as connected with the upper row of triples can be disconnected and connected with the second set of fifty triples, which may be applied to the lower row of reservoirs. All the fittings, such as angle cocks, hose couplings, drip cocks, etc., found upon a fifty-car train are made a part of the train line, so that the action of the triples on the last reservoirs of the rack will be similar to that found upon an actual train of cars. The plant is provided with recording devices arranged to accurately register the time of application of the brakes in different portions of the train.



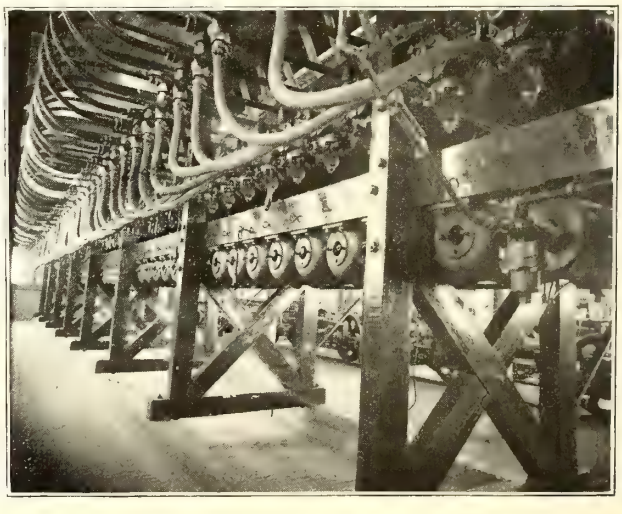
BRAKE SHOE DEPARTMENT



AIR BRAKE DEPARTMENT



MACHINES FOR TESTING STRENGTH OF MATERIALS



BRAKE TESTING RACKS

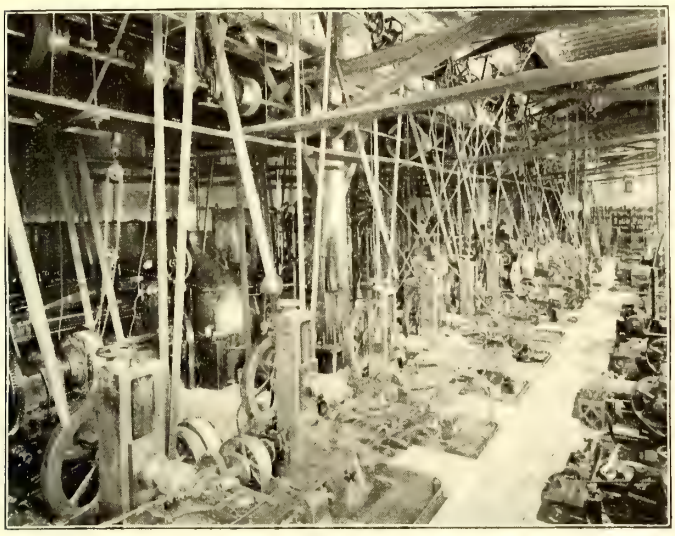
In another portion of the room are located testing machines ranging in capacity from 600 to 300,000 lbs. and adapted for the testing of iron and steel, wood, stone, cement, wire and brick. This portion of the laboratory is shown in Fig. 3 Provision is also made for, and a good deal of work has already been done in the testing of various elements entering into car construction, such as brake beams, truck and body bolsters, truck frames, etc. Among other interesting pieces of equipment may be noted a full-sized model, consisting of cylinders, smokebox and stack of a Richmond compound locomotive; this model was exhibited at the 1897 Master Mechanics' Convention, and there attracted a great deal of attention. There are also interesting and valuable exhibits of freight and street-car trucks, among which are three Brill and one "Lord Baltimore" trucks, couplers, brake beams and interlocking apparatus.

Motor Gears and Pinions

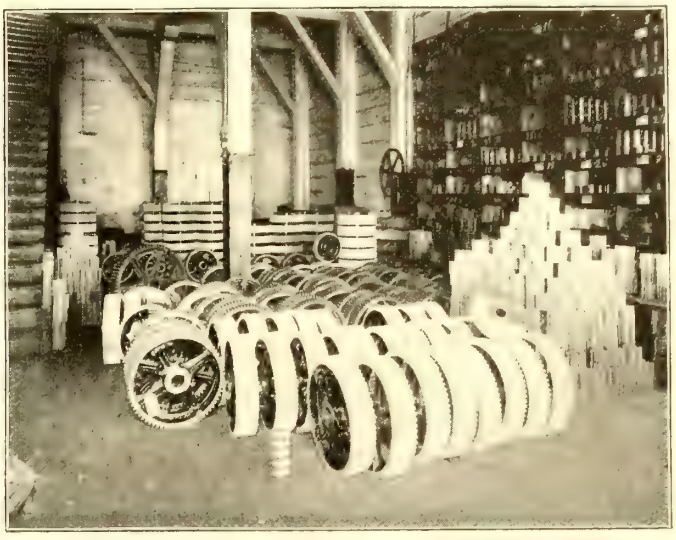
There are few industries allied to industrial traction that have grown into greater magnitude than the making of gears and pinions for street railway service. The users of machinery and appliances of any kind are naturally interested in knowing how the machines they buy are built, of what material, and the capacity and reputation of the establishment engaged in their manufacture. This is especially true of the industry of which this article treats, and in this case, is of double interest because it is found, so far as the records show, that the R. D. Nuttall Company, of Allegheny, Pa., was the first outside of the electrical manufacturing companies to engage in the making of gears and pinions. At the suggestion of one of the local street railway companies, this company, before 1890, had undertaken the manufacture of gears and pinions, and soon after began their manufacture for the general market. The business of the concern, however, was started in 1885 by R. D. Nuttall, and was directed to the making of machinery of every description. The present company was incorporated in 1891, and in 1893 came under the present management, F. A. Estep president, J. R. McGinley vice-president and Thos. Fawcus superintendent. The works are located on Grant Avenue, Allegheny, and occupy a two-story brick building, 100 ft. x 80 ft., with a new addition just completed of 60 ft. x 20 ft. This is being equipped with new machinery, not only for increasing the capacity for making motor gears, but for spur and beveled gears of every description. One of the new machines has a capacity for cutting spur gears 15 ft. in diameter up to 24 in. face, and another machine for beveled gears, up to 8 ft. in diameter, with the latest improved milling machines and key seaters, and a Betts turning and boring mill. The new shop is also to be equipped with a 20-ton traveling crane.

It is the motor gears and pinions, however, in which the reader is especially interested, and which will now be followed in detail. The gear blanks are made chiefly of cast steel, although occasionally, when specified, cast or malleable iron is employed. The blanks are cast in half circles, being split through the spoke, and the first operation in fitting them for service consists in milling the faces of the halves to an accurate male and female fit, the two halves being fastened side by side to the bed of the machine with the curved side down, so that the milling cutters for both faces are on the same shaft. From this machine the parts go to the gang drills, where holes are drilled for receiving the bolts, by means of which the two parts are united into a perfect gear. In the process of drilling, steel templates are employed, which being clamped to the face of the sections, serve as a guide for the drill. This work, as well as all the different operations throughout the shop, is done by the piece, the workmen receiving a certain price for a certain operation, and, in case of the drilling, one man is able to attend to three machines. Following the drilling, the parts are bolted together, when the hub is bored out to the axle fit. Next, the face and edges of the rim are turned to an exact diameter, and in this operation two classes of tools are employed, on one a broad knife cuts the face and edge of the rim as the blank is revolved, while in another process a milling tool runs against the face of the rim and cuts it down as the latter slowly revolves. Of course it is understood that there are a number of tools for each of these operations, so that a large number of gears are undergoing the same operation at the same time. The blanks are now ready for cutting the teeth, and this process is done on automatic gear-cutting machines, of which there are two different styles, some being of the Gould & Eberhardt type, and others of the Brown & Sharpe make. There are twenty-six of these machines, arranged on two sides of a narrow aisle and all are on the same floor with the machines previously described, together with various machines for other purposes.

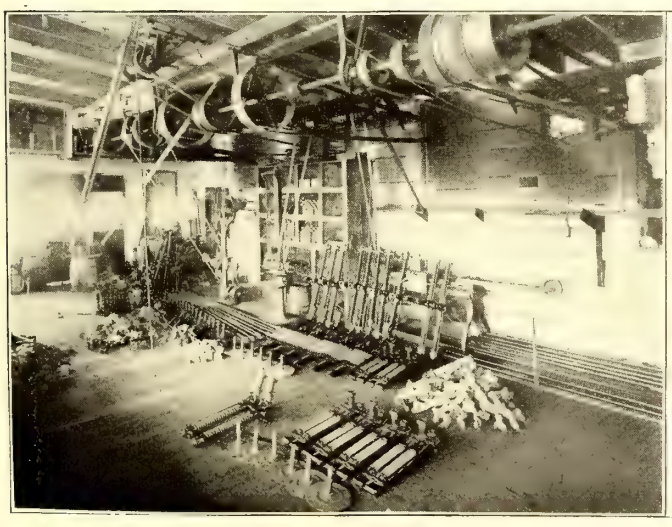
In the process of gear-cutting the blanks are set up edgewise across the face of the table, and the cutting tools work on the un-



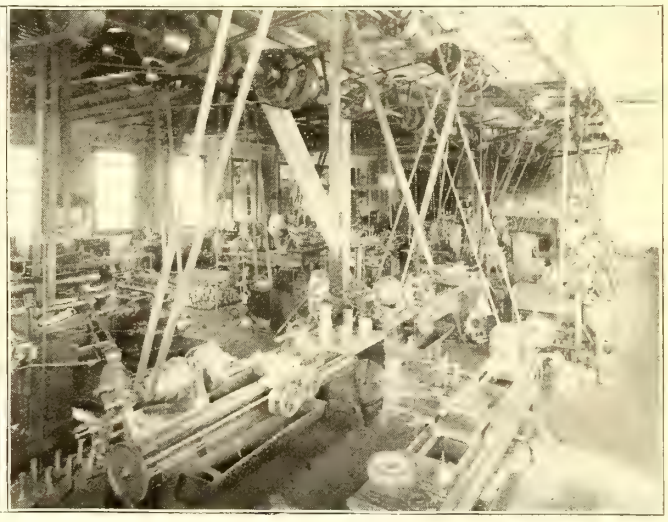
CUTTING GEARS



A CORNER IN THE SUPPLY DEPARTMENT



TROLLEY SHIPPING DEPARTMENT



MACHINE SHOP

der side of the blank, as it moves back and forth. The practice is to finish one tooth at a time. Although it is possible to cut more than one tooth, the result is less accurate than when only one tooth is cut. In the process of cutting, the milling tools are flushed with a lubricating mixture, which flows in a copious stream from small pipes through which it is pumped from a large tank located in the basement, and to which the surplus is returned by drain pipes.

The blanks for pinions are in all cases forged steel, hammered to nearly accurate size, and the first operation consists in drilling or boring out the centre to fit the armature shaft; next, the surface is turned down to accurate size, when the teeth are cut in the same manner as for the gears, the most accurate measurements being followed in all the operations. When finished, the gear and pinion are mounted on suitable mandrels for testing, and the gears are driven by means of a belt at a high speed forward and backward, to see that there is a perfect mesh of the teeth, so that they will run at high speed without noise. The same test also determines the amount of back lash. The plain surfaces are then painted with white lead, and the rough parts with japanned paint, when they go to the store room, ready for shipment. They are not found, however, in any great quantities in the store room, as the company has never yet been able to keep ahead of its orders to any great extent. A few are noted, however, one lot being the last of a hundred to fill an order from Woolwich, Kent, England, and some others, the last of an order for 200 from a city in Italy, which show the wide range of market to which the works cater.

The output of the works is not confined, however, to gears and pinions, but embraces other street railway supplies, including trolley wheels and harps, which are made by the thousands, trolley poles and bases, journal boxes and bearings, in both babbitt and bronze. The trolley bases manufactured by this concern are known as the Standard, and include five different patterns. In the manufacture of bearings, a shell of malleable iron is generally employed for both the axle and armature bearings. These are babbitted and faced down ready for service. The company manufactures many of its own small tools, and for this purpose a separate room is equipped with a fine line of machines, specially designed for tool making, and in the same room is a specially fine tool, designed for planing the teeth of beveled gears down to an accurate finish. Other operations consist in finishing the bolts for side bars of the trolley bases, and the threading of bolts for uniting the parts of the gears. The blanks for the parts are bought from the manufacturers, but the thread cutting is done in the company's shop, for which purpose a number of bolt and nut threading machines are employed.

The wood-working department, including the pattern shop, is located on the second floor, and is provided with the usual equipment of wood-working tools. On the same floor are the offices of the company, while the engine and boiler room occupy a section of the first floor. A 100 h.p. Phœnix engine serves to drive the shafting on the first floor, and a Westinghouse 35 h.p. engine that on the second floor. There is, as well, a lighting generator, incandescent lamps being located about the various tools, an essential feature, as the works are required, generally, to run night and day to keep up with the orders, a double shift of hands being constantly employed. The capacity of the works is about one hundred gears and pinions a day, besides the other appliances above noted, and the employees number usually about one hundred. The affairs of the company are under the immediate direction of F. A. Estep, president and treasurer.

Collection of Blanks and Forms of the Accountant's Association

W. B. Brockway of Toledo, Ohio, secretary of the Street Railway Accountants' Association, has announced that the department of blanks and forms of that association has progressed so far that it is almost in a state of completion, but is being held open for about thirty days in order that those companies who have not already done so may be enabled to contribute their blanks and forms, as requested in a circular letter mailed from the association headquarters on Nov. 15, 1898. As this department gives promise of becoming an important factor, it is hoped that prompt attention will be given to this appeal so that the collection may be absolutely complete.

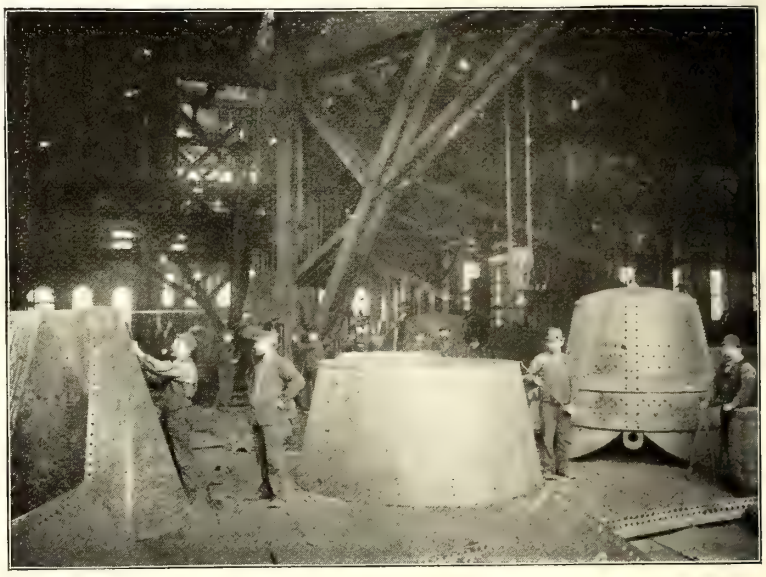
Plate and Structural Work of Steel

Although several years have elapsed since steel in plates and in bars has been employed in structural work, or for smoke stacks, smoke flues, water and oil tanks, gas holders, etc., the actual manipulation of the material is still a new industry to most people. This is not to be wondered at, however, for the products have such a wide application and the manufacturing establishments are necessarily of so great magnitude and so few in number, that unless one is in the market for some one of the various products to which steel readily lends itself, he is not particularly interested in viewing a tank, a cold storage bin or even a towering stack.

One of the largest firms engaged in this industry is the Riter-Conley Manufacturing Company, of Pittsburgh, which, in addition to its construction work, maintains a corps of expert engineers for the purpose of designing and giving expert advice on all questions of economical construction.

The works of the company occupy two plants, one in Pittsburgh and the other in Allegheny. In both about 30,000 tons of sheet and structural steel are consumed annually, and about 1200 men are usually employed. The Pittsburgh plant occupies three buildings, each extending through a block. The first fronts on Water Street, facing the river, and extends through to First Avenue, while the second, a large brick and steel structure, has 240 ft. frontage on First Avenue, reaching through to Second, and the third extends from Second to Third Avenue. The tank department occupies the Front Street building, in which are also located the main offices and designing rooms. To this department the plates are delivered by wagons, the material being purchased for the most part from the neighboring steel mills, or mills in the vicinity of Pittsburgh. The leading tools consist of punches, shears, drills, bending rolls, hydraulic flangers, pneumatic tools and cranes. Of these what are known as rack punches are of special interest. These are fitted with a table to which the metal sheets are attached, and being adjusted to the punch, the sheets are advanced a notch at a time, so that a row of holes equally spaced are punched along the entire edge of the sheet without any attention being given to centering or adjustment. At the last hole, at a corner, the sheet is swung around the punch as a center until the holes are complete on all four sides. In the same building is a blacksmith department, in which the hand flanging is done. Here the most difficult elbows and bends are designed, the workman showing marvelous ingenuity in forging the plates to accurate fit. Air and hydraulic riveters are located at intervals through the works, one a vertical machine, on which flues or tubes, 35 ft. in length and up to 8½ ft. in diameter, can be riveted in single sections, the shell being supported by block and fall from a tower and lifted by hydraulic power. There is also a pneumatic reamer which is attached to the long arm of a jib crane by means of a trolley wheel, so that it has a range of 18 ft. in every direction,

One set of bending rolls is 21 ft. in length, and is driven by an independent steam engine. Passing by the jib cranes, we come to a gang punch, an enormous machine which is capable of punching at one stroke sixty 13/16 in. holes, in ½ in. steel plate. The punches are ranged in three rows and have capacity of receiving



MAKING 40 TON LADLES

a sheet 8 ft. across. The most powerful tool, however, is a 150 ton hydraulic flanger, which has a movable bed plate 10 ft. in diameter, and which will receive plates of the same size. In this machine the upper bed is stationary, while the table is forced up by two enormous plungers, supplemented by several smaller plungers that work through openings in the bed and give a special bend to the plates as may be required. The shipping facilities of the establishment are excellent, as a siding from the Pennsylvania Railroad runs along one end of the main building, where is located a powerful steam crane, by means of which the



CONSTRUCTING A 200 FT. SELF-SUPPORTING STACK

parts or finished structures are readily loaded upon the cars. This concern has during the past year provided structural work for the power and car stations of the Dublin Tramway, of Dublin, Ireland, and more recently has made four smoke flues, each 1000 ft. in length and 12 ft. x 11 ft. sections, for the Metropolitan Street Railway Company, New York City. Among other large orders noted were the material for ten open hearth furnaces, each of 50 tons capacity, for the Alabama Steel & Ship Building Company, to be erected at Ensley, Ala. There was also noted an enormous quantity of riveted steel gas pipe, from 20 ins. to 48 ins. in diameter, designed for a plant in Everett, Mass.

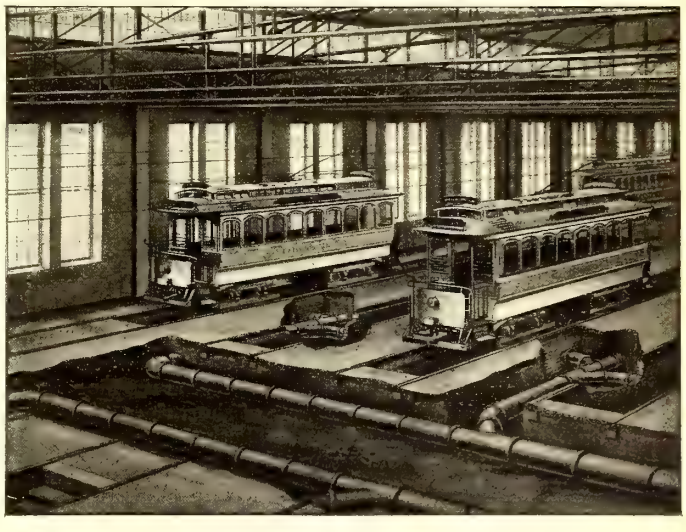
The Allegheny plant is devoted chiefly to the manufacture of structural work and gasometers, and the works occupy seven acres and consist of five buildings, located on Preble Avenue. The buildings are arranged on the four sides of a square, with the power building between. These buildings are known as the receiving shed, are 52 ft. x 175 ft., and from the ends of this lead out the gasometer building, which is 42 ft. x 370 ft., and the structural department, which is 72 ft. x 306 ft. The shipping shed, which is located a little distance from and opposite the other ends of the other buildings, is 60 ft. x 260 ft. Sidings from the neighboring steam railway lead directly into the receiving and shipping sheds. In the former the material is checked up and distributed, the unloading being done by means of an electric traveling crane of 15 tons capacity. This department also included the wood-working branch, in which templates for laying out the work are made. From the receiving shed the material is delivered to the structural department, where it is first laid out from the templates, when, by means of trolley hoists and trucks, it is progressed in regular order to the punches, shears and riveting machines, of which there are a great variety, chief among which are portable air riveters. Some of these are capable of heading a rivet 1¾ ins. in diameter. In this department are five hydraulic jib cranes of enormous capacity. Here are turned out lattice columns and girders and roof structural work of every possible design.

In the manufacture of gas holders, the material is received from the shed as for the other department and progressed in regular stages through the different classes, while in this department, in addition to the punches, are a number of radial drills for making the holes in plates that are too thick for the punches. These are frequently 1¾ ins. in diameter and take corresponding rivets, for the heading of which special riveters are used. Between the main buildings and the shipping sheds is a large area of yard space in which structural work is set up and fitted before shipment, when it is taken down and advanced to the shipping shed, which is of sufficient length for receiving seven freight cars, upon which the materials are placed by means of another traveling electric crane. The company not only manufactures the materials above described, but provides and ships with the products derricks, hoists and other appliances for their erection. The power equipment consists of three engines, the largest of which is 175 h.p. These drive two air compressors of the Rand type, a pump for operating the hydraulic machines and three generators for light and power. The electric power is used for operating three traveling cranes of the Morgan manufacture of fifteen, twenty-five and thirty-five tons capacity and for stationary motors, one of which drives a line of shafting in a gasometer department. As noted above, shipments go to all parts of the world, competing in the price and quality with the reputable high grade products of the old world. In addition to the structures mentioned in this article, the company erects blast furnaces complete, including the hot blast stoves and stacks, stand pipes and towers for water works, penstocks for turbine power stations, grain elevators and miscellaneous work of all descriptions.

The business was established by James M. Riter in 1860, and up to 1873 the work was principally that of steamboat and oil tank construction. In 1873 the firm of Riter & Conley was formed. In 1898 a company was organized under the name of Riter-Conley Manufacturing Company. The affairs of the company are conducted under the direction of the following officers: Thomas B. Riter, president; W. C. Coffin, vice-president; J. S. Craig, secretary and treasurer, and Robert A. McKean, general manager.

The Heating of Car Barns

The extent to which means are being introduced for the heating of car barns is the best evidence of the advisability of maintaining within them a comfortable temperature. They are no longer to be considered as mere storage houses, for the extent to which work is carried on within them converts them rather into work rooms. The process of washing, cleaning, removing snow and ice and making repairs necessitates a tempera-



METHOD OF VENTILATING A CAR HOUSE

ture which will render such work both rapid and comfortable. In barns provided with pits the old method has been to apply the heat locally by stringing steam pipes along the sides of the pits, so as to rapidly melt such snow and ice as may be upon the running gear, and to simplify the matter of making repairs. But such an arrangement is seldom sufficient to also warm the building throughout, particularly along the walls. It is a well-recognized fact that car-house workmen can perform a much greater amount of work in the same time in a warm shop than in a cold one.

For a considerable length of time the hot air feature of the blower system has been utilized in locomotive round-houses and repair shops, the air being discharged directly into the pits, whence it rises, passing on its way through and around the running gear,

and rapidly clearing it of ice and snow. An arrangement of this character, as applied in a car barn by the B. F. Sturtevant Company, of Boston, Mass., is shown in the accompanying illustration. The air in this case is conducted through tile pipes from the central heating plant. This plant consists of a steel pipe heater, made up in sections, inclosed in a steel-plate jacket and connected with the fan, which is driven by an independent engine.

The air is conducted from the main underground pipes through branches and sub-branches to the pits, where it is discharged immediately beneath the cars. The large volume of air which is delivered is sufficient to perform the local work required, and at the same time to effectually heat the whole structure. The deflecting influence of the cars is such that they break up the vertical air currents, and spread them out more or less horizontally, so that the building is well heated at the floor level. By this system a plenum condition is maintained throughout the whole building; all pressure is outward, preventing inward leaks at crevices, and securing thorough circulation of the air. This large supply of hot air, which is a greedy absorber of moisture, keeps the building clear, and rapidly takes up the vapor arising from damp or wet cars.

Compressed Air Cars for New York

The Metropolitan Street Railway Company is making preparations to run several of its crosstown lines by compressed air, notably, the Twenty-eighth and Twenty-ninth Streets line, between the North and East Rivers. Aside from the motive power, the compressed air cars have a number of interesting features of construction, and in their framing are entirely novel. They were built by the J. G. Brill Company, of Philadelphia.



COMPRESSED AIR CAR, NEW YORK

The crosstown lines in New York City below the Harlem River are mostly short, and the traffic, except at the most crowded hours of the day, is composed largely of short rides. The type of car, therefore, to accommodate this business differs materially from that needed in any other part of the city. With compressed air as a motive power, certain changes become necessary in construction, and the result is the car shown in the accompanying engraving. The body is 22 ft. 4 ins. long. The car over the buffers measures 31 ft. 5 ins. It is 6 ft. 6 ins. wide at the sills, and 7 ft. 6 ins. wide at the posts. The platforms, which are not inclosed, are but 4 ft. long. The car stands 27¾ ins. high to the sills, giving a step 14 ins. from the head of the rail. With a low platform, this gives a 12-in. riser. The car is mounted on a No. 21-E truck, and has an 8-ft. wheel base and 30-in. wheels. The gage is standard, 4 ft. 8½ ins.

The whole center of the truck is left open to receive machinery, etc. Three compressed air cylinders, each 9½ ins. in diameter, are to be placed under both of the longitudinal seats, with which the car is fitted. The great wheel base is not a disadvantage of any importance, since these crosstown lines have a very large proportion of tangent. Some of the lines, indeed, are perfectly straight, with the exception of the curves at the switches near the ends of the lines. This feature, of course, makes the long wheel base very advantageous, in fact, because, even with a long body, the car is very steady.

The floor framing of these cars introduces a number of special features. It consists, first, of two side sills of wood, into which two end sills are mortised in the usual way. The side sills are then plated with iron on both sides. The inside plating is turned up at the ends against the end sills, and takes a firm bearing on them. A heavy plate is also put on the outside of the end sills, completely covering the ends of the side sills also. There are in all eight crossings, or cross sills, as they are sometimes termed. Six of these are of angle iron. The two nearest the ends of the car are deep plates turned up against the side sills and bolted fast. All the other crossings are of angle iron carried by malleable iron brackets, which are bolted to both angles and side sills. This form of construction gives an enormous amount of strength and stiffness. In order, however, to obtain good fastenings for the floor and for such attachments as must be necessarily connected to the bottom of the car, each one of these angle iron crossings has a 3-in. "nailing" piece attached to it, and held in place at each end by another malleable angle. These "nailing" pieces are also properly bolted to the angles. The usual diagonal struts are introduced at the ends of the car to keep the frame square.

It will be seen that in this form of construction the wood has been used where its strength can be employed to best advantage, and the metal is introduced in places where wood has naturally its greatest weakness, namely, at the joints. It must be understood that the side sills are only mortised for the timbers at the two ends, thus the whole strength of the wood is preserved. The car body, being very long and having a great overhang, requires an unusual amount of strength to support the long ends, and this strong floor frame was designed to give the required strength.

The springs under these cars were designed to give a very easy motion. The semi-elliptics were made 36 ins. long, not only giving ample support, but making galloping entirely impossible. The side bars of the truck, being under great strain, were made accordingly heavy and stiff, to carry the weight of a heavy car body and the propelling machinery.

There are four folding gates, with solid iron hood supports. The body of the car is, in general, finished according to the Metropolitan standard, the woodwork being selected white ash, and the veneer seat covered with standard Broadway carpet. The ceiling is of three-ply maple, without decoration. The trim inside is all of bronze, and the sash have metal styles. The brakes are of the Sterling pattern.

Each of the posts are provided with a push-button for signalling the conductor, and the lighting is done by three Pintsch gas lamps. The body is supported by a deep gas-pipe truss, well anchored at each end of the sills.

Insulating Compounds

The letters P. & B., under which the compounds and material manufactured by the Standard Paint Company, of New York, are issued, continue to be recognized as synonymous with preservative and roof paints, insulating tape, armature and field coil varnish and other insulations, as well as various products of rubberoid, which are manufactured by the Standard Paint Company. This company reports that its business during 1898 in electrical compounds was considerably in excess of that in any previous year since the organization of the company. The sale of this material in Europe is particularly satisfactory, and the P. & B. electrical compounds and armature and field coil varnish are rapidly attaining as high a position in the estimation of electricians there as they have in this country. The branch factory at Hamburg, Germany, has been kept busy ever since it opened at the beginning of 1898, not only in the manufacture of materials referred to above, but also in that of P. & B. preservative and roof paints, building sheathing and insulating papers and rubberoid roofing. The company also states that the orders for P. & B. insulating tape in both Europe and America have for some months past been far in excess of that in any previous time since the company began the manufacture of goods.

Handsome Parlor Car

The accompanying engravings show a director's parlor car recently constructed by the American Car Company of St. Louis for the Baltimore City Passenger Railway Company of Baltimore, Md. The car has elicited favorable criticism from quite a number of railway officials, and the following description will be of interest.

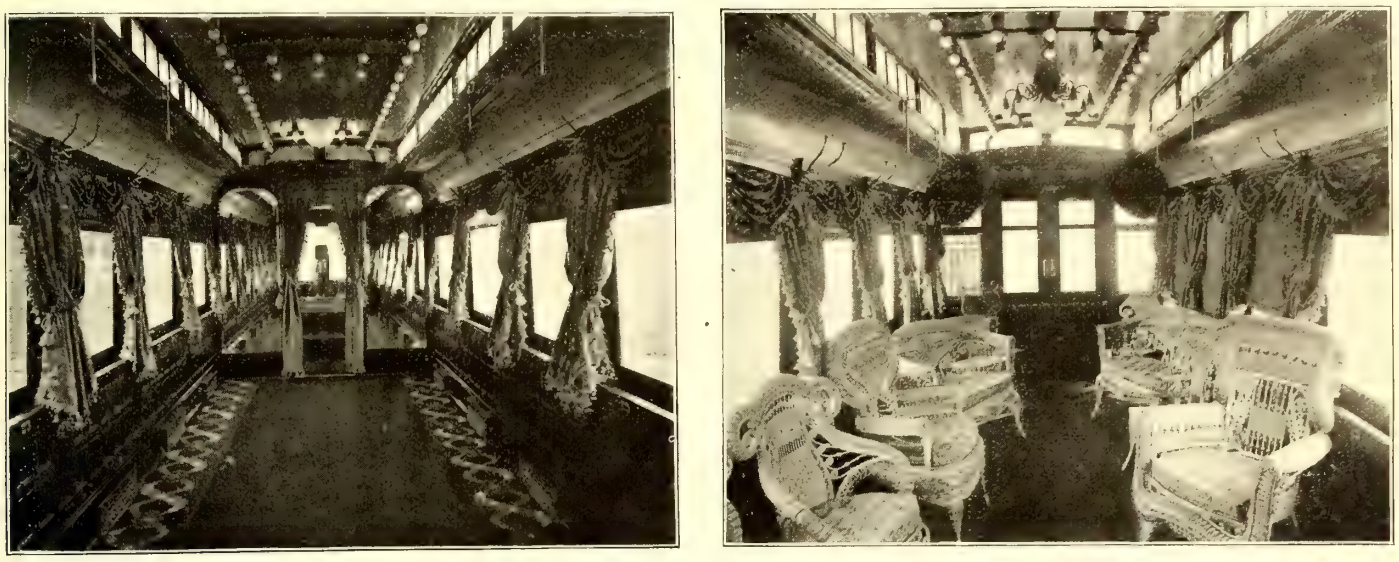
The body is of the swell and concave panel type, 30 ft. over corner posts, with 5-ft. platforms, and is mounted upon high-speed double-motor trucks. The smoking compartment is 10 ft. in length, and the ladies' parlor 20 ft. The doors leading to either compartment from the platforms are of the twin automatic type. The eight side windows are double-sashed, and glazed with beveled crystal polished plate, two windows at the center having large observation lights. Between linings on the inside the car measures 8 ft. in the clear.

The wood for the interior finish is a finely figured East Indian mahogany, known to the trade as Padouk, and was specially imported for this car. It is solid throughout, and a few beaded mouldings and delicate carvings stand out in clear-cut bold relief on the smoothly polished surface, accentuating the rich glowing amber and vermillion tints natural to this species of wood.

The interior lines of architecture are plain, modest and neatly elaborated into the colonial and empire style. The upper deck, being very broad, is recessed into a secondary dome, from which the opalescent center electroliers depend, surrounded and bordered seemingly by a myriad of translucent electric globes encased in bronze gilt husks.

The curtains are of green, silk-faced pantasote, mounted on spring rollers and Acme holding devices. The overhangings, portieres and upholstery are of a luxuriant texture in soft green tints, harmonizing nicely with the Royal Wilton floor rugs. The reed furniture of fantastic designs is stained and tinted to match the general color scheme. Two cheval mirrors are set in massive frames at the further end of the ladies' parlor.

Every convenience conducive to comfort and luxury has been admirably placed and planned. The appointments include adjustable tables for games and refreshments. A folding lavatory and ice cooler, as well as a cosy buffet closet, find place in the smokers' den. The refrigerator, supply chests and tables are carried beneath the car body, being suspended between the trucks.



INTERIOR VIEWS OF PARLOR CAR

Twelve electric Gold car heaters are placed in the side walls, and a regulating switch turned to any of three points provides a varying degree of heat. A system of electric call bells is arranged to conveniently summon either porter or conductor, and the latter signals to his motorman by touching a push button. The other motor car accessories are of the latest and best types in use, and were specially manufactured for this car. The hardware trimmings, coat and hat hooks and parcel racks are of gold bronze. The electric headlights are 14-in. copper, silvered reflectors, incased in solid bronze frames.

The platform gates are of solid gold bronze of the grille folding type, and the dashers are capped with bronze and ornamental scroll designs. The exterior decorations of this car are in entire harmony with its interior furnishings. The color is a rich olive, the striping and ornaments gold, the lettering trim and neat. The car is called "Maryland," in honor of the state of that name.



PARLOR CAR, BALTIMORE

Car Building in St. Louis

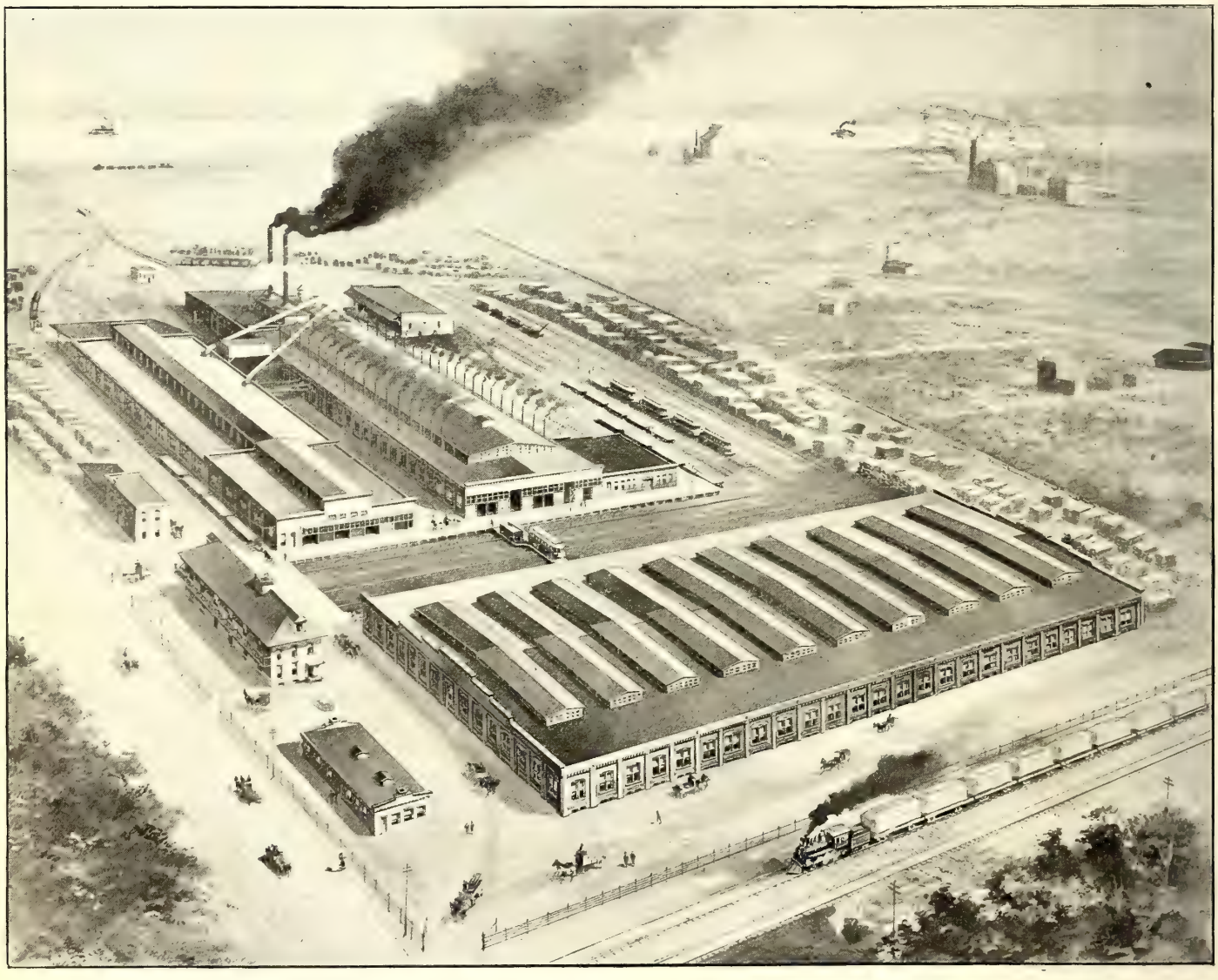
St. Louis has long held a commanding position in the lumber market, and has been regarded as a center for all lines of industry in which lumber plays a prominent part. Its leading position in the car building industry, particularly that of street railway cars, has long been recognized, and this will now undoubtedly be increased with the new facilities for building cars possessed by the city through the completion of the new works of the St. Louis Car Company.

Ten years ago the most sanguine street railway man hardly dreamed of the coming development of the street railway industry, but the introduction of electricity has so widened the possibilities of street car service that the field to-day offers opportunities to the manufacturer almost equal to those of the steam roads. With 50,000 street cars running on some 1500 different lines in the United States, and with scores of new roads being constantly added to the list, without considering the foreign demand for this class of rolling stock, the necessity of supplying this equipment and replacing worn-out or out-grown equipment has created a competitive interest between the manufacturers, and compelled them to improve their facilities, which were considered more than ample a few years ago.

To this end the St. Louis Car Company, of St. Louis, Mo., has just completed the erection of the new plant mentioned, which is complete in all modern improvements. The works were planned and laid out by an experience born of years of car building, and incorporate every idea for the successful and economical building of street cars.

The site is on the north side of the city on the line of the St. Louis, Keokuk & Northwestern Railroad, at a point convenient to the North Broadway street cars, and covers some twenty acres of ground. The idea kept uppermost in mind in laying out the works has been to so plan every detail that each piece going into the construction of a car will be handled the least possible number of times and, during the various processes which it must undergo, will be carried the least possible distance.

The shops are equipped for turning out everything necessary in the construction of a car. In the rear and to the east of the buildings are the yards for the storing and curing of raw material. These are served with a system of stone ballasted tracks, 4 miles in length, and equipped with four electric motor engines or dummies, power being furnished by overhead electric system. The railroad company connected with the plant is not required to do any switching whatsoever, as all freight cars are moved with the electric dummies and all raw material is handled in this manner. As the various shops are covered with a network of tracks, it is possible to load the material from the yards or directly from the cars, by smaller dummies, which deliver the material to the very spot where it is required.



WORKS OF THE ST. LOUIS CAR CO., ST. LOUIS, MO.

Opening into the yards on the rear are the blacksmith and machine shops and the mill. The mill is separated lengthwise into three divisions; through the first go all heavy materials, such as sills, bottom and platform materials, through the second all heavy irregular pieces, and through the third the lightest pieces. From this shop the material goes to the cabinet shop, each part passing successively from workman to workman and from machine to machine until it reaches the further end completely finished and ready for the erecting shop. In one corner of the mill is a department for sharpening and repairing wood-working tools; one man, with the assistance of several automatic grinding machines, can keep all the shop tools in good condition.

In the blacksmith shop the conditions are similar to those in the mill. Here are lines of forges, steam hammers, presses, bolt cutters, lathes, etc., and each step forward of a piece of material brings it so much nearer to its finished condition. In one end of the

blacksmith shop is the truck department, where the St. Louis Car Company trucks are manufactured. A future article will be devoted to the advantages of these trucks, which are giving the greatest satisfaction. Adjoining the blacksmith shop is the store room; in the rear of the blacksmith shop are the engine and boiler rooms. A right and left-hand engine are coupled together, making a double engine of 750 h.p., which furnishes the motive power for the plant. There is also installed a smaller engine directly connected to an electrical generator for furnishing light and power.

In case of emergency electric motors are distributed in various parts of the mill and blacksmith shop connected with outside Commercial Electric wires, which will enable the work to go on at any time should any mishap take place in the engine room. An air compressing plant is about to be put in, and will be utilized in the construction departments, and will enable a more rapid construction than can be possibly supplied by manual labor.

The boiler room has five fire tube boilers with a capacity of 750 h.p., with a refuse from the mill that will furnish an abundance of fuel in the summer time. The small quantity of coal required in the winter time is maintained at a minium cost, St. Louis being in the center of the most abundant steam coal region in the world.

Along the eastern end of the blacksmith and mill runs a wide platform, from the western end of the erecting shop projects a corresponding one, and between these runs a traveling electric table 60 ft. long. The range of this table is the full length of the erecting shop, and it is equipped with block and tackle, and a winding drum; by its means two men can load cars, trucks, or car load of material from any part of the shops and deliver them to any other part. When cars are completed for shipment with motor attachments, they are run out of the erecting shop on to the flat car in two minutes.

The erecting shop is 300 ft. x 624 ft. This immense building is entirely under one roof and contains 55,000 sq. ft. of glass; it is 20 ft. in height, has forty tracks and a capacity for 300 cars. The construction of a car body is started upon small wooden trucks and the car is not moved until it is ready to be shipped. The eastern end of the erecting shop is reserved for the painting department, where panels, head linings, etc., that require to be painted before entering into the car, are given attention. The manufacture of car seats, which is a special feature of this company, is also carried on in a part of this large building. The painting department is equipped with all modern improvements, and equal to any set apart for that purpose. A small building to the west of the erecting shop contains the storage room for oils, varnishes, etc.; the machinery here for grinding and mixing pigments is operated by a small electric motor.

The buildings are all of brick with composition roof, are made to afford excellent ventilation, and throughout the shops are distributed 1100 incandescent and 75 arc lights.

The blacksmith and machine shops are heated with a hot air system which will raise the temperature from zero to 60 degrees in an hour. In the erecting shop, the largest single building on the place, is installed the Warren Webster exhaust steam heating system. By its use it is possible to heat the entire building with exhaust steam with an atmospheric pressure and down to 3 in. of vacuum, that in the very coldest weather a comfortable temperature can be obtained, and with the additional advantage that no dust can interfere with the painting in this shop. The system requires 50,000 ft. of 1½-in. pipe, and is one of the most improved methods of heating, and at the same time the most economical.

The general offices adjoin the shops on the west. They are large, commodious, elegantly furnished. The doors, railings, fittings, desks, chairs and every article of furniture are of mahogany and in every way modern and up to date. On the second floor of the office building is the draughting department and the photographic department. The latter is completely equipped with all modern photographic appliances, dark room, etc., and every car built is photographed. A telephone system connecting all departments with the office is one of the many convenient arrangements of the new plant.

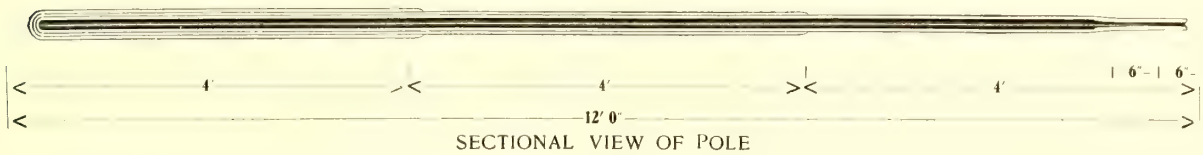
For the purpose of delivering its products the St. Louis Car Company has one hundred 60-ft. modern flat cars, which are operated over all the railroads in the country, and are especially built and designed for this service. Within the last year these cars have been loaded with street cars for almost every important city in the United States, and the foreign shipments of the St. Louis Car Company have been to Germany, England, Ireland, Brazil and various South American ports.

Cold Drawn Seamless Steel Trolley Poles

The use of cold drawn seamless steel tubes for structural and other work has demonstrated so clearly the strength of this material that railway managers have been interested in learning the application of this material to trolley poles. The accompanying engravings show a pole of this character manufactured by the Shelby Steel Tube Company of Cleveland, Ohio. The pole is built up of three pieces of cold drawn high carbon seamless steel tubing, which are put together in the manner shown in Fig. 2, after which the surfaces are cold welded. This makes, it is claimed, a pole having a maximum amount of strength with a minimum weight, and one which will meet all requirements without accident and delay in traffic.



SEAMLESS STEEL TROLLEY POLE



SECTIONAL VIEW OF POLE

Spiral Springs

One of the oldest establishments in the United States for the manufacture of spiral springs is owned by Miller & Van Winkle, of Brooklyn, N. Y. For about thirty years this firm has made steel and steel wire springs for all purposes, and its collection of dies now includes one for almost every form of spiral spring that can possibly be required.

The springs manufactured by Miller & Van Winkle go into a large variety of industries. Among the standard forms carried in stock in all sizes are trolley springs, packing valve springs, dynamo and motor brush-holder springs, upholstering springs, machinery and electrical springs; also tempered steel wire and flat steel springs. The officials of the firm give as a reason for the steady growth and increase of their business the fact that they give extremely close attention to the purchasing of all materials that enter into the manufacture of their products, an expert being employed to do all the purchasing. The same care and watchfulness are exercised throughout the entire process of manufacture, every detail of construction and workmanship being given close consideration.

As an indication that the Miller & Van Winkle goods give satisfaction, it may be stated that their springs have been in use on the Brooklyn Bridge for a number of years, and several large contracts have also been received from the United States Government.

The Frank Ridlon Company, of Boston, has made an important addition to its force by the acquisition of Charles N. Wood, who has been elected vice-president of the company, and who will hereafter combine his business with that of the Ridlon Company. This latter will, therefore, continue the important agencies in New England which Mr. Wood has been conducting so successfully under his own name, viz., the R. D. Nuttall Company, the International Register Company, the Van Wagoner & Williams Hardware Company, the Bradford Belting Company, the Monarch Stove & Manufacturing Company, the American Electric Heating Corporation, and Wilson, Thomson & Company. It is the intention of the Ridlon Company to establish in this connection and under Mr. Wood's management, a strictly street railway supply business. It will be in a position to fill orders for all street railway supplies, and its facilities for doing repair work and rewinding armatures are the very best. For the time being Mr. Wood will continue his office at 31 State Street, but as soon as the company can obtain commodious offices, of which it has leases at 200 Summer Street, the business will be consolidated in one office.

New Attraction for Street Railway Parks

The demand made by street railway managers for new attractions at parks and pleasure resorts has led a number of companies which make a specialty of supplying attractions of this kind to devise several novel and ingenious arrangements for the coming season for attracting pleasure seekers. Among the most noticeable of these is one furnished by Paul Boyton, of Brooklyn, N. Y., who is one of the best-known inventors of amusement enterprises in this country. His latest idea is known as a "Trip Down the Rivers of the World," and bids fair to rival in popularity the "shoot the chutes," of which he is the inventor.

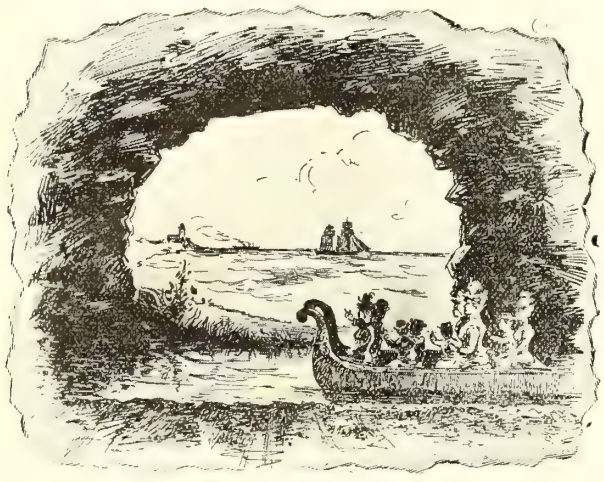


FIG. 2.—VIEW FROM CAVE

This latest attraction consists of a miniature river from 4 to 5 ft. wide and 24 ins. deep, in which is a strong current of water to carry the boats loaded with passengers for a long, cool ride through artificial tunnels, caves and rocky caverns, with openings at intervals, through which the voyagers observe the most pleasing scenery. The river way is built of wood made water-tight, so as to prevent all leakage, and can be made any length, although the best results have been obtained with a length of from 1200 to 1400 ft. The river can be built in almost any sized and shaped lot, but preferably in an oblong space about 100 ft. x 300 ft. A gentle grade is given the river bed by making one terminal about 18 ins. lower than the other. This has been found sufficient to give a fairly swift current throughout the entire length of the stream, and a small 10-h.p. gas or steam engine or electric motor-driven pump is employed at the termini to lift the water from the lower end back into the higher end. In this way the same water can be used over and over again, the only loss being from evaporation.

The boats are sent out without attendants, as it has been found that the current will take them around without any difficulty whatever, and all the employees required to operate the entire attraction are a ticket seller, ticket taker, engineer and two or three men to load the boats and take charge of them at the terminal. The boats are lifted from the lower level to the higher one on rollers. The scenic effects are secured by placing painted screens immediately in front of the openings in the wall along the river. The scenery may be varied, of course, to meet any requirements, and can be changed at intervals at slight expense. A favorite scheme is a representation of a trip down one of the principal rivers of the world, in which the prominent points of interest along each shore are seen. The impression would be, after riding in one of the rapidly moving boats, that a trip of fully a mile or more had been taken, when, as a matter of fact, the distance covered might not be more than a quarter of a mile. The accompanying diagram, Fig. 1, gives an excellent idea of the general arrangement of the river, showing the openings, with scenery screens before them. Fig. 2 shows a possible view from one of the caves.

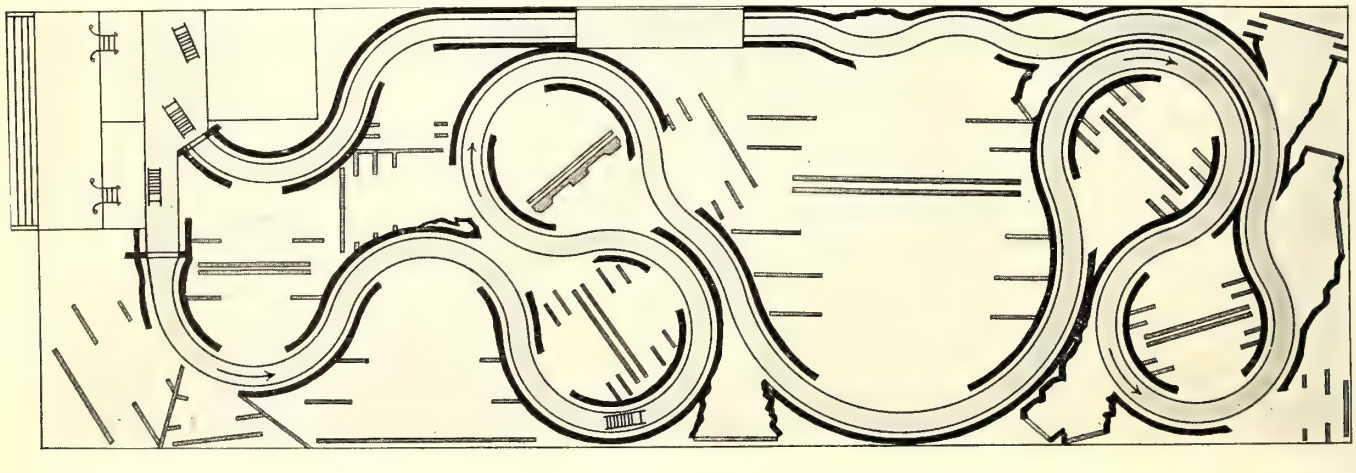


FIG. 1.—GROUND PLAN OF A SCENIC RIVER

Rolled Steel Gongs

Signal gongs and conductors' bells, cold pressed from steel plate, have been extensively used for a number of years in place of gongs made from cast metal, and there seems to be an increased demand for them. The special claims made for this type of gong are that they are not liable to crack or break, and that the tone is agreeable and can be regulated to any pitch. The Pittsburgh Steel Hollow Ware Company of Allegheny, Pa., is the principal manufacturer of this type of gong, and the gongs are made in all sizes, from 3 ins. to 20 ins. in diameter. The prevailing size for street railway service, however, is 14 ins. The products of the firm embrace in addition to gongs for street railway service, locomotive trip gongs and gongs for fire apparatus. Besides this, the works turn out large quantities of circular coulters, which are sold to the manufacturers of plows and agricultural implements.

The gongs are all pressed or stamped from circular metal plates, which are purchased, already circled, from neighboring steel mills. The peculiar tools employed in the process of manufacture press the metal into shape without forming any wrinkles or kinks, and give a uniformly smooth surface. The company has recently undertaken the manufacture, by the same process, of large church bells and bells for musical chimes, the tone being regulated by the gage of the metal and the amount of carbon it contains. The works of the company are located at Cheswick, 14 miles from Pittsburgh, and occupy two buildings, the principal one of which is 75 ft. x 200 ft., the other a warehouse, which is 25 ft. x 60 ft. The tool equipment is mostly of the company's own design and manufacture, and is of such a character as to enable it to compete in price with any other dealers. The products of the works go to all parts of the world, and as noted above, the demand for these goods is constantly increasing. The works employ about thirty-five men, and have a capacity for turning out 1000 car gongs a day. The company was organized in 1892, and the works are operated under the direction of the following officers: John S. McIntosh, president; Joseph McNaugher, secretary, and J. T. Duff, superintendent.

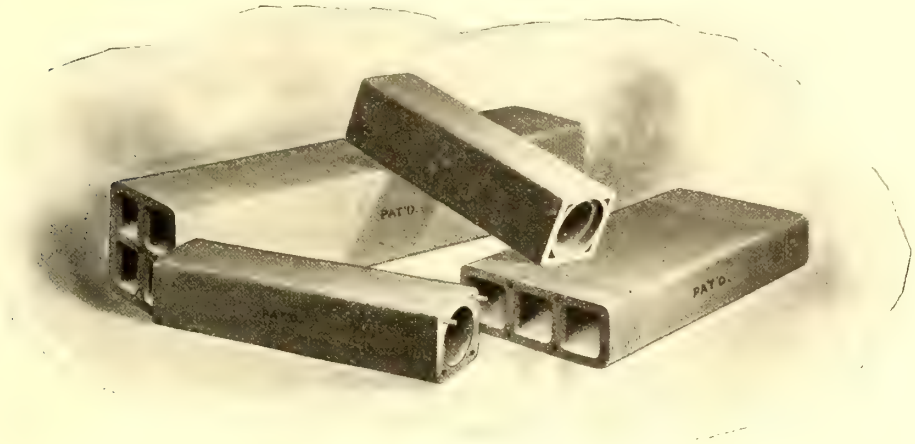
Electric Railway in Thorn

The electrical equipment of the Thorner Strassenbahn of Thorn, Germany, which was recently installed by the Electricitäts Gesellschaft, Felix Singer & Co., of Berlin, was put in electrical operation Feb. 1. The same company has also undertaken the construction of a new electric line from Thorner to Mocker, as well as the electric lighting station for both cities, and both of these will soon be put in operation.

Contracts for Conduits in Baltimore

The board of awards of the city of Baltimore, upon the recommendation of the chief engineer of the electrical commission, Charles E. Phelps, Jr., recently awarded the contract for the entire electrical conduit system for the city of Baltimore to the American Vitrified Conduit Company of New York, of which C. J. Field is general manager. This contract is for several million feet of vitrified tile, multiple duct conduits, the multiple being from 2 to 16 ducts. It was let upon specifications which were very carefully prepared by Mr. Phelps, and on which bids were received for various kinds of multiple and single duct tile conduits, cement pipe, wooden and indurated fibre, etc. The system of conduits about to be installed will include provisions for all the electric light, street railway feeder, telephone, telegraph and other wires throughout the city, and the latest practice in installations of this kind in all the large cities of the country has been carefully studied, and the best points from each adopted.

In addition to this contract, the American Vitrified Conduit Company has on hand a large number of orders, some of them from the leading cities of the country, for conduits of different patterns. Among these are one for several million feet from the Narragansett Electric Lighting Company of Providence, and an order for several thousand feet from the Edison Electric Company and the Western Union Telegraph Company at New Orleans, where some of the most difficult problems in underground construction are being worked out. The same company is taking contracts for complete installation of systems, including all details, where it is desired. The accompanying engraving shows some of the ordinary types of conduits made by this company.



DIFFERENT TYPES OF CONDUITS

A Change of Name

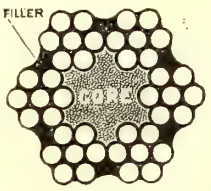
The Falk Manufacturing Company, of Milwaukee, Wis., has decided to drop the word "manufacturing" from its title, and will hereafter be known as The Falk Company. This change is made because one of the most important parts of the company's business is that of acting as engineers and contractors in the building of street railways, so that the word manufacturing does not seem appropriate. With this change of name the company has also been making other important changes, which will result in materially enlarging its facilities for business. During the last month it has acquired the plant and business of the Western Gear Company of Milwaukee, which, as is well known, has been a large manufacturer of street railway gears and pinions. As Mr. Falk, president of the Falk Manufacturing Company, has also been president and a heavy stockholder in the Western Gear Company, the combination of interests was only natural.

The Falk Company has also purchased a large tract of ground about a mile east of its present works, upon which it will immediately begin the erection of three large buildings for steel foundry, machine and blacksmith shops. The buildings will be entirely of brick and steel, equipped in the most modern manner, with open-hearth steel furnaces, electric traveling cranes, compressed air, etc. All of the machines will be driven by the independent motor system, doing away with pulleys and shafting. The company will add to its business the manufacture of steel castings for all purposes, and will also enlarge and improve its special work department. While pushing energetically the work in its manufacturing and construction departments, the company will be even more active than heretofore in the field of cast-welding, and in efforts for improvements in that direction. As stated previously, the company will appeal from the recent decision of the United States District Court in St. Louis adverse to one of its patents, and will also vigorously defend its rights in all of its other patents.

The additions to and reorganization of the company's business mentioned above have also brought about some changes in officers. Mr. Falk and Mr. Wurster will continue as president and secretary and treasurer, respectively, while Mr. Smith, who has been general superintendent and engineer of the company, will be vice-president. Adolph Quentin, late vice-president of the Western Gear Company, will be second vice-president of the Falk Company, and Charles L. Jones, secretary of the Western Gear Company, will be assistant-secretary of the Falk Company.

Preservation of Wire Ropes

The acquiremnt of a material for treatment of the manila or jute core in the process of manufacture of wire ropes possessing pliability, lubricating and waterproof qualities, and free from destructive acid, has been diligently sought by wire-rope manufacturers. There are numerous places where wire ropes are liable to become water soaked almost immediately after installation (where not specially prepared to resist moisture), such as cable railway service, wet mines, dredging machinery, power transmission, and in many other places of exposure. The wire ropes of elevators in offices, stores, warehouses, and in general buildings sometimes show an outside corrosive effect, which too often is but suggestive of the more serious hidden internal conditions. Not infrequently the interiors of wire ropes reveal disintegrated cores and corroded wires, even where there may be but little evidence of deterioration externally.



CROSS SECTION OF ROPE

The illustration herewith presented shows application of a special material, known as "wire rope filler," by which the core is lubricated and a flexible cushion interposed between it and the strands. The filler, exuding between wires, prevents abrasive wear, seals against acid, gaseous, sulphurous or water attacks, and forms foundation on which an outside coating should speedily build. Many of the prominent wire-rope manufacturers have adopted the use of this filler on all kinds and sizes of operative wire ropes. The manufacturers of this filler also make an outside coating, termed "wire rope shield," for external protection against abrasive wear, and to completely seal against exterior attacks. A substantial increase of life is evident from the internal treatment, and furthered by the external protection. The Ironsides Company, Columbus, Ohio, manufactures these materials.

International Tramways Union

The secretary of the permanent International Tramways Union, F. Nonnenberg, of Brussels, has just issued the official report of the tenth annual convention of that association, held at Geneva in August, 1898. It is also announced that the following questions will be discussed at the next convention of the union, to be held in Paris in 1900:

1. How have urban rates of fares been changed in the last five years? Why were changes made? What are the results as affecting receipts, expenses and profits? Give total figures, and figures per car mile. Do you consider your present rates reasonable?

2. What have been the consequences of electric traction upon the operation of transformed lines, as affecting traffic, expense of operating and net profits? Give total figures and figures per car mile. State nature of your electric lines as to profile, and also special circumstances influencing results, such as duration of concession, etc.

3. What are the advantages and disadvantages of narrow and

standard gages, particularly in view of the use of powerful motors?

4. What is the arrangement and equipment of your power station? (There is inclosed a list of questions covering the station, equipment and operation in great detail.)

5. What is the best system of distributing current in extensive systems using electricity—continuous, alternating, polyphase?

6. Have you used the Falk joint? For how long? On what length and what type of roadbed have you used these joints? On what technical considerations did you adopt it? What is the cost, giving items of cost in detail? What proportion of the joints break? Why do they break? Do the number of failures vary with the season? After what time do they occur? What is the maximum length of rail you have been able to cast-weld without making special expansion joints? What else can you say on this point?

7. What progress has been made concerning accumulators, as to construction, increase of capacity, decrease of weight, duration, cost of maintenance, practical and economical application on tramways?

8. Give your experience as to the best means of heating cars. Give cost of installation, operation and maintenance of the various systems you have employed.

9. What are the advantages and disadvantages of operating branch lines as compared with main lines?

No Car Vestibules in New York

The question of the advisability of compelling the street railway companies in New York City to vestibule their cars was considered at a meeting of the Board of Aldermen on Jan. 24, 1899. The proposed ordinance, which was introduced Oct. 4 by Alderman Gledhill, provided that the front platform of every car in the City of New York "operated by electricity, cable, compressed air or any other motive power except steam and horse . . . shall be vestibuled or enclosed so that no passenger shall be permitted to ride thereon, under penalty of $25, for each violation." The ordinance was referred to the committee on railroads, who held public hearings on the subject, but no advocate appeared for the measure. The committee, therefore, at the meeting Jan. 24, rendered the following report:

REPORT.

The humane purpose of the measure is fully appreciated by the members of the committee, who are in full sympathy with our vice-president, as to the necessity of devising some means to relieve gripmen, motormen, drivers, etc., from the severe hardships of storm and weather.

We feel, however, the remedy proposed is impracticable in this city, and that if applied, life and limb of pedestrians would be in jeopardy, while truckmen and others in charge of vehicles of all kinds would be in constant peril.

We have taken from the stenographer's report, and make as part hereof, the logical argument presented by one of the counsel at our hearings, to wit:

"It is really impossible to put vestibules on cars operated in the city, because, in case of a snow-storm, rain or sleet, or storm of any kind, unless the motorman drops the front glass, it is impossible for him to see more than a few feet ahead of him; and after he has gone a mile in a storm such as I have described, it would be impossible for him to see anything outside of the glass."

. . . . "It may be true that it might be tried with success in other cities, it is equally true that it would not do for traffic in the City of New York. The congested traffic in the City of New York would not allow it, in the first place. . . . Take a snowstorm like we had last week and you would find it would be absolutely impossible for a motorman to run a car even a single block with glass up in front of him. He could not run his car even at a snail's pace without striking something. You must remember that a motorman has an awful lot to do. He has got to attend to his brake. He has got to set the car in motion. He has got to start the car and stop it. He has got to listen to the bell signals. He has to look out for parties on both sides of the street. He has got to watch the track on the surface of the street in front of him. He has got to look out for small objects on the track as well as large objects, such as trucks and carriages. He has got to be alert every minute. He has got to look out for the people standing on the sidewalks wanting to get on, and he has got to listen for the conductor's bell for people wanting to get off. He has got to look out at the corner of every street for people wishing to cross the streets. He could not possibly attend to all of these things if he was enclosed in a glass case."

Another of counsel presented the following valuable opinion:

"I have heard the statement that in other cities they have tried the vestibule with success. I know they use it in Buffalo, and I have a letter in answer to one which I wrote to the manager of the Buffalo Railroad, Mr. H. H. Littell, one of the best railroad men in this country, to whom I propounded certain questions on the subject of this proposed ordinance, to wit:

" 'Do you operate vestibule cars on your road?'

"Answer—'We have about one-fifth of our cars equipped with vestibules.'

" 'Do you consider the danger of accidents to the public using the streets is increased by the use of vestibule cars in crowded cities where the climate is cold and stormy during the winter months?'

"Answer—'We find the percentage of accidents very much greater where vestibules are used than we do where they are not. They obstruct the view of the motorman when he most needs the protection afforded by the vestibule, and he is compelled to throw open the front glass in order to see. We find that during rain, sleet and soft snow it adheres to the glass and prevents him from seeing. In such cases he is forced to open the vestibule and stand in a draft which results in severe colds and sickness.'

"In other words, Mr. Littell claims that it creates a special draft, and is liable to be an injury to the motorman. He then goes on to answer the following questions:

" 'Do you think an ordinance of this character would benefit the public, irrespective of the railroad's interests?'

"Answer—'I do not see how the public could be benefited by an ordinance requiring vestibules. On the contrary, I think that vehicles and pedestrians would be subjected to a great deal more danger from vestibuled cars that obstruct the view than from open platform cars.'

"We look at this thing in exactly the same light as Mr. Littell. I am the engineer of the Nassau Electric Railroad of Brooklyn, and I know it is not a question of expense with the company that I represent in the slightest degree. Our streets in Brooklyn are narrow, as you all know; they are crowded, and they are used by a great many vehicles. We have to run our cars on a certain schedule time in order to give any rapid transit at all; and if we were to put these vestibules on our cars, I do not see how we could make time, without running the risk of a greater number of accidents than we have now. We have accidents enough now, as everybody knows, and we certainly do not want to increase the number."

The following from "The Municipal Record and Advertiser," of Feb. 26, 1898, on the subject of vestibules, sustains fully the views heretofore quoted, and has had much weight in influencing your committee to report adversely hereon, i. e.:

"The street car vestibule is, comparatively speaking, a new product in the street railway industry; as it has only been during the last four winters that it has been used to any extent. By the laws of many States the railroads are compelled to use them, and there is also a growing sentiment among managers in favor of it, even where there are no laws compelling its use. But there are also managers who will not think of adopting the vestibule unless they are finally driven to it by the courts. . . . The serious objection is the danger of running down pedestrians and running into other vehicles.

"The vestibule is simply put on the ends of the cars as a protection to the motorman, who has to face the storm, and in consequence must, in certain weather, suffer considerably; but, if he is unprotected, he is in a position to see whatever is in front of him on the street, and can manage his car accordingly. With the vestibule, at best, he can only see in front of him, and at certain angles, at the sides, as the woodwork of the vestibule shuts off his view to a great extent. In storms and snows, just when he needs the protection, he has to open the front window and stand with his face to the storm, as of old, or his view will be entirely cut off, and accidents absolutely certain to occur. If he keeps the window closed, the snow or rain will accumulate on the glass and render the operation of the car impossible. As it is, even with his face exposed, the accident possibilities are greatly increased, as the side windows are rendered nearly useless in any kind of snowstorm. Again, in very cold weather, if the windows of the vestibules are not made double, but in single panes of glass, the different temperatures of the outside and inside surfaces of the glass will cause a frosting, or thin sheet of ice, to form on the glass, through which it is impossible to see. And even if the windows are put in double, in a snowstorm where the flakes of snow are large and damp, the snow will stick to the outer glass and impair the view of the motorman.

"This one objection, on account of the greatly increased possibilities for serious accidents to the public in general, is sufficient

to condemn the use of vestibules in climates that are subject to very cold and stormy weather. The benefit is only for the few employees of the road, but the danger is for the whole public at large. This danger has been considered by railroad men to be so great that many roads have refused to equip their cars with vestibules, even though the law demands it, and they are going to let the law take what steps it may, and then fight the question out in the courts. . . ."

The importance of this subject and the desire to afford relief to the men at the front end of our cars prompted one of our members, Alderman John T. McCall, while recently at Springfield, Mass., and at Hartford, Conn., where vestibule cars are being operated, to inquire from railroad men whether they were beneficial and practicable. The responses were in the negative and the views expressed conformed absolutely to those hereinbefore quoted.

We offer the following:

Resolved, That the committee on railroads be and it is hereby discharged from further consideration of the proposed ordinances relating to vestibules on surface railroad cars, and that the said proposed ordinance be placed on file.

The recommendation of the committee was followed by the board.

Personals

MR. H. B. WESTCOTT has been appointed general manager of the Cortland & Homer Traction Company of Cortland, N. Y.

ING. S. TIVOLI has resigned from the general managership of the tramways of Alexandria and is now engaged in the commission business in that city.

MR. H. H. LITTELL, vice-president and general manager of the Buffalo Railway Company, left Feb. 26 for a two months' trip through Mexico and California.

MR. TOLNEY W. MASON, JR., has succeeded Thos. H. Gibbon as chief engineer of the Lap Joint Railway Track Company, of New York, Mr. Gibbon's term having expired Feb. 2, 1899.

MR. W. F. D. CRANE, who for seven years has been connected with the H. W. Johns Manufacturing Company, in its electrical department, has associated himself with the Electrical Vehicle Company of New York.

MR. C. G. ADNEY, formerly assistant superintendent and chief electrician of the Northeast Electric Railway Company of Kansas City, Mo., has accepted the same position with the Ogden Electric Railway of Ogden, Utah.

MR. GEO. H. PEGRAM has been appointed chief engineer of the Manhattan Railway Company of New York, and JOHN WATERHOUSE, formerly chief engineer, has been appointed consulting engineer of the system.

MR. W. C. WEAVER has retired from the management of the Northeast Electric Railway Company of Kansas City, Mo., and has accepted a position as general manager of the Ogden Electric Railway Company of Ogden, Utah.

MR. J. F. HINES has been appointed superintendent of the Winchester Avenue Railroad Company of West Haven, Conn. Mr. Hines has been connected with this road for seven years, as foreman and inspector of the city lines.

MR. WILLIAM A. GRAUTEN, formerly chief engineer of the Hartford Street Railway Company, and later of the Middletown-Goshen Traction Company, has been appointed chief engineer of the Union Railway Company of New York.

MR. HENRY H. ARCHER has accepted a position as general manager of the Belmont Tram Company of Port au Spain, Trinidad. Mr. Archer is quite well known in the United States, having been connected with the Scranton Traction Company of Scranton, Pa., and also with the J. G. Brill Company of Philadelphia.

MR. F. L. HART, general manager of the City Passenger Railway Company of Baltimore, Md., has made a splendid record for economical and effectual management. The experts who have been examining the books of this company in the interests of the syndicate that has recently purchased the property, characterize the economical showing made as "remarkable."

MR. WM. E. BAKER has been appointed general superintendent and chief electrical engineer of the Manhattan Railway system of New York. Mr. Baker for some time has been connected with the Metropolitan Elevated of Chicago, and is therefore perfectly familiar with the engineering problems arising in the application of electricity to elevated railways.

MR. H. G. FLEMING, general manager of the Little Rock Traction & Electric Company of Little Rock, Ark., has given up that position, and will be succeeded by Mr. Walter A. Badger of Boston. Mr. Fleming voluntarily resigned for business reasons, and he was presented on his departure with a letter from the directors of the company expressing their regret that he had found it necessary to leave.

LIEUT. T. C. WOOD, president of the Ball & Wood Company of New York, and who served on the "Gloucester" under Lieutenant-Commander Wainwright during the war with Spain, has been recommended for advancement eight numbers by the board of officers appointed by the Secretary of the Navy to examine into the records of the officers of the navy who made themselves conspicuous by their bravery.

MR. ALEXANDER S. GARFIELD, consulting electrical engineer with the Compagnie Francaise Thomson-Houston, arrived in the United States late in February, and will remain here from two to three months. Among other things he will inspect and pass upon the new electric locomotives for the Orleans Railroad, now building at Schenectady by the General Electric Company, and which are to be delivered by next fall.

MR. J. CLIFTON ROBINSON of London, received a very pleasant reminder of his popularity with the employees of the London United Tramways Company, of which he is managing director, upon the silver anniversary of his marriage. A committee of the tramway men waited upon him on that occasion and presented him with an elaborately engrossed address, and Mrs. Robinson with a diamond star brooch and earrings.

MESSRS. HENRY GRAFTIO, engineer of ways of communication of the Russian Government and BRONISLAS DE MINKEVITCH, railway attaché of the Russian Government at Paris, are visiting this country to investigate the subject of the electric equipment of suburban and heavy railroads. They will visit Hartford, Baltimore, Detroit and several other cities where this class of road has reached a large development, before their return to Europe.

MR. W. F. KELLY, general superintendent of the Columbus Street Railway Company of Columbus, Ohio, delivered an interesting lecture before the Department of Economics of the Ohio State University recently upon the subject of street railways. Mr. Kelly very ably compared European and American tramway practice, showing the rapid development made in America, and also gave an account of some of the operating difficulties encountered in Columbus.

MR. W. B. BROCKWAY, in recognition of his efficient services, has been promoted to the position of secretary and auditor of the Toledo, Bowling Green & Fremont Railway Company of Toledo, Ohio. Mr. Brockway was for some years assistant secretary of this company. His energetic work in connection with the Street Railway Accountants' Association of America has made Mr. Brockway very well known throughout the street railway field, and has gained for him many friends.

MR. G. PELLISSIER, the well-known French electrical engineer, arrived in New York recently from Havana, where he has been in the interests of a French syndicate, which, with the Harvey Syndicate of New York, has recently purchased the street railway system of that city. Mr. Pellissier's last visit to this country was about a year ago, when he was on a trip to New Zealand to investigate the street railway conditions in Aukland, with a view to the electrical equipment of the system in that city.

MR. W. W. CHURCHILL has been appointed to the position of mechanical engineer of Westinghouse, Church, Kerr & Co. of Pittsburgh. Mr. Churchill has been closely associated with all of the largest engineering work of Westinghouse, Church, Kerr & Co., including the Boston terminal and Third Avenue Railway power station, and well deserves the place and title which has been given him. He is a graduate of Cornell University of the class of '89, and has been with the Westinghouse Company for nine years.

DR. LOUIS DUNCAN, long well known in engineering circles as the engineer in charge of many important electric railroad installations, including the Baltimore & Ohio Tunnel electric plant in

Baltimore, and the Third Avenue Railroad in New York (on which he is now engaged), has taken into partnership Lieut. M. K. Eyre, a graduate of the Annapolis Naval Academy, and for several years past manager of the Edison Lamp Works at Harrison, N. J., which he left to join Dr. Duncan. The new firm will be conducted under the name of Duncan & Eyre, and its principal office will be in New York city.

MR. H. F. J. PORTER of the Bethlehem Iron Company, lectured to a large audience at the 521st meeting of the Boston Society of Arts on Feb. 16. His subject was "Modern Forging," and he presented in a very interesting way, with numerous illustrations by the stereopticon, the methods in vogue at the Bethlehem works of forging such articles as hollow and solid shafts, dynamo field rings, guns, armor plate. Views were shown of the hollow shafts of the "Oregon" and of the "Brooklyn," made at these works. Defects in the old methods of forging and the steps leading to the present methods were well explained.

MR. HENRY CONANT, manager of the Boston office of Westinghouse, Church, Kerr & Co., has recently received an appointment to a much higher position in that company. He will continue to reside in Boston, but his work will be of a broader nature and will be connected with the general affairs of the concern. Mr. Conant has of late been particularly well known in connection with the execution of the large engineering contract at the Boston terminal, of which he had complete charge in both management and engineering. He is a graduate of the Massachusetts Institute of Technology, of the class of '87, and by his many years of work with Westinghouse, Church, Kerr & Co. is peculiarly well fitted for the larger duties now intrusted to him.

MAJ. RUSSELL B. HARRISON, who, at the commencement of the war with Spain, went to the front with the Seventh Army Corps, is now in Camp Columbia, and is serving as provost marshal of the Seventh Army Corps for the department of the Province of Havana. Maj. Harrison, before going to Cuba, was provost marshal of the city of Savannah, Ga., while his corps was encamped there, and he was pleasantly surprised to receive from the clerk of the council of that city, a short time ago, a set of resolutions which was passed by the council expressing the high appreciation of the people of Savannah of the thoroughly efficient manner in which he discharged the delicate and important duties of provost marshal while in charge of that city.

MR. WILLIAM A. HOUSE, president and general manager of the Baltimore Consolidated Railway Company, has been one of the most conspicuous figures in the street railway history of Baltimore, and has been more intimately connected, perhaps, with the development of the Baltimore consolidated system than any other one man. He commenced his career in 1879, with the People's Passenger Railway Company, in the capacity of general utility man, his chief occupation being to collect the fares at the end of the day from the street car fare boxes. In 1883, when the People's Passenger Railway Company was reorganized, with T. Edward Hambleton as its president, the faithful services of Mr. House were recognized, and he was made secretary and general superintendent. Under his management the system, which was operated by horses, was greatly improved, and in 1889 when the Baltimore Traction Company bought the People's Railway Company and the Citizens' line, he was made general manager of the entire property. Several additional lines of the city were absorbed, and in 1892 the work of equipping the system with electricity was begun. This work was carried out entirely under Mr. House's supervision, and the present efficient and satisfactory condition of the Consolidated Railway lines is due very largely to his engineering ability and skill.

Obituary

MR. EDWIN S. CARPENTER, assistant treasurer of the Westinghouse Electric & Manufacturing Company of Pittsburgh, Pa., died very suddenly in New York on Feb. 16.

MR. A. B. JOHNSON, father of Edward H. Johnson, president of the Sprague Electric Company of New York, died on Jan. 29 from the effects of injuries received in a runaway accident at his home in Greenwich, Conn.

MR. WM. PENN COOPER, who was probably the oldest street railway superintendent in Philadelphia, died Feb. 23, at the age of seventy-six. Mr. Cooper was superintendent of the Thirteenth & Fifteenth Streets line.

MR. JOHN H. CALLAHAN, secretary of the United Traction Company of Pittsburgh, died at his residence on Feb. 13. Mr. Callahan practiced law in Pittsburgh and Chicago until about six years ago, when he accepted a position as secretary of the Second Avenue Street Railway, which position he held until the consolidation with the United Traction Company, when he was made secretary of the entire system.

AMONG THE MANUFACTURERS

THE ELECTRICITAETS-GESELLSCHAFT, Felix Singer & Co., announce that they have moved their office to Tempelhofer Ufer 10, Berlin, S. W.

THE POWER AND MINING DEPARTMENT of the General Electric Company has now under construction twelve electric locomotives for domestic use.

W. W. BIERCE has been appointed general agent for the American Rail Joint & Manufacturing Company of Cleveland, Ohio, in the Middle Southern States, with headquarters at 1106 Hennon Building, New Orleans, La.

EUGENE MUNSELL & COMPANY, of New York and Chicago, report a very gratifying demand for their India and amber "mica," of which they make a specialty for electrical insulation. Some very large orders have been received at both their Chicago and New York addresses.

THE ELECTRICAL POWER STORAGE COMPANY, LTD., of London, has found it necessary to increase the price of all its goods 10 per cent. This increase has been necessitated by the considerable advance in the price of raw materials, especially lead, during the past few months.

HOBSON & CO., of Tatamy, Pa., are sending out an illustrated catalogue of the carts, wagons, wheels, etc., which they manufacture. The list of different types includes dumping carts for every class of service, sprinkling carts, express wagons, contractors' carts and emergency wagons.

WESTINGHOUSE, CHURCH, KERR & COMPANY, of New York and Pittsburgh, received an order from the Metropolitan Street Railway Company of New York last month for the equipment of the boilers in its new Ninety-sixth Street power station with Roney mechanical stokers.

HAROLD P. BROWN, of New York, will soon place upon the market a new tie plate plastic rail bond for rebonding roads in service and for steam roads adopting electricity. The claims made for the new bond are, conductivity equal to the rail, will last as long as the rail, improves riding of track and lengthens life of rail.

THE AMERICAN ELECTRICAL WORKS, of Providence, R. I., in commemoration of Washington's birthday, sent to its friends a handsome engraving, about 7 ins. x 9 ins., of the home of Washington at Mount Vernon. This little gift will be highly appreciated by all recipients, and it is well worth a place in any office or home.

THE VAN DORN & DUTTON COMPANY, of Cleveland, Ohio, has just received an order from the Cleveland Electric Railway Company for twenty-two trucks of its latest 99 B type. The Van Dorn & Dutton Company reports that never in its experience has it been so overcrowded with work, and all departments are running to their fullest capacity.

THE LESCHEN-MACOMBER-WHYTE COMPANY, of Chicago, Ill., has been sending to its friends a very acceptable desk calendar for 1899. The calendar for each month is printed on separate cards, which are inserted in a very suitable frame made of celluloid, prettily decorated. This company reports an excellent business in railway supplies, and it is receiving orders from companies all over the country.

THE PENCOYD IRON WORKS, of Pencoyd, Pa., have received the contract for building the elevated structure of the Boston Elevated Railway in Washington Street, Boston, and Main Street, Charlestown. This is one of the most important iron contracts let for some time, and many thousand tons of metal work will be required to complete the work. The specifications require that the work shall be completed by Oct. 1, 1899.

THE CHICAGO CITY RAILWAY COMPANY, in addition to the 100 new cars now being delivered from the Stephenson Company, will soon receive fifty from the Pullman Company, and is in its own shops rebuilding thirty of its old cars. The Moore motor truck has been adopted as standard and 165 new trucks of

this type are now being erected in the company's shops. The steps on 750 open cars are being replaced by a folding step.

THE CHASE CONSTRUCTION COMPANY, of Detroit, Mich., on account of the rapid growth of its business, has been compelled to seek larger quarters, and has removed from room 1113 to suite 1321 and 1322, Majestic Building, Detroit, where it will continue its business as general contractors. This company makes a specialty of building and equipping electric railways, central stations and municipal electric lighting plants of any capacity.

THE FIRM OF Edwin C. Jones & Co., of New York, formerly the Edwin C. Jones Company, has recently been formed by the association of Peyton C. Rogers, Henry H. Pearson, Jr., and Louis H. Roberts with Edwin C. Jones. The gentlemen first mentioned have been associated for some time with Edwin C. Jones, but have not until now been financially interested in the firm. The new company will continue to make a specialty of the purchasing and selling of high-grade bonds of all kinds.

THE CAHALL SALES DEPARTMENT, of Pittsburgh, has found it necessary, owing to the very rapid increase in the price of raw materials entering into boiler construction, to advance the prices of all boilers of its manufacture 20 per cent, to take effect March 1. This action has been delayed as long as possible, as the company hoped it could go through the season without any advance, but materials have risen so rapidly in price, and continue advancing so sharply that it announces that it is obliged to take this step in order to come out even.

ELECTRIC PUMPING.—This is the title of a very attractive pamphlet just issued by the Goulds Manufacturing Company, of Boston, Mass., which describes fully the Goulds pumping machinery adapted for use with electric motors. The different types shown include direct-connected and belt-driven apparatus for a number of different pressures, varying from extremely light work to the very heaviest pressures. Street railway companies proposing to install pumping machinery at their power stations will do well to carefully investigate the apparatus manufactured by the Goulds Company.

THE C. W. HUNT COMPANY, of New York, whose work in the developing of efficient and economical hauling and hoisting machinery is well known throughout the engineering world, has published a new catalogue devoted to the description of steam and electric hauling engines. The catalogue is well illustrated, and describes a few of the many different types of Hunt hoisting engines. The hauling machinery manufactured by this company, including the "noiseless conveyor," is also shown, and will be of interest to owners of street railway power stations where it is necessary to move coal for any considerable distance from barges or railroad cars to the boiler room.

A SUCCESSFUL CAR HEATING TEST.—The Long Car Heating Company of New York city made a very successful test of its new system of hot air heating for street cars on Jan. 27, before a number of representatives of the press, including one from the STREET RAILWAY JOURNAL. The party was taken in one of the cars of the North Jersey Traction Company from Jersey City to Newark, where an elaborate luncheon was served, after which the return trip was made. The car in which the invited guests rode was equipped with the new heating system, and although the weather was damp and chilly, the interior of the car was easily kept at a most agreeable temperature.

E. F. DEWITT & CO., of Lansingburg, N. Y., received last month an excellent testimonial to the value of their boxes through the award of an order from the Third Avenue Railroad Company, for the equipment of 160 of its new cars with the common sense sand box. One hundred of these will be equipped with four boxes each and will go on cars now being built for the Third Avenue Railroad Company by the St. Louis Car Company; the other sixty cars will be made up by combining two short cars of the company's present equipment, and these will be furnished with two boxes each. The order was given after a careful investigation of the entire subject by the officials of the Third Avenue Railroad Company.

THE ALLEN & MORRISON BRAKE SHOE & MANUFACTURING COMPANY, Fisher Building, Chicago, announces to its many friends and patrons that it has gone a step higher, and has moved its office from the fifth to the sixth floor. The brake shoes turned out by this company are making some phenomenal records, some having made 30,000 miles in heavy steam road service. Some of the company's locomotive shoes have made records of 24,900 miles. The company is just now putting a new shoe on the market, which, instead of containing chilled inserts, will have the same action through the medium of deeply chilled sections of the solid shoe. This is a tire dresser, and is meeting with much favor.

IN THE ISSUE for Feb. 1, of the "United States Health Reports," a periodical published at Washington, D. C., appears an article on "Hygienic Covering for Furniture," by A. N. Tally, Jr., M. D. This article deals with the subject of the necessity for thorough cleanliness in all articles of furniture and draping used in homes, street cars and public places generally. It also draws attention to the fact that chairs and lounges, car seats, etc., are often breeding places for bacilli of various kinds, and that therefore a hard, firm, cleanly covering for seats and furniture of all kinds is extremely desirable. It further points out that Pantasote, which is a covering manufactured by the Pantasote Company of New York, very fully fulfills all the requirements of good sanitation.

THE MICA INSULATOR COMPANY, of New York and Chicago, reports very large sales, both in the United States and in Europe. This company makes a specialty of furnishing segments manufactured from micanite for any style or type of machine, and has made some segments recently as long as 30½ ins. and 4 ins. in height. Builders of electrical apparatus will do well to have before them this company's sheet, "Insulation Manual and Data Book." It not only gives the breakdown tests of its insulations, but also contains samples of micanite. A large stock of micanite plates, cloth, tapes, paper and "Empire" and "M. I. C. compound" insulation is carried at New York and Chicago; also at the company's agencies in Cincinnati, St. Louis, San Francisco and Cleveland.

THE WESTINGHOUSE MACHINE COMPANY, of Pittsburgh, Pa., is sending out another of its very readable catalogues, this one being devoted to the Westinghouse standard engine. This type of engine is designed for those locations where the use of a simple non-condensing engine is consistent with the principles of good engineering and commercial economy, the conditions under which it is particularly economical being, of course, wherever there is a good demand for exhaust steam. Although its field is somewhat limited, yet the manufacturers state that the demand for this type is constantly increasing, and the company believes that with variable loads and light loads the Westinghouse standard is superior to the usual type of four-valve simple non-condensing engines.

THE GARTON-DANIELS ELECTRIC COMPANY, of Keokuk, Ia., has recently appointed Mayer & Englund, of 10 South Tenth Street, Philadelphia, its representatives in the Middle States territory for its line of railway lightning arresters. The Garton-Daniels catalogue for 1899, just issued, is unusually complete, and should be in the hands of every one using lightning arresters. The catalogue clearly describes the requirements of lightning arresters for all classes of service, and gives data regarding the different types of Garton arresters, and shows how these instruments have been designed to fully meet the difficulties encountered in practical operation. The last few pages are devoted to letters from customers, testifying to the perfect satisfaction given by the Garton instruments.

THE INTERNATIONAL AIR POWER COMPANY, which was organized in January with a capital of $7,000,000, as stated last month, has increased its capitalization to $8,000,000, and of this amount $600,000 is in preferred stock. This preferred stock has all been taken up and was largely oversubscribed. It is understood that the common stock will shortly be issued and placed upon the market. In addition to the works of the American Wheelock Engine Company, and the Rhode Island Locomotive Works in Providence, the company has recently purchased another large engine works. Among those interested in the International Air Power Company are Joseph Leiter of Chicago, P. A. B. Widener, George W. Elkins and Thomas Dolan of Philadelphia and J. H. Hoadley of New York.

THE ANNUAL MEETING of the Newburyport Car Manufacturing Company of Newburyport, Mass., was held Feb. 20, 1899, at the office of the company and the following officers were elected: President, E. P. Shaw; treasurer, W. F. Runnells; directors, E. P. Shaw, L. Marquand, L. W. Sargent, W. F. Runnells, all of Newburyport, and Chas. A. Haines of Melrose, Mass. The company has rebuilt its factory, which was destroyed by fire last April, and has now a complete modern plant with the latest labor saving machinery and starts once more with good prospects and several large orders. J. W. Evans, the general manager, who has been ill, is much improved and again takes an active part in

the affairs of the company. The showing made last year, considering the delay occasioned by the fire and consequent loss of orders was satisfactory and the outlook for the future promising.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, Mo., has added some very satisfactory agencies to its street railway department, and makes the announcement that it has secured the Southwestern selling agency for the Star Brass Works of Kalamazoo, Mich., for the well-known "Kalamazoo" self oiling trolley wheel, also for the Van Dorn & Dutton Company of Cleveland, Ohio, for its gears and pinions, that have been meeting with success among the street railways throughout the country. The Western Electrical Supply Company has also secured the agency for the Sterling Varnish Company of Pittsburgh, Pa., for its well-known varnish and insulating compound. With the above agencies added to its already very complete assortment of street railway supplies, the Western Electrical Supply Company believes it can handle any street railway orders to the entire satisfaction of its customers.

THE J. G. BRILL COMPANY, of Philadelphia, has received some very interesting testimonials to the value of its metal seat-end panel. One of these is from the Mobile Light & Railway Company, the manager of which writes that about four years ago he purchased some second-hand cars of the Brill make, equipped with these panels. These cars had been in use by another company for ten or twelve years, yet they are still in good condition, while two other cars at Mobile, made by another car builder, have gone to pieces within three years, largely for the want of these malleable end seat panels. The Brill Company is also in receipt of a letter from the Chattanooga Electric Railway Company, referring to the Brill 21 E truck as the smoothest riding truck on the market, and another from a railroad official of Bristol, England, referring to a parlor car built by the Brill Company for the railway in most favorable terms.

VALUABLE COLLECTION OF RAIL SECTIONS.—The American Rail Joint & Manufacturing Company, of Cleveland, Ohio, has published its new catalogue describing the American rail joint, which is well known to street railway managers in the United States. An extremely valuable feature of this catalogue, and one which will be appreciated by street railway managers, is a collection of rail sections, which includes the shapes, makers' names and weight of every rail section manufactured by all the well-known rail manufacturing concerns in the United States, with the exception of one. The cuts are all one-fourth size, and the method of adapting the American rail joint to each section is shown. As this is probably the first time that such a complete collection of rail sections has been published in so convenient a form, the American Rail Joint & Manufacturing Company is certainly to be congratulated upon its enterprise in undertaking the work. Copies of the catalogue will be mailed by the publishers on request.

WARREN WEBSTER & COMPANY, of Camden, N. J., report the following plants in which the Webster system of steam heating has been installed: Creedmore Mining Company, Creede, Colo.; Ohio State Capital Annex, Columbus, Ohio; Washington County Court House, Washington, Pa.; Steel Pier, Atlantic City, N. J.; St. George's Hotel, Evansville, Ind.; Pennsylvania Railroad Ferry, Jersey City Terminal, N. J.; J. G. Brill Company, Philadelphia, Pa.; Pennsylvania Institute for In. of Blind, Overbrook, Pa.; Toronto Carpet Company, Toronto, Canada; Fraser & Chalmers, Chicago, Ill.; Elgin National Watch Company, Elgin, Ill.; Reliance Building, St. Louis, Mo.; Dental Snuff Mill, Lynchburg, Va.; West End Trust & Safe Deposit Company, Philadelphia, Pa.; Penobscot Chemical Fibre Company, Great Works, Maine; Consolidated Fruit Jar Company, New Brunswick, N. J.; St. Louis Club, St. Louis, Mo.; Indiana State University, Bloomington, Ind.; New York, New Haven & Hartford Railroad Company's depot, Providence, R. I., and many others.

THE JOSEPH DIXON CRUCIBLE COMPANY, of Jersey City, N. J., has received the following letter from C. D. Shepard, superintendent of the Palmer & Munson Street Railway Company, to whom the credit for this new use for graphite is due: "A lubricant of some sort must be used on the cylinders of controllers on all electric cars. Every electrician having charge of electric cars knows, or has experienced, the trouble pertaining to the use of any kind of grease or oil, by dust sticking to the cylinder contacts, thereby cutting the cylinder and making poor contact, which causes the controllers to arc, thus destroying the life of the cylinder and fingers, also making it necessary to look over the controllers at least once a week, and sometimes oftener. By the use of Dixon's No. 635 graphite this trouble can be remedied. Pure graphite being of high conductivity, and at the same time the best solid lubricant known, it has been demonstrated by practical experience that it is the only lubricant which dust will not stick to, and which will not interfere as a lubricant with making a sure contact between cylinder and fingers, giving a smooth surface on cylinder, allowing controller to be turned easily and smoothly, requiring attention only once a month."

A VERY HANDSOME PORTFOLIO.—An extremely handsome and novel portfolio is being sent out by the Crouse-Hinds Electric Company of Syracuse, N. Y., manufacturers of the Syracuse changeable electric headlight. It is made of heavy green paper and is richly embossed on the outside. Contained in the portfolio are some twenty-nine letters from street railway companies indorsing the Syracuse headlight and testifying to its good qualities, but instead of printing these indorsements in the ordinary way, the Crouse-Hinds Company has had each letter reproduced in its entirety and printed upon the same kind of paper as the originals were written upon. This has been done at a very considerable expense, and the results are very pleasing and must certainly prove very effectual. The testimonials are unusually strong and, in a number of cases, in addition to expressing satisfaction, contain orders for more headlights. The portfolio will be sent on request. The Crouse-Hinds Company reports that its factory, which was lately enlarged to twice its previous size, is already overflowing with orders. The fact that the Syracuse headlight can be changed in a moment from one end of a car to the other, or from a winter car to a summer car, thus practically doing the service of four ordinary lights, makes it extremely popular.

New Publications

The Register of Lehigh University, South Bethlehem, Pa., for year 1898-99. Paper. 220 pages. Published by Lehigh University, South Bethlehem, Pa.

The Register contains the usual announcements for the coming collegiate year, a full description of all the courses and a full list of all students at the college and also of the alumni.

Fowler's Mechanical Engineer Pocket Book, Edition of 1899. Edited by William H. Fowler. Leather. 324 pages. Illustrated. Price 1s. 8d. post free. Published by Scientific Publishing Company, Manchester, Eng.

This is one of the most reliable and valuable of the engineers' pocket books published, and contains an immense amount of well digested and carefully indexed material of use to engineers.

Map Showing Street Railway Lines in Massachusetts, Rhode Island and Connecticut. Published by Robert H. Derrah of the Boston Elevated Railway Company, Boston, Mass. Mounted on cloth. Price $15.

This map is printed in four colors and shows all existing and projected street railways in Massachusetts, Rhode Island and Connecticut, as well as the steam roads. The map is drawn to a scale of four miles to the inch. To one not familiar with the situation, a glance at this map will be most surprising, as there is hardly a corner of this territory that is not already occupied by street railway lines. According to this authority, it will soon be possible to travel from Boston or points fifty or seventy-five miles east or south of Boston by electric cars, via South Framingham, Worcester, Springfield, Mass., Hartford, New Haven and Stamford, Conn. The map will be of great value to anyone interested in the development of electric railways.

Trade Catalogues

Carts, Trucks and Wagons. Published by Hobson & Company, Tatamy, Pa. 52 pages. Illustrated.

Electric Pumping. Published by the Goulds Manufacturing Company of Boston, Mass. 24 pages. Illustrated.

Steam and Electric Hoisting Engines. Published by C. W. Hunt Company of New York. 20 pages. Illustrated.

Lightning Arresters. Published by the Garton-Daniels Electric Company of Keokuk, Ia. 20 pages. Illustrated.

Catalogue. Published by the American Rail Joint & Manufacturing Company of Cleveland, Ohio. 72 pages. Illustrated.

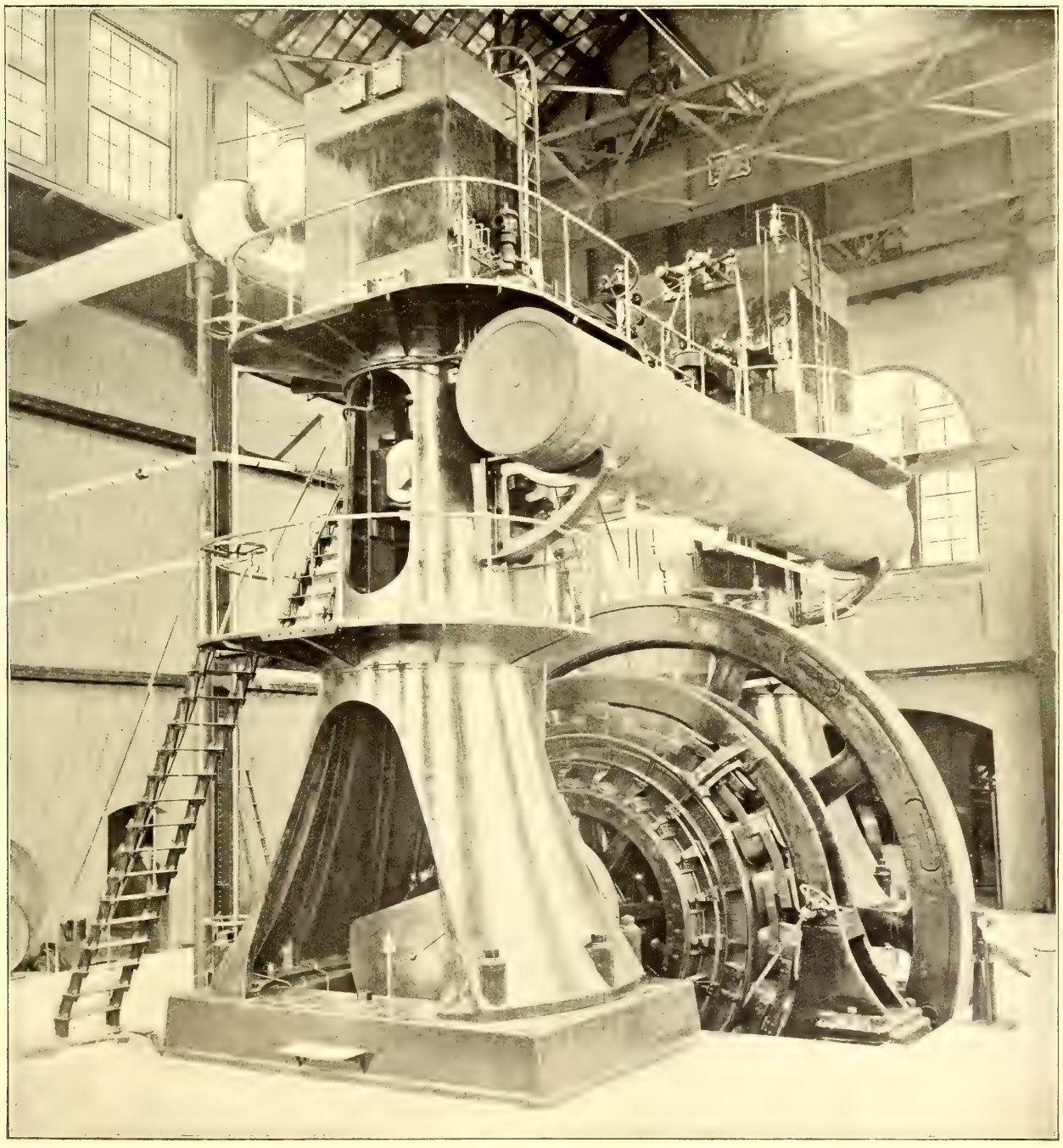
The Westinghouse Standard Engine. Published by the Westinghouse Machine Company of Pittsburgh, Pa. 54 pages. Illustrated.

Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, APRIL, 1899. No. 4.

POWER STATION AND REPAIR SHOPS OF THE CLEVELAND ELECTRIC RAILWAY COMPANY

There are very few stations in this country where it is possible to find in operation equipments that illustrate in distinct stages the evolution that electric railway power houses have undergone since the introduction of this new power for transit purposes. Such a condition exists, however, in the station of the Cleveland Electric Railway Company, generally known as the "big consolidated" company. The principal interest in the station centers in the new engine and generator, illustrated on this page. This machine stands 32 ft. high above the floor line, and is artistically designed, all the curves being graceful, while strength is not sacrificed. The engine is direct coupled to a 2400-



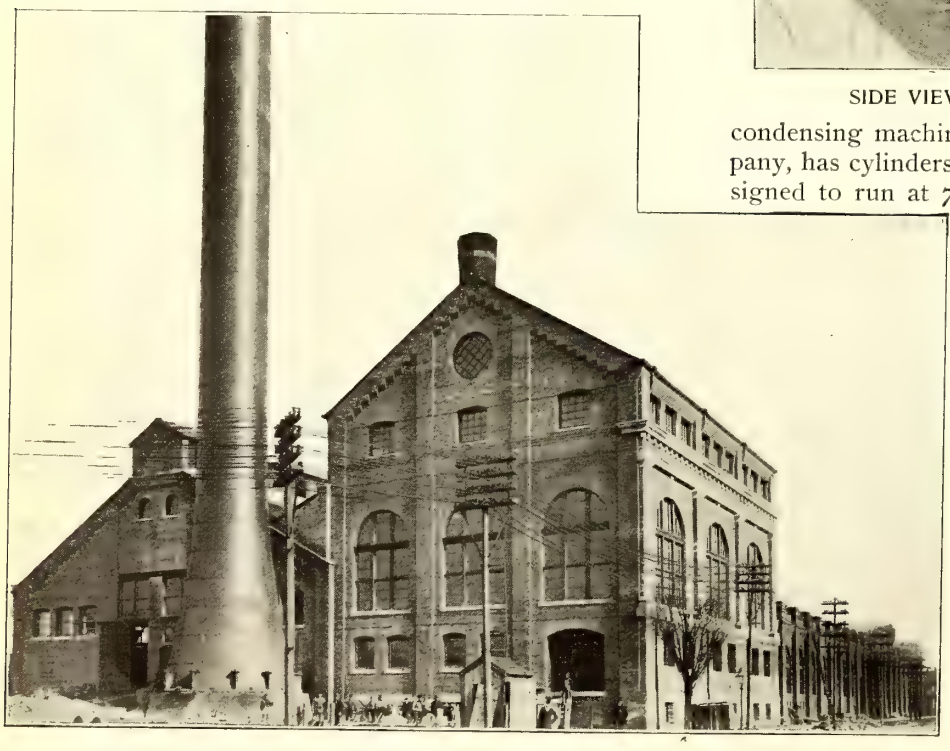
VERTICAL COMPOUND ENGINE AND 2400 KW. GENERATOR IN CLEVELAND ELECTRIC RAILWAY STATION

kw. twenty-two pole, railway generator, the armature of which is 12 ft. in diameter and 2 ft. across the face.

The generator is of the General Electric make, wound for 550 volts and 4300 amps. The magnet frame is of cast steel of highest permeability, and is heavily ribbed, to give great mechanical stiffness. It is provided with feet of large area, in order that the machine will rest firmly on the foundations. The pole pieces are of laminated sheet iron, and are rectangular in cross section. The poles are so shaped that the eddy current losses are reduced to a minimum. The spools are composed of heavy brass flanges, the body of the spool being of two thicknesses of sheet iron. The spools are thoroughly insulated by means of veneer board flanges, oiled cotton and mica. The series winding consists of copper strip, and the shunt winding of triple cotton-covered wire.

The armature spider is of such construction that all shrinkage strains are obviated. The spider is made in halves, in order to facilitate assembling on the engine shaft. The spider arms are hollow, to give the greatest strength with the given amount of material. The laminations are thoroughly insulated from one another by means of japan. The slot insulation consists of alternate layers of oiled muslin, paper and mica. The armature bars are of such a shape that the only joints occur at the commutator leads. That is, the bars have no joint at the flywheel end. The armature bars are held in position by means of wooden wedges, thus doing away with binding wire over the laminations.

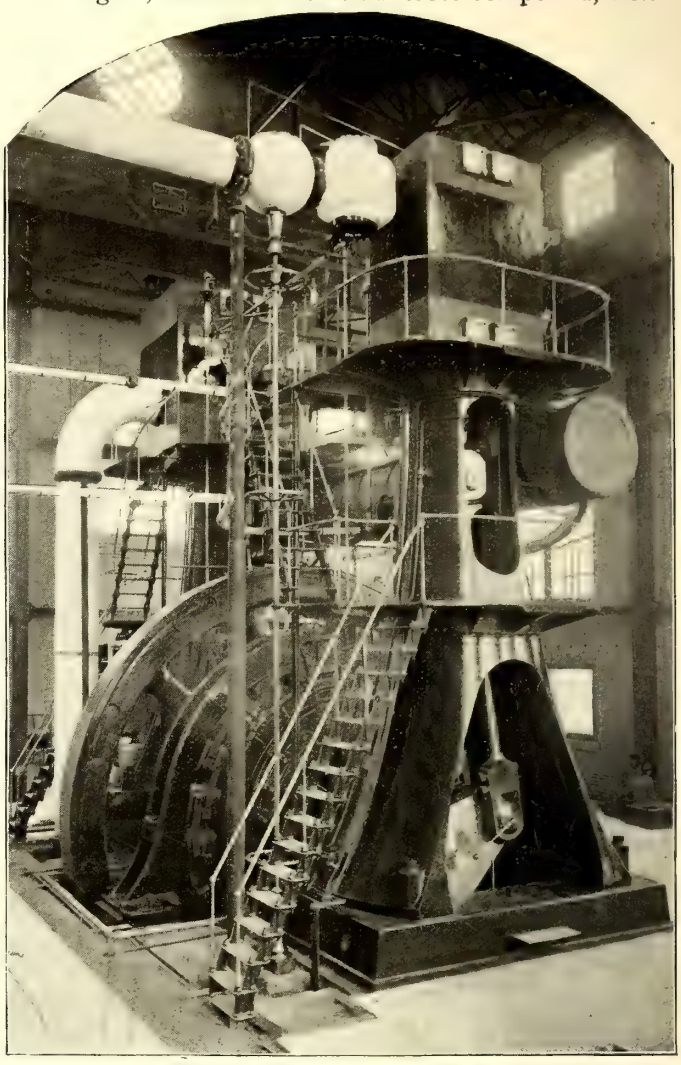
The commutator shell is supported on an extension of the armature spider, to avoid any possibility of movement between the commutator spider and the armature spider. The bars are hard-drawn copper, insulated from one another and from the spider with the best grades of selected mica. The commutator is of such a size that a large number of brushes can be used. This gives low current density in the brush with attendant low heating. The brushes are supported by means of a heavy cast-iron yoke, which is operated by suitable worm gearing.



EXTERIOR OF POWER STATION

The main dimensions of the generator only are: width, 270 ins.; length along shaft, 61 ins.; diameter of shaft, 27 ins.; total weight, 180,000 lbs.

The engine, which is a vertical cross-compound, non-condensing machine, was made by the E. P. Allis Company, has cylinders 40 ins. and 68 ins. x 60 ins., and is designed to run at 75 r.p.m. with 160 lbs. initial pressure. The valves are in the cylinder heads, and a separate governor is used for operating an automatic safety stop. The main throttle valve is operated from the different platforms by means of hand wheels attached to a vertical shaft, and each cylinder is approached by steps, as shown in the illustration. The flywheel is 25 ft. in diameter and weighs 160,000 lbs. The shaft is 25 ft. long, and at the center where it carries the armature it is 26 ins. in diameter, but reduced to 24 ins. at the bearings. The bearings are 48 ins. long, and made with shells supported by ball-joint bearings, thus insuring perfect alignment.



SIDE VIEW OF ENGINE AND GENERATOR

While the engine is rated at 3500 h.p., it is capable of being worked up to nearly 5000 h.p. for short periods. The engine room is supplied with a 30-ton electric traveling crane having three motors of the railway type. This crane is carefully designed in every detail, even the forged hook of the hoist being hung in ball bearings, so that it swivels easily. The crane was designed and manufactured

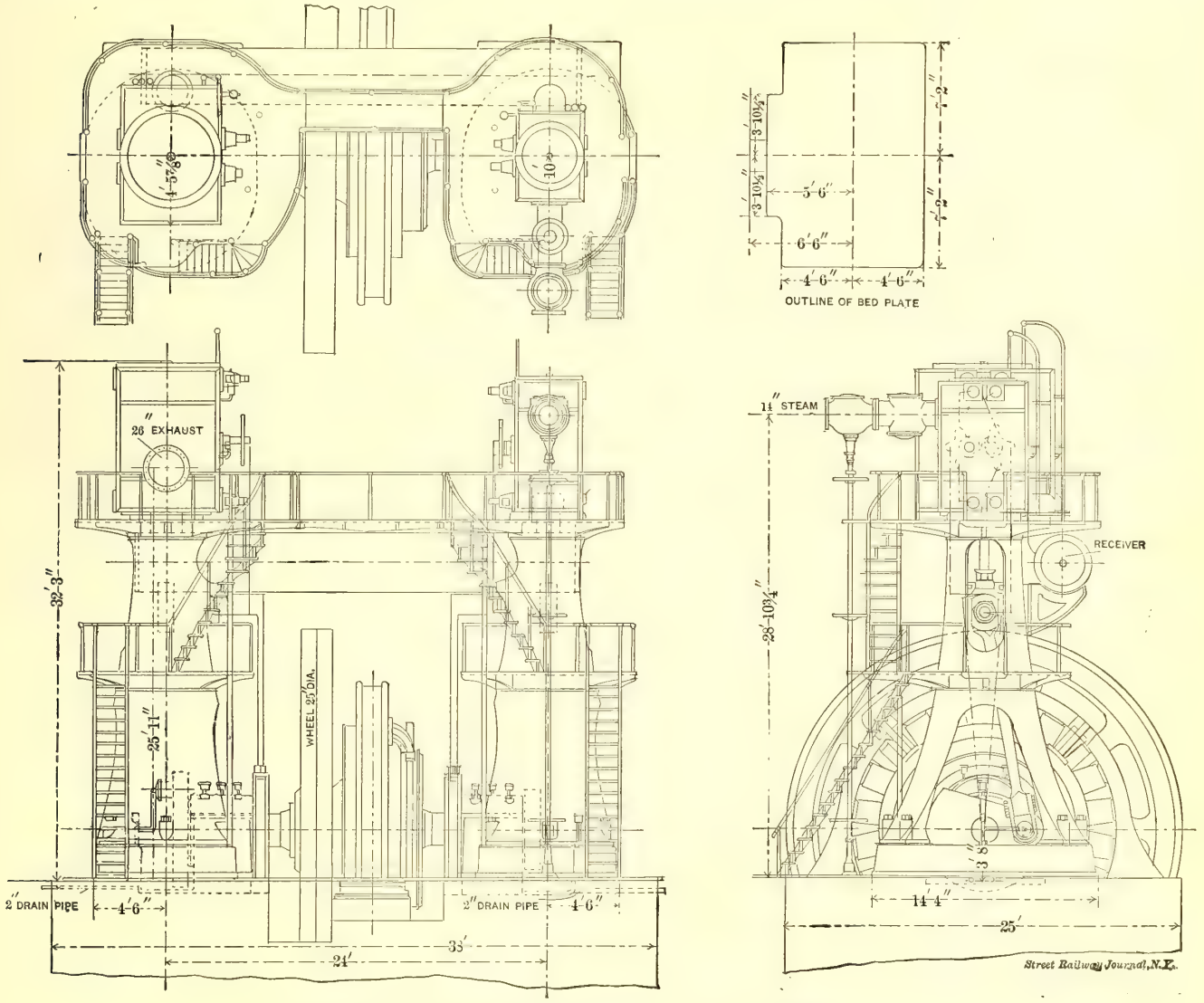
by the Brown Hoisting & Conveying Machine Company, of Cleveland.

The auxiliary steam equipment consists of duplicate pumps of the Worthington manufacture, and is located in the engine room. The valves are all of Chapman manufacture. There is a complete automatic oiling system and other detailed features that embrace the very latest in power house design.

The boiler room adjoins the engine room, and both are extensions of the old plant, but at a higher level. The new boiler equipment consists of ten water-tube boilers of the B. & W. type, each rated at 264 h.p. at 30 lbs. evaporation. These boilers are arranged in batteries on each side of the boiler room floor, there being six on one side and four on the other. These are each equipped with the B. & W. type of chain grates, which are operated from a horizontal shaft above the boilers, and which in turn is actuated by special engines.

The steam piping is all of lap-welded type, and is bent in suitable curves in order to avoid as much as possible fittings, and at the same time provide for expansion. The boilers are connected by 8-in. pipes, which lead directly into a 20-in. steam header. Those from the boilers on the off side of the room pass over the area between the boilers and just below the coal bunker, when, coming alongside of the pipes from the other boilers, they bend in pairs on the same curves and are attached to the top of the steam header. The connection is made through a specially designed T, having two openings on top, in which the stop valves to the boilers are placed. The main header is supported on a steel platform built out from the walls of the station just above the back of the boiler. This is guarded by a railing, and the header, except at the center, is supported on small steel trucks, which are designed to move back and forth to accommodate expansion and contraction. In order to prevent these trucks from vibrating the weight is supported on small journals, while the surface of the rollers, which are about 3 ins. in diameter, rests on a plate, so that because of the different diameters a sort of breaking power is obtained. A 15-in. curved pipe leads out from the top of the header, and, passing through the wall, leads directly to the throttle of the high-pressure engine.

Drain pipes are attached to the valves and lead across into the bends of the steam pipes to provide for automatic drainage. From the bottom of the steam header short loops connect with a drip header, which is located beneath the main header, and from this the drip is returned to the end of the boiler with the use of any special appliances. The sections of pipe are provided with weldless soft steel flanges manufactured by the Latrobe Steel Company. These are faced and beveled to a slight taper, the greatest diameter being at the face where the pipe is flanged and peaned into a groove in the face of the flange. The pipe is then faced off so that it affords a smooth seat for the gaskets, so that the greatest pressure comes directly on the end of the pipe, all pipes from 8 ins. and upward being peaned in this manner. The feed water pipes are attached



SIDE AND END ELEVATIONS AND PLAN OF ENGINE

to the front of the boilers above the stoker in a peculiar manner, as shown, and provide for expansion, the pipes being bent to 90 degs. and a 1½-in. pipe leads down to an automatic stop check valve. The main header is ⅜ in. in thickness, and all the pipes are of standard weight, except those for feed water and blow off, which are extra heavy, to provide for corrosion.

The exhaust pipe from the low pressure side leads down and bends beneath the floor and enters the feed water heater, which is of the Goubert type.

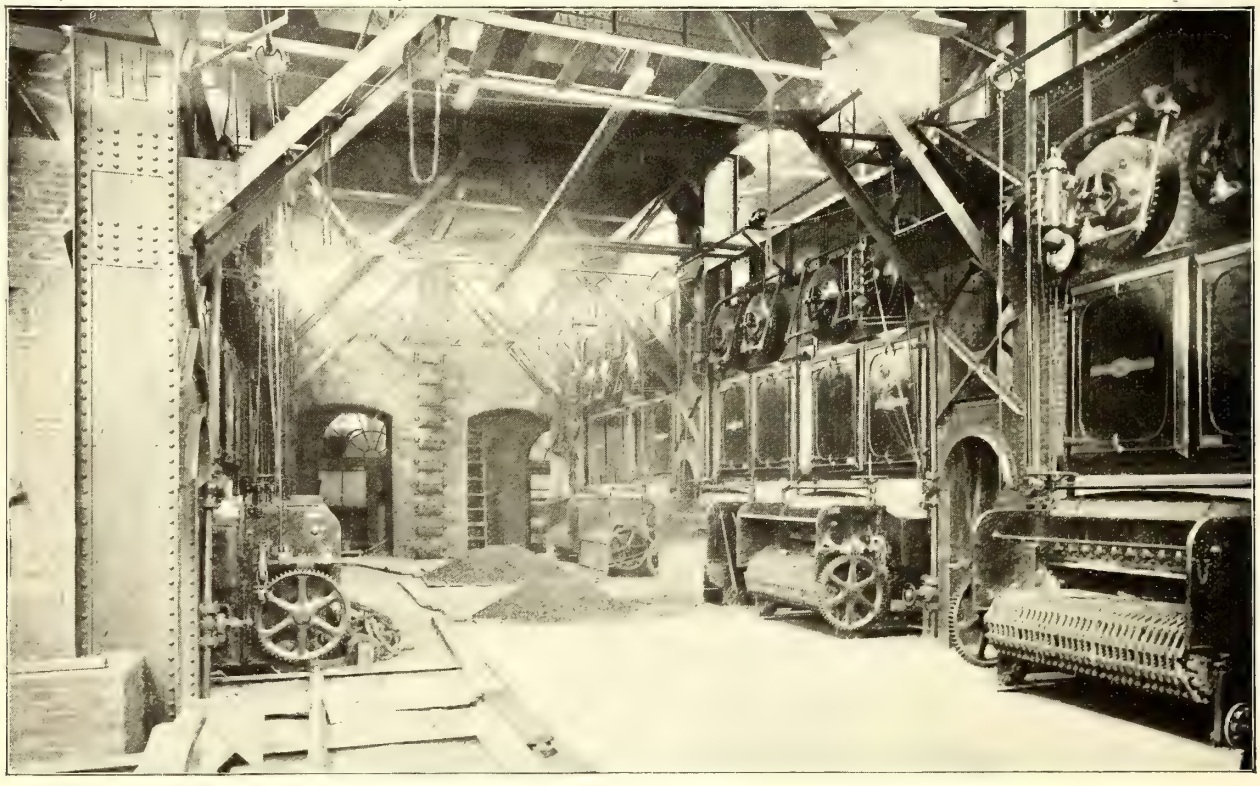
The steam pipe leading to the pumps is provided with a check valve which automatically regulates their action. This is known as the Foster valve, and avoids the use of the ordinary type of regulating valves.

The exhaust from the high pressure cylinder is led into a cylindrical connecting chamber about 4 ft. in diameter, from which it is directed to the low pressure cylinder. This chamber, as well as all the steam piping, is thoroughly covered with magnesia heat insulation material, manufactured by the Keasby & Mattison Company, of New York, but installed by the Cleveland branch of that company.

The coal handling equipment is very complete, and consists of a steel bunker located above the boiler room, having a capacity of 11 tons to the linear foot, or a total storage capacity of about 900 tons of coal. From the bunker coal is delivered to the chain grates by chutes. The bunker is lined with brick to prevent wear. Coal is received direct from the steam railways in bottom hopper cars, and dropped into a receiving bin underneath the track, which is also brick lined, whence it is conveyed by means of a trough belt conveyer part way across the station, when it is transferred to a bucket conveyer running underneath the boiler room floor, and making the circuit along the sides and above the coal bunker. The belt conveyer is of the Robbins Company's manufacture, and the bucket conveyer of the C. W. Hunt type. Cast iron is employed for these buckets, because it is less liable to rust than rolled steel. Both are driven by independent electric motors. The bucket conveyer serves for handling the ashes as well as the coal, and these are delivered into an elevated hopper placed at one end of the room in line with the boilers, and of sufficient height to allow of trolley construction cars being run under the spout, so that the ashes are loaded direct without any shoveling. These ashes are employed along the line of the road as ballast.

The extension of the building for the accommodation of the additional equipment above described is of brick, and quite artistic in design. The engine room has a ground dimension of 55 ft. x 82 ft.; the walls are 58 ft. to the eaves, and the roof is supported by steel trusses having curved lower chords. The boiler room is 85 ft. wide, and of the same length as the engine room, but is not as high, although there is a peculiar combination of the steel structural work in both departments, as it was necessary to carry the wind strains of the engine house through to the boiler house in order to get to the ground.

Two flues lead out from the boilers under the floor and communicate with the smoke stack, which is located against the end of the building. This is self-supporting, brick-lined and of steel. The base is bell shape, 25 ft. in diameter, and thoroughly anchored to the foundations, as shown in the illustration. The trunk of the stack is 13 ft. in diameter, and the flue is 10 ft. 6 ins. inside diameter. The total height above the base is 225 ft.



INTERIOR OF BOILER ROOM

An interesting feature should be noted in connection with this new equipment to account for the engine being run non-condensing. It is proposed to employ the exhaust steam in the evaporating appliances of a neighboring salt plant, which is located about 800 ft. from the power station, The steam will be carried in an underground conduit, suitably insulated, and delivered as above noted to the salt works under an agreement from the salt manufacturing company to pay one-half the cost of fuel required to run the station. In this connection it is interesting to note that these works have recently drilled three wells, 2000 ft. in depth, where is found a bed of salt which underlies, it is supposed, the whole city. The process of mining con-

sists in forcing a stream of water down one of the tubes of the well. This dissolves the salt, which is then forced out through another pipe. The salt is then extracted by an evaporating process.

The first power equipment consisted of two high-speed 125-h.p. Armington & Sims engines, each belted to a No. 32 Edison generator. The next installation consisted of three 225-h.p. engines of the same make, each belted to two No. 32 Edison bipolar generators. The third installation introduced the jack shaft, and this was driven by three Cooper Corliss engines, each having cylinders 28 ins. x 48 ins., one being attached by belt to each end of the shaft, and the second to an intermediate pulley. From this shaft, by means of belts, seven No. 60 Edison generators are driven. The fourth step included the installation of four Cooper Corliss engines, each belted direct to a 500-kw. multipolar G. E. generator. A fifth installation consisted of an E. P. Allis Corliss engine, which drives by means of two belts from the flywheel two No. 60 Edison generators. The sixth and latest installation is the direct-coupled unit described above. All of these equipments are now in use, except the first.

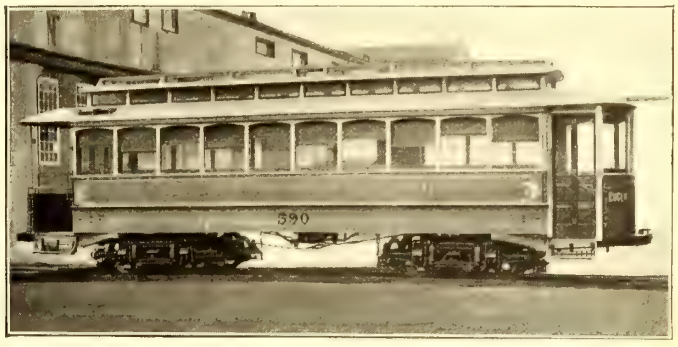
The boilers of the original plant are horizontal return tubular, but are equipped with Murphy stokers. The entire output of the old station is 6500 amps. at 550 volts. There is also a supplementary station on Canal Street of 2200 amps. capacity, consisting of Ball engines and old D 62 T. H. generators, which are still in service.

The current from the new equipment is directed to a temporary switchboard near the middle of the old station, the principal features of which are an automatic circuit breaker of the capacity of 6000 amps., which is of the G. E. manufacture, and the new static meters of the same make.

The new plant was designed by E. J. Cook, the company's electrical engineer.

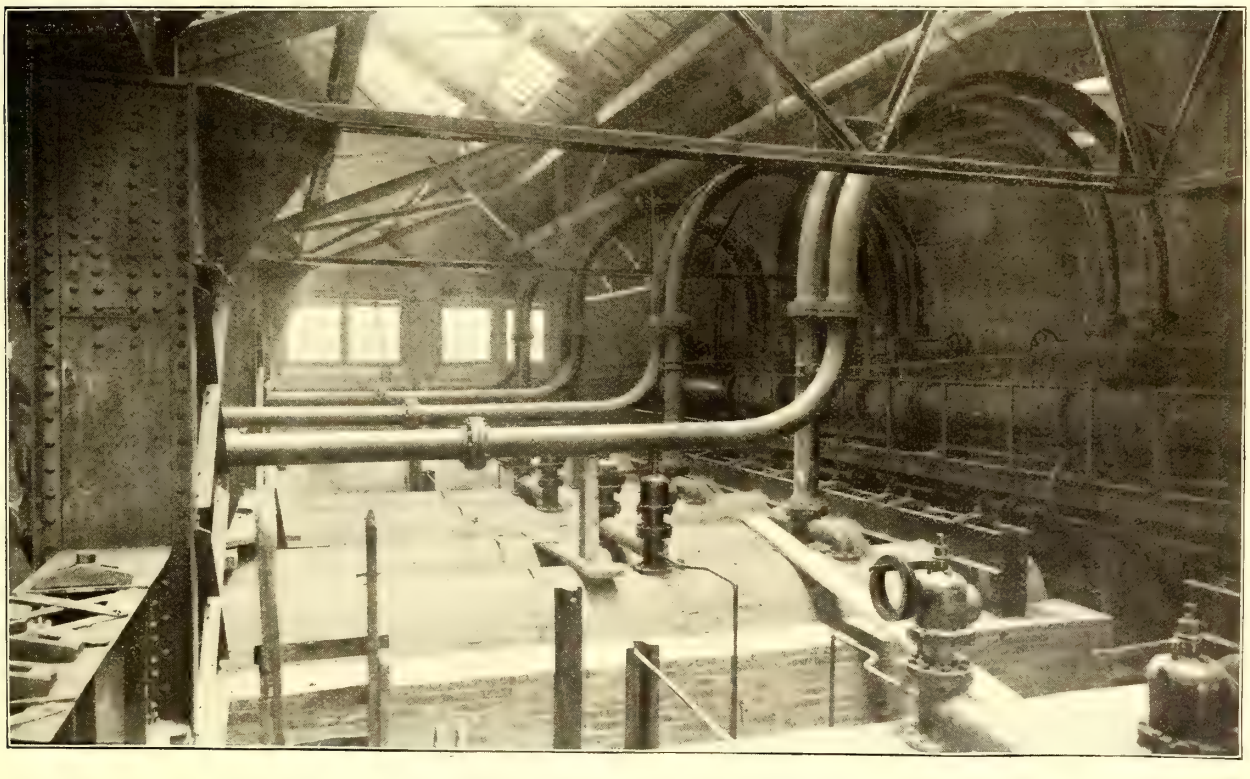
REPAIR SHOP.

The principal repair shop of the system is located at Lakeview, well on the outskirts of the city. All the repair work for the system is done here, and the large cars of two of the suburban railways of Cleveland are also brought to these shops for painting. Just at present part of the work at these shops consists in changing one of the eight-wheel high-speed cars and making it over for use as a



STANDARD CAR

funeral car. One compartment of the car is being furnished with four drop doors on the side, through which the caskets are to be loaded. The floor of the car is fitted with sunken rollers to facilitate handling of the caskets. The second compartment is designed for carrying the friends and attendants, and it is intended to run in connection with this car special funeral trains. The car is suitably designed and decorated, the exterior being black with gold trimmings. The expense of refitting this car is to be borne jointly by the two principal companies controlling the city lines, and the car is designed to run to all the principal cemeteries, of which, at present, there are six. These cars are to have the right of way, and suitable switches are being put in near the entrance gates of the cemeteries. New signs have recently been designed, which are to be carried by such cars as pass the different cemeteries.

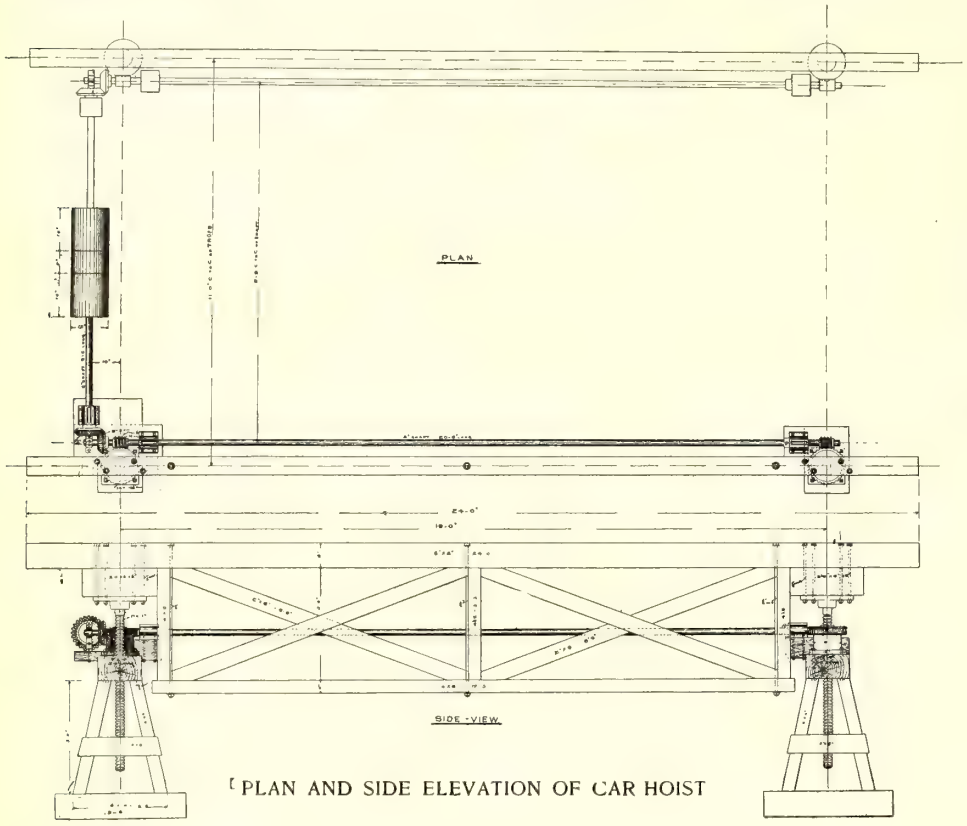


VIEW OVER BOILERS SHOWING PIPING

The company is also rebuilding a number of its six-bench open cars and making them into eight and ten-bench cars. The sills and floors will be entirely new, and

the end posts, while the old intermediate posts and the seats are retained.

The company has recently ordered 100 new eight-wheel cars. Fifty of them are to be fourteen-bench open cars, 34 ft. in length, and the others closed cars with side seats. The closed cars are to be 28 ft. over all. Six of these cars have already been built, five of them being from the John Stephenson Company and one from the J. G. Brill Works.



PLAN AND SIDE ELEVATION OF CAR HOIST

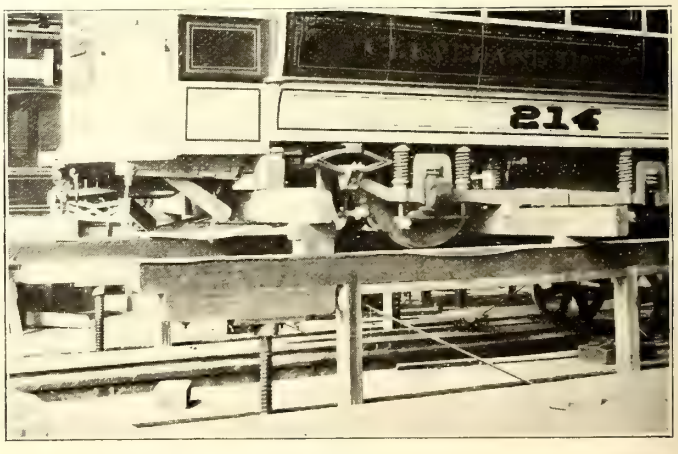
Five cars are mounted on Brill trucks and one on Peckham trucks. These cars are modeled after those employed on the Metropolitan Street Railway Company's lines in New York, and are all painted canary yellow. This is to be the standard color for all cars on the Cleveland electric system, and the present equipment is being repainted as fast as it comes into the shop. A number of box motor cars are being fitted up and equipped with two No. 49 Westinghouse motors, which will haul trailers and will be used for picnic parties, but it is the intention of the company to replace all its trains with long cars, so that within a year it is expected that the practice of running trailers will be discontinued, and the present side-door cars will also be replaced with long cars. A dozen new trucks, designed by the master mechanic and manufactured in Cleveland, but known as the Dorner truck, have recently been substituted for another truck formerly employed under the side-door cars.

The company has also recently ordered 200 new motors of the No. 49 Westinghouse type, which will replace a number of the motors now running. A number of Westinghouse No. 12 motors that formerly had center suspension have been made over in the shop for nose suspension. These motor cases have also been equipped with new armature bearings, or rather, blocks for supporting the bearings. It is now the practice of the master mechanic to cast his motor bearings, solid or cylindrical, of babbitt metal and use them without shells. When worn, the bearings are recast, and at each remelting a letter is stamped in the end of each bearing which indicates how many times the metal has been recast. After it becomes too hard for use as armature bearings, it is employed for the axle bearings, and when all the wear is out of it the metal is scrapped.

Illuminated signs are carried on all cars, one on the hood, which indicates the principal street or avenue on which the car runs, the other on the dash, which indicates the terminal point. In the closed cars the socket for the illuminated sign is on the end of the dashboard, while on the open cars it is in the middle.

Four dismantling devices are employed in the motor repair department of the shops. Each of these consists of a timber bent or truss of the same length as the car, and one is placed on each side of the repair pits. When not in use the top of these trusses comes flush with the floor, but they are designed to be elevated by means of screws, which are placed one under each end of each truss. These screws are connected together with beveled and worm gear, and are driven by an electric railway motor, so that the two trusses are lifted at the same time. By placing timbers from one to the other under the car body the car is readily lifted and held firmly in position, when the axles and motors are readily run out and a new set substituted, while necessary repairs are being made. Two of these dismantling appliances are placed near together along the same pit, so that one motor operates two. By means of a friction gear either set is operated.

Another convenient device employed in this department is an armature shifting truck, which consists of a pair of small wheels with long handles, which terminate on one side of the truck in curved hooks, the whole being so designed that the hooks may be placed under the ends of the armature shaft, when, by pressing down on the handle, the armature is lifted and can be readily rolled to any position. The repair pits are also equipped with a portable hydraulic armature removing device, which has previously been illustrated in these columns.



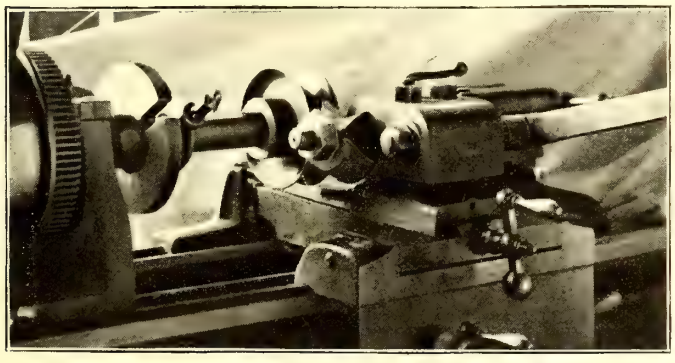
SIDE VIEW OF CAR HOIST

In the winding department only six men are employed for all the repair work, with the exception of the commutator repairs. These are refilled and new ones pur-

chased from some one of the armature repair companies and commutator builders in the city. All armature repair work is done by the piece, the price being fixed for every part of the armature. Coils are made and taped, and all other work done as indicated above. Piece work is found to be more satisfactory both to the company and to the employees, as each man is held responsible for his job, and if it is not satisfactory is required to do it over. A large galvanized iron oven with folding top is used for baking the armatures and coils. The heat is generated by means of a number of electric heaters of the Consolidated Company's type. Self-heating soldering irons are also employed; in these a stream of gas and compressed air is delivered to the head through suitable flexible pipes, so that no time is lost in waiting for an iron to heat.

The warehouse and storeroom to which all material is delivered is located on the second floor of the building, and is served by an elevator, by means of which the material is received and delivered. All material is dealt out on an order, which is made out by the man in charge of a piece of work. All orders are then countersigned by one of the foremen, so that not even a screw can be gotten from the storeroom without a proper order. By this means a careful record of all material is kept, and it is charged up to particular jobs. Cars are shifted between the paint shop and the other departments by means of an electric transfer table, which operates in a sunken way and takes its current from a third rail. This table is to be enlarged, and to make room for it the side wall of the paint shop is to be set back.

The iron-working department is equipped with a good complement of iron-working tools, to which has recently been added a wheel-boring mill, made by Henry Bickford, Lake Port, N. H., but was purchased from the W. H. Patterson Supply Company of Cleveland, Ohio. Among the labor saving devices in the shop is noted a turning head for turning out the groove of trolley wheels, which is automatic in action, and when set on one flange bores



LATHE FOR TURNING TROLLEY WHEELS

down the side and around the groove and up the other side without attention, so that all wheels are turned to an exact diameter.

The shop tools are operated by a 75-h.p. electric motor, which is located in one corner of the room and housed in for protection. It is the practice in the shops to prepare and press on all wheels, and for this purpose there are a hydraulic press and other suitable appliances. In connection with the repair department should be noted a wheel grinder of the Murphy type.

The affairs of the Cleveland Electric Railway Company are now under the direction of Henry Everett, president and general manager. Mr. Everett is also interested in a number of cross country lines which reach out from Cleveland, and in which department of street railroading Cleveland has until recently taken the lead.

Cast Welding Joints in New York

When the Third Avenue Railroad Company decided to change over its horse and cable lines to conduit electric construction the most careful consideration and thought were given to the subject of joints; in fact, this company's experience with joints on its cable construction had been so unsatisfactory that more attention was given to this point, perhaps, than to any other one feature. The cable track was laid in 1893 in accordance with the best engineering practice known at that time. It consisted of 7-in. 80-lb. rail laid on the concrete structure of the conduit. The rail rested upon cast-iron yokes spaced 5 ft. apart, but between these supports the concrete was packed tight under the base of the rail. The splice bars were 30 ins. in

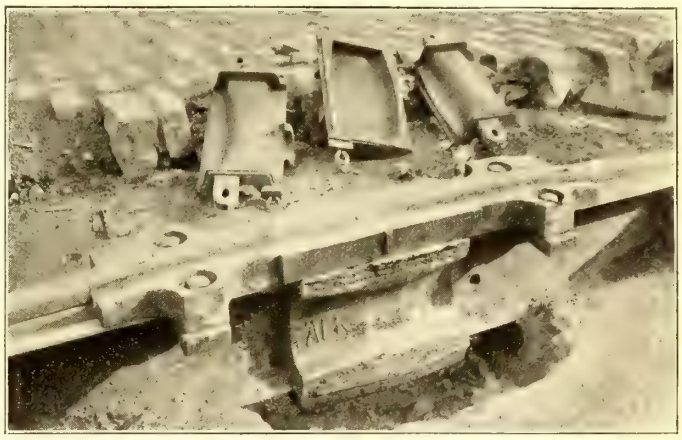


FIG. 1.—BRIDGE FOR COVERING JOINT

length and connected through the web with six $\frac{3}{4}$-in. bolts. The joints were suspended and broken. Owing, however, to the enormous traffic passing over these cable lines, this construction has not proven effectual. The joints have gone down $\frac{3}{8}$ in. in some places, and the rail itself has become badly worn, not only on the head and tram, but also underneath both, owing to the action of the splice bars. Some of the curious results of this heavy traffic on the joints and rails were described in the STREET RAILWAY JOURNAL for July, 1898

In view of this experience, and also taking into consideration that the traffic on the new electric construction will undoubtedly be heavier than it was on the cable lines, it can be seen that the problem of properly supporting the rails and joints in the new work was a most serious one. The type of conduit construction finally decided upon was shown and described in the STREET RAILWAY JOURNAL for December, 1898, and it was also there stated that the company would cast weld a large number of the joints according to the Falk system. The contract for part of this work was made some time ago, and the Falk Company has been at work for several months cast welding joints on the Amsterdam Avenue line, and also on the main line on Third Avenue. The first order was for welding over 10,000 joints, or about 65 miles of track.

In order to meet the peculiar conditions existing in New York, the Falk Company made a number of important changes and improvements in its method, a description of which will be of interest.

On a large portion of the system it was absolutely impossible to interrupt the car service for any length of time during the twenty-four hours of the day, and it was therefore necessary to devise a method of welding the joints while cars were passing over the rail. This was accomplished by means of a bridge, which is shown in Figs. 1 and 2. This bridge is carefully fitted to the rail and is se-

curely held in place by bolts. Long, tapering approaches are furnished at both ends, so that cars have no difficulty in passing over without interfering in any way with the joint underneath. The mould proper is of a new design, and consists of three main parts. These are shown upon the ground in Fig. 1, and attached in place to the joint in Fig. 2. The parts can be placed in position around the joint ready for the pouring in a very few minutes. They are held together by bolts, and in addition a small clamp is used for supporting the under piece.

Before the moulds are placed in position the ends of the rails are carefully cleaned and polished by means of a sand blast, which is also of recent design. This blast is operated by a gas engine, and with it the rails can be burnished and made absolutely clean in about a minute. The very best grade of sand obtainable is used with this machine. This blast opens the pores of the steel at the ends of the rails, thus giving a better opportunity for the welding or fusion of the cast iron and steel.

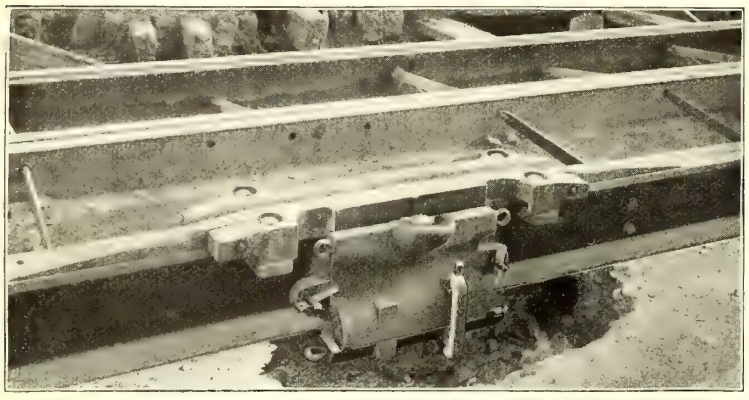


FIG. 2.—JOINT READY FOR CASTING



FIG. 3.—CUPOLA IN OPERATION

The cupola for heating the metal is illustrated in Fig. 3, and the method of pouring is shown in Fig. 4. The cupola contains a number of improvements, and is giving excellent satisfaction. The process of pouring is very simple, although quite ingenious. The ladle or pot for holding the molten metal is attached to two long rods, one of which has two branches at its end, as shown in Fig. 4. The rods are carried by means of two wooden poles, having at their centers an eye or staple, through which the rods are inserted. Five or six men are required to carry the ladle from the cupola to the joint to be welded, and four men are employed in the actual process of pouring; two to support the ladle, one to tip it, and the other to closely watch the process and regulate the flow of metal. From 200 lbs. to 205 lbs. of cast iron are poured into each joint.

The finished joint is shown in Fig. 5. After the metal has become thoroughly cooled, which occurs in a very few moments after the pouring, the bridge and mould are taken off, and the joint is carefully trimmed and smoothed with heavy files. Concrete is then thrown under the base of the joint and the ends of the rails, and carefully tamped into place so as to support the entire joint.



FIG. 4.—CASTING JOINT

In a recent interview, Mr. Robertson, superintendent of the Third Avenue Railroad Company, expressed himself as very much pleased with the results so far obtained with the Falk joint. He stated that a large number of the joints had been installed since the first of January, 1899, and since that time had been exposed to a change of temperature from 8 degs. below to 50 degs. above zero, and during this period not a single joint had broken, while the rail has kept in perfect alignment throughout the different changes of weather, although there has been no paving done of any account.

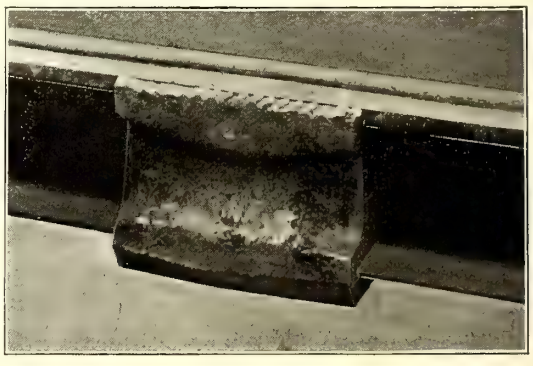


FIG. 5.—COMPLETED JOINT

The annual convention of the Southwestern Gas, Electric and Street Railway Association will be held in Austin, Tex., on April 19-21, 1899. In connection with the convention, an electric, gas, water-power, light and heating exhibition, lasting from April 19 to the 29th, will be held under the auspices of the Austin Commercial Club. Much time and labor has been expended in the effort to make this convention unusually valuable.

Electric Street Railway in Bahia

Sao Salvador de Bahia, the principal city of the Brazilian province of Bahia, is about 800 miles north-northeast of Rio de Janiero, and has a population of about 250,000 inhabitants. The city is the terminus of a number of railway lines, and possesses an enormous export trade in the many staples of the country, such as tobacco, coffee, cocoa, sugar and hides. The harbor is one of the best in America and is crowded with steam and sailing vessels of all nations. The Hamburg South American Steamship Company, the North German Lloyd, Royal Mail, Lambert & Holt and other steamship companies run regular lines to this place. A large part of the import and export trade is in the hands of German merchants.

The city, when seen from the sea by the approaching traveler, presents a beautiful panorama, consisting of the upper and lower city. The former lies for the greater part upon a long half-moon shaped plateau, rising from a narrow strip along the coast about 1 mile long and 700 ft. wide, on which is the lower city. Here is located the business district, including the warehouses of the merchants, the custom house, arsenal and railroad station of the Sao Francisco Railway, which connects the city with the interior. Further along the shore of the bay this narrow strip contracts until the base of the hills forming a plateau seems almost to meet the sea. The streets in the lower city extend parallel to the bay for a distance of about 1½ miles, when they terminate in a mountainous peninsula on which are located the rich suburban towns Bom Gosto, Roma, Boa Viagem and Itapagipe, as well as the famous Bom-Fim Church, or cathedral, the objective point of many pilgrimages on every holiday. In January, when the great Bom-Fim festival occurs, the traffic toward this cathedral is enormous, both day and night.

The upper city is situated at a height of from 200 ft. to 300 ft. above the lower city, and contains the residential quarter, being cooler, dryer and luxuriant with orange and banana orchards. Here also are the principal government buildings.

The upper and lower cities are connected by hydraulic cable inclined railways, steps for foot passengers and a few roads with an average grade of 5 per cent for vehicles.

The favorable impression made by the view of the city as seen from the sea is dispelled as soon as the traveler lands in the lower city. He finds here no regularly laid out quays, no wharf cranes, such as one is accustomed to associate with the handling of merchandise, and no regular arrangement of the streets. The buildings look as if they had been erected by Indians, and the hoists for loading vessels are operated by treadmills, with negroes as motive power. A striking contrast to this conglomerate appearance is afforded by the upper city, which is laid out with beautiful streets lined by handsome villas.



VIEWS OF BAHIA ELECTRIC RAILWAY

The tramway system of Bahia consists of a single line traversing the lower city, running parallel to the sea, and extending to the outer terminus of the Itapagipe peninsula. It has a total length of 13.7 miles of track, occupying 7.7 miles of street, and is owned by the Companhia Carris Electricos, formerly the Companhia Vehiculos Economicos. When using animal power this company had considerable difficulty in taking care of its traffic, especially on Sundays and holidays, when the demand for transportation is always great. Moreover, about three years ago the stock of mules which was formerly used suffered from a severe epidemic, so that the question of electrical equipment immediately became an imperative one, and the company gave a contract for its electrical equipment to the Siemens & Halske Aktien Gesellschaft, of Berlin,

In June, 1896, the contractors began their work of electrical construction, which proved to be no easy task, on account of the heavy falls of rain which occur in South America during the tropical winter, which commences in March and extends until August, as well as the difficulty of securing intelligent and desirable labor. These difficulties were aggravated by others, including that of securing transportation of materials. In Bahia only one kind of wagon or truck is used, namely, two-wheeled carts called *carossas*. These wagons are mounted on enormous wheels and can carry at most only about 35 cu. ft. of merchandise, so that transportation is exceedingly expensive. Added to these natural drawbacks, there were others which augmented materially the difficulty of installation. The existing track on this railway was in an extremely bad condition, so that an attempt to repair it would have entailed much more labor than the laying of new track. In addition, a considerable portion of the line extended through the small streets of the lower city, already mentioned. These streets had a width of only 16 ft., and lying between the sea and the base of the hills, formed the only connection between the lower city and the populous suburbs which it was desired to reach. In this narrow space were located the warehouses of the tobacco exporting firms, which, with their *carossas*, practically blocked the street and prevented the laying of track. All efforts to do this and thus interfere with the existing order of things were naturally followed by streams of invective poured upon the tracklayers by the native truckmen, as well as frequent quarrels and disputes.

In spite of all these difficulties and the hindrance caused by them, half of the railway, the Roma-Itapagipe section, was put in operation in the early part of March, 1897, and the opening of the entire line followed on June 6, 1897. On part of the old route the existing track was used. This consists in part of chair construction, the chairs containing jaws in which the rail is held by means of a wedge. Opposite chairs are connected together by a tie rod. Besides this there are 6½ miles of new track laid with T rail, with angle plates and metal ties.





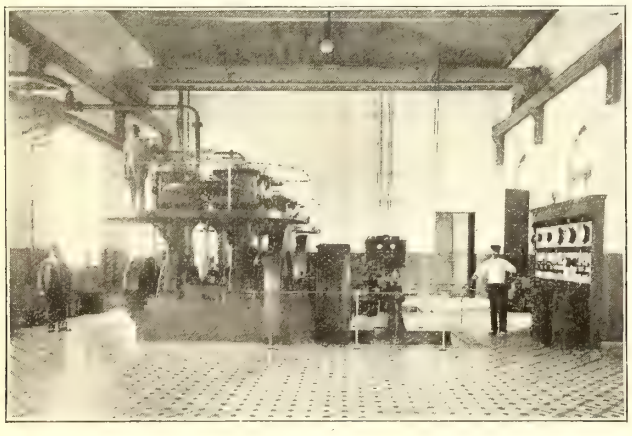


VIEWS OF BAHIA ELECTRIC RAILWAY

No feeders are used in the overhead system. The trolley wire is carried partly on span and partly on bracket poles, and partly on wall rosettes. The poles are set in concrete.

The power station is located about the center of the line, at Roma, and is 700 ft. from the sea. It is on the corner of two streets, is of hewn stone, and contains a stack 130 ft. high. Adjoining the power station is the car house, with room for twenty motor cars and pit room for nine cars, behind which is a storeroom and repair shop.

In the power house are two vertical compound con-





INTERIOR AND EXTERIOR OF POWER STATION

densing engines of 150 h.p. and 180 h.p., built by Burmeister & Wain, of Copenhagen, with direct-coupled type J 76 machines. The engines make 190 r.p.m., have Corliss gear, and cut-off controlled by a flywheel governor. The sea water for condensing is taken from the bay through a duplicate set of pipes, which extend 250 ft. into the sea in order to secure deep and clear water. In this distance they pass a coral reef, within which the water at ebb tide is too low, and during storm too tempestuous, to be used. The pipes terminate in a crib of wood, which is also used as a dock for the receipt of fuel.

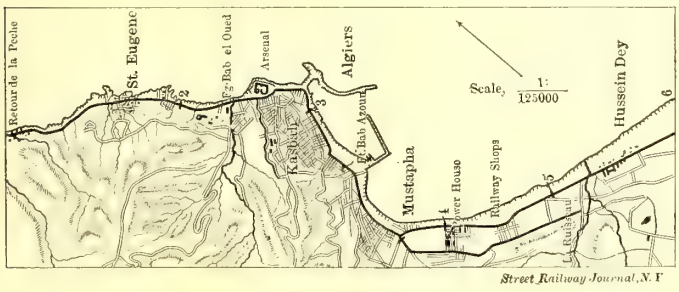
The boilers are of the water-tube type, built by the Babcock & Wilcox Company. The feed water is taken from a spring which is near the boiler house. Both engine and boiler room have space for 300 h.p of additional equipment.

At present there are twelve motor cars, which, on account of the climate, are open. Of these ten are equipped with one 20-h.p. and two with two 15-h.p. motors. Each motor car holds twelve passengers. Experience has shown that the number of motor cars is not sufficient to carry the traffic, and orders have been placed for six additional motor cars and a third engine.

The electric system is very popular with the inhabitants, especially since none of the fears first felt in regard to the use of electric power have been realized. The European system of fares is in force, by which each passenger is given a fare receipt, which he keeps, and which is afterward inspected by a controller. The operation has been carried out with great regularity and safety, even during the continuous festival of the Bom-Fim in January, with an enormous traffic, and many encomiums were passed on the excellence of the equipment.

Electric Railway in Algiers

The Société des Chemins de Fer sur Routes d' Algérie is the title of a French company, which operates an interurban railway system in Algiers, Africa, connecting that city with a number of neighboring towns. The line, which is operated mainly by steam power, has a total length of 170 km. (107.4 miles), but in addition several important extensions are projected and in part under way, which will considerably increase the total amount of track. The government concession for this railway was given May 1, 1891, but on March 9, 1897, was so modified that the company was permitted to use electricity on that part of its system



MAP OF ALGIERS

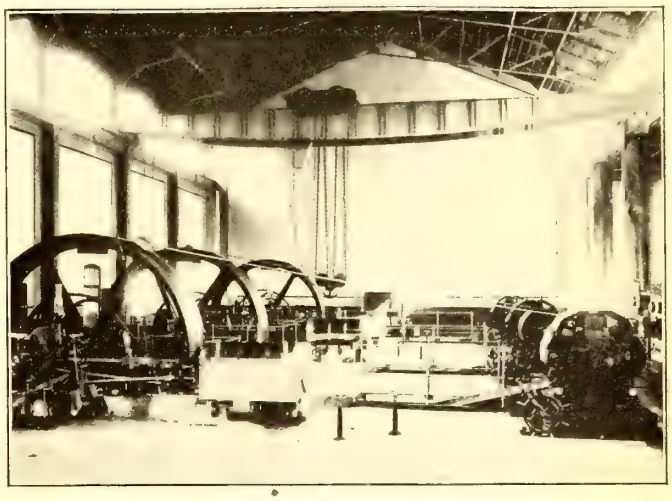
which connects St. Eugéne, on one side of the city, with Le Ruisseau and Hussein on the other, and including the connecting link in the city itself. The contract for the necessary equipment was awarded to the Société Anonyme Electricité et Hydraulique, of Charleroi, Belgium, which, with its corresponding French company, the Société Anonyme Transmission, Transport et Traction, commenced work toward the end of 1897.

Electric operation of the line was begun commercially on Sept. 23, 1898, after considerable delay occasioned by the complete loss of the structural iron for the power station, which sank on the "Gallia" Feb. 1, 1898, while being carried to Algiers. This disaster necessitated the duplication of this part of the plant.

TRACK AND OVERHEAD CONSTRUCTION

The entire length of the sections upon which electric power has been substituted for steam power is 15.7 km. (9.7 miles). The principal line, which connects Deux-Moulins with Nouvel-Ambert, has a length of 12.3 km. (7.6 miles), and is double tracked, with the exception of a short distance near each end.

The cities of Algiers, St. Eugéne and Mustapha are located on the Bay of Algiers, the shore of which, a short distance from the water, rises rapidly, leaving a narrow band only of comparatively flat territory between the base of the hills and the sea. This circumstance confines all



INTERIOR OF STATION

the traffic between the cities to near the coast, with the result that the new electric line enjoys an extremely large business. When formerly operated by steam, trains were run every fifteen minutes, but the headway of the electric cars is now five minutes, each car drawing a trail car.

The climatic conditions of Algeria are not particularly favorable to the operation of electric cars. In summer the prevailing winds are from the south, especially during the season of the *sirocco*, and, coming from the Sahara, are laden with a fine dust, which penetrates everything, and, getting in the journals of the cars, and, in fact, of all machines, materially shortens their life. On the other hand, in winter the country is subjected to almost continuous rains, which, falling with tropical fury, frequently convert the streets into regular rivers. As a result, the cars often have to run for a half mile or more in water half a meter (20 ins.) in depth. Again, certain parts of the track are in constant danger of being undermined by the sea during a storm. During the month of March, 1898, the rails were torn up for a distance of more than 100 meters (330 ft.), and often the spray from the waves is thrown against the electric cars.

The profile of the road does not present any remarkable features. The steepest grade is about 4 per cent for a distance of about 132 meters (425 ft.). The minimum curve radius is 28 meters (91.6 ft.).

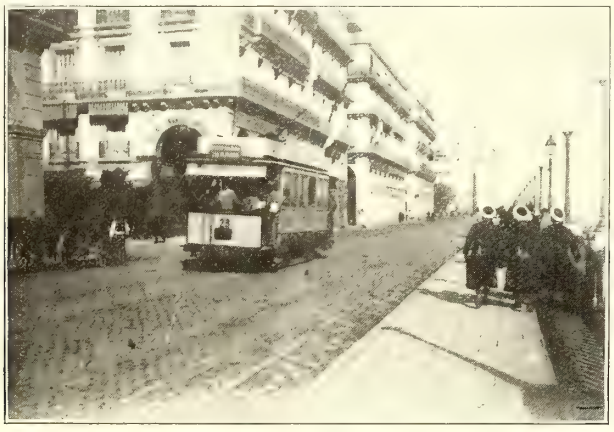
The track in the center of the city is laid with Broca rail weighing from 36 kg. to 44 kg. per running meter (72.7 lbs. to 88.9 lbs. per yard).

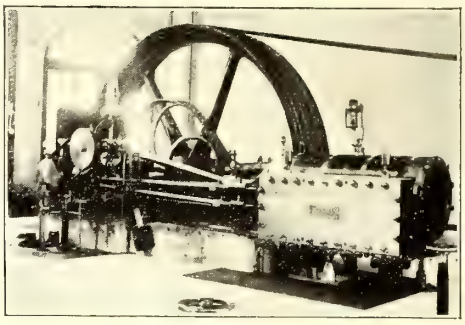
The ties, which are 1 m. wide x 0.1 m. deep (39 ins. x 3.9 ins.), are of metal and spaced 2 m. (6 ft. 7 ins.) apart. They are bolted to the rails and intended to keep the gage perfectly accurate. The track is laid on a continuous bed of concrete with hydraulic cement.

Outside of the city the company uses a Vignole or T rail of 20 kg. per m. weight (40 lbs. per yard), laid on wooden ties spaced 0.8 m. (2 ft. 7 ins.) apart. The gage is 1.055 m. (3 ft. 6 ins.), and on a double-track road the distance, center to center, is 3 m. (9 ft. 11 ins.).

Each joint is bound with two copper bonds of 8 mm. diameter (No. 0 B. & S.), connected to the rail by conical bonding chucks. Every 30 m. (98 ft.) the two rails of the same track are cross connected by a wire of the same size. On certain sections of a single track where the Vignole rail is used, the conductivity of the return circuit has been increased by the use of a return conductor made up of old rails buried in the soil, and bonded in the same way as the regular track. The use of buried bare cables as return conductors has not been looked upon with favor by the engineers. The return circuit as installed has been satisfactory, and on no part of the line has any difference of potential between the rails and the earth of over 3 volts been noticed.

A map of the line is given on the preceding page. The station is located at *C*, which is 8 km. (5 miles) from one of the termini. On the entire length of the route, even where single track is used, two trolley wires are employed, of 8 mm. diameter. The overhead system is divided into six sections of about 2.5 km. (1.5 miles) each. Three of these, viz.: one to two, two to three, and five to six, are supplied with separate feeders; in the case of the first two, by 150 mm. sq. (300,000 c.m.), and in the latter, where the difficulty is less, 50 mm. sq. (100,000 c.m.). The other three sections have no feeders. In the open country the feeders are bare wire, carried on porcelain insulators, but within the city they are buried, insulated by a layer of jute and paper, saturated with asphalt and protected by a lead sheath and outside steel wire armor. In spite of the excessive heat, which in summer is sometimes as high as 38 deg. C. (110 deg. F.) in the shade, the insulation of the cables has remained in good condition. It is doubtful whether a rubber insulating cable would have given such good results under the same conditions of temperature. The length of the underground feeders is 7400 m. (24,000 ft.), and they were supplied and installed by the Société Industriele des Telephones, of Paris. Each of the six independent sections into which the overhead line is sub-divided is protected at the power station by an automatic circuit breaker, so that any short circuit on one section will not interfere with the operation of the rest of the system. The overhead line is constructed for the use of the Dickinson trolley, and the distance between the wire and the car axle in no case exceeds 2½ m. (8 ft. 3 ins.). About 9.1 km. (5.6 miles) of overhead line is span construction, the other 6.6 km. (4 miles) bracket construction. All poles, even those in the suburbs, are steel tubes.









VIEWS IN ALGIERS

POWER STATION

Owing to the difficulty in finding a convenient site large enough to accommodate the power station and car houses together they have been located at different points along the line. The station occupies an area of 1600 sq. m. (17,200 sq. ft.), of which 710 sq. m. (7630 sq. ft.) are taken by the engine room, 550 sq. m. (5910 sq. ft.) by the boiler room and coal storage bin, and 340 sq. m. (3650 sq. ft.) for the court occupied in part by the cooling plant and the base of the stack, which has a height of 45 m. (148 ft.) and an internal diameter at the top of 2 m. (6.5 ft.). In the basement under the engine room are located all the feed and steam pipes.

The boilers, to the number of six, are connected in batteries of two each, of the French or elephant (bouilleur superposé) type. The heating surface for each boiler is

100 sq. m. (1076 sq. ft.), and the grate surface is 2.56 sq. m. (27.5 sq. ft.). This type of boiler was adopted after considerable investigation, as being the best adapted to steam generation in any country like Algeria, where the greatest simplicity of construction and ease of operation and maintenance are necessarily of great importance. They maintain the steam pressure very constant in spite of rapid variation in the load. The normal evaporation is 1200 kg. (2640 lbs.) per hour per boiler. Four other boilers of the same type are being installed.

One feed pump of the Worthington type is used, with an injector installed as a reserve, each having sufficient capacity for the entire plant. The feed water is taken from a well, a sheet-iron reservoir carried under the roof of the boiler, or from a cistern with a capacity of 200 cu. m. (52,800 gals.). The normal steam pressure is 7½ atmospheres. The boilers are guaranteed to 9 atmospheres and tested to 15 atmospheres. The piping is of steel and copper, and is duplicate.

The engines are of the simple condensing type, with steam-jacketed cylinders, and the cylinder dimensions are 500 mm. x 1000 mm. (19.7 ins. x 39.4 ins.); they run at 100 r.p.m.; the steam admission for 100 h.p. is 0.04; for 200 h.p., 0.12, and for 300 h.p., 0.25. The fly-wheel has a weight of 12,000 kg. (26,400 lbs.), and the diameter of the shaft is 20 cm. (7.9 ins.).

The condensing apparatus is placed in the basement, but all valves are to be operated from the engine floor. In case of necessity the condenser can be cut out of use and the engines made to operate automatically with free exit.

The air-pumps discharge the hot water into several small hot wells constructed between the foundation pillars. From there it is taken by a small centrifugal pump operated directly by a steam engine, and pumped to a height of 12 m. (39 ft.) into a cooling tower. This apparatus is composed of 540 triangular tubes 7 m. (23 ft.) in height and surrounded by cloth. They are placed vertically in a framework of wood. The hot water, arriving at the top, is spread over these pipes, and is cooled by running slowly along the cloth. A large zinc tank catches the cooled water, which then flows into a cistern, from which it is again pumped by the condensers.

The engines are belted to three six-pole, compound wound generators of 200 kw. each, turning at 450 r.p.m. The output is 350 amps. at 575 volts.

The switchboard is of the panel type, and carries automatic circuit breakers, ammeters, etc.

ROLLING STOCK

The company has in actual service thirty motor cars and eighteen open trail cars. The motor cars contain seats for twenty passengers and room for eighteen standing passengers. The car body is divided into three compartments. The wheel-base is 1.80 m. (5 ft. 11 ins.). Each car is equipped with two 30-h.p. motors, permitting the motor car to draw two open trail cars if necessary. Fully loaded, the weight of the entire train is about 20,000 kg. (44,000 lbs.). The controllers are of the series parallel type.

CAR-HOUSES

The car-houses are situated on the line of route of the road, and adjoining them is a repair shop equipped with all tools necessary for ordinary repairs, and driven by an electric motor.

The change from steam to electric traction has been followed by a large increase in the receipts. The report of the system for the month of December, 1898, shows the following figures; coal per train-km., 2.150 kg. (7.8 lbs. per train-mile); coal, per kw.-hour at the switchboard, 2.5 kg. (5.5 lbs.).

The Breakage of Car Axles

BY J. F. THOMPSON.

Opinion among manufacturers of car wheels and axles differs as to whether iron and steel axles crystallize in service, but, taken as a whole, seems to be against the theory, or, at all events, that the cause for failures in street car axles is not due to crystallization, but to insufficient inherent strength. While this cannot be said to have been proved, the advocates of the theory of non-crystallization claim that if axles break in use and the fracture shows crystallization, that the same axles if tested before being put into service would have shown the same characteristics. It is certainly true that new axles, upon being broken, do show a crystalline structure, proving that service is not necessary to acquire it. On the other hand, a great many axles which have been in use for some time have broken suddenly where the fracture, though fresh and bright, showed no sign of crystallization.

It should be remembered that the car axle, when in place under the car, with the motor attached, is practically rigid, and unlike that under steam railroad cars, because it cannot bend or take up any shock in the middle. When, therefore, an unusual strain or shock occurs, the break in the axle comes at the weakest point, which is sometimes on the



FIG. 1.—FRACTURE OF FINE STEEL AXLE

outside of the wheel next to the journal, and sometimes on the inside, according to the style of motor used. In all cases in the use of steel axles, shoulders and sharp corners should be avoided by the use of fillets as far as possible. In many cases the key-way is cut at a point so that it extends up to the inside hub of the wheel, and if the wheel is fitted to a shoulder, the axle frequently breaks at this point.

The accompanying engravings, which are full size reproductions of actual fractures of car axles, will give an idea of the appearance of the fracture of different kinds of axles. In each case the axle has been turned down somewhat to admit of breakage, so that the diameter in the engraving is not that of the original axle.

Fig. 1 shows the surface of a broken axle from an electric car. The diameter of the wheel fit was 3⅝ ins.; diameter between hubs, 3½ ins; diameter of journal, 3½ ins. The axle broke back of the hub. A piece of the axle, 15 ins. long, could not be broken under a drop hammer of 1850 lbs. falling 12 ft., although the hammer was reversed several times. It will be noticed that the grain of the steel is quite fine. The material is fair and the axle undoubtedly broke because of the shoulder at the back of the hub where the axle was turned down ⅛-in. smaller than the wheel fit. Fig. 2 is a sample of a broken motor axle from a street railway company in Pennsylvania. This axle had a 3¾-in.

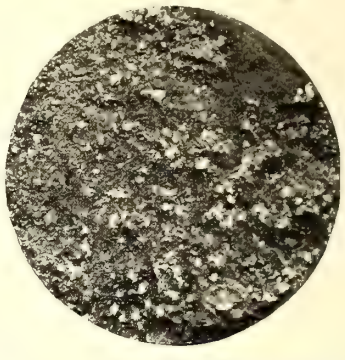
wheel fit and 3-in. journal and it broke at the end of the journal next to the dust guard. It will be noticed that the grain of the metal is coarser than that shown in Fig. 1. Fig. 3 is a sample from the driving axle of a traction engine and was 4 ins. in diameter back of hub, with wheel seat turned down to $3\frac{1}{2}$ ins. This axle broke back of the wheel at the key-way, which was $\frac{1}{4}$-in. deep. The wheels were 30 ins. in diameter and the gage of track 3 ft. It will be noticed that the grain of the metal is about as coarse as that in Fig. 2.



FIG. 2.—FRACTURE OF STEEL AXLE



FIG. 4.—FRACTURE OF STEEL AXLE



FIC. 5.—FRACTURE OF HAMMERED IRON AXLE

Fig. 4 is an engraving from a photograph of a new $3\frac{3}{4}$-in. steel axle. As will be seen the grain of this metal is a little coarser than that in Fig. 1, but finer than that in Figs. 2 and 3.

Fig. 5 shows a sample of a hammered iron axle cut from a 4-in. diameter journal. It will be noticed that the fracture shows large open crystals.

It is a well known fact that iron castings will stand a better physical test a year or two after they are made than they will soon after casting. It is claimed that at the time of casting, the molecules are disarranged and that it takes time for them to readjust themselves. The evidence is all in favor of this theory, as observations show that where chilled cast iron car wheels break in service from other causes than wrecks, it is quite early in the life of the wheel. It is very rarely than an old car wheel breaks in service unless the flange or thread has become worn very thin. An examination which has been made of a large number of 33-in. steam car wheels that have been in service from fifteen to twenty years, has shown that they were tough under the wheel breaker and were free from cracks or flaws, seeming to prove that there is not only no tendency to crystallize, but that, if anything, the effect of age is to increase the structural strength of the iron. If this theory of the readjustment of molecular formation is correct as to cast iron, it would also seem reasonable to suppose that it holds true also of hammered iron or steel.



FIG. 3.—FRACTURE OF STEEL AXLE

A great deal could be written upon the importance of employing for the purpose of car axles the best material, and here, if anywhere, a "penny-wise and pound-foolish" policy will tell in the long run against the user of poor material and small axles. The most economical policy is to be generous in the size and material of axles installed, so as to avoid as much as possible any danger of breakage. The curves on electric railways are often of very short radius, and as most of the axles are driving axles, the entrance into these curves at speed may have the effect of twisting off the axle, as well as of breaking the wheel flanges. The latter form the soundest part of a wheel casting, as they are the drag or bottom side in casting, and any strain in curving where flanges generally break, sufficient to break them off, or tending to do so, must cause a severe torsion on the axles.

The axles in most common use are the hot rolled steel and cold rolled steel, both of which have shown excellent results in service. An effort has also been made to employ hammered iron, which has a number of advocates. In iron, fibre is generally considered an indication of strength, and to secure this one manufacturer builds up iron axles by placing together four or nine bars of 2-in. square iron, with a top and bottom piece $4\frac{1}{4}$ ins. x 1 in. or $6\frac{1}{4}$ ins. x 1 in., with corners chamfered to prevent the pile from being overheated. This, it is claimed, will avoid heat cracks, which are almost unavoidable when axles are made from square corner piles. The effect of this axle in use is claimed to be a freedom from breakage, but in point of wear it would probably not have as long a life as a steel axle.

Hollow steel axles have been employed to a considerable extent in steam railroad service, but outside of the third-rail roads of the New York, New Haven and Hartford Railroad have not been employed in surface electric railroading.

It is a common practice on some roads when pressing wheels on axles to leave them wide in the gage, making the flange run close to the rail. The object of this is to prevent the lateral play of the car as much as possible, and the practice is a good one when the tracks are kept in good condition, are straight and level and the rail joints are kept up well. But the railway manager should remember that the practice of a close working flange is severe on the axle, as the crowding of the flanges against the head of the rail has a constant tendency to bend the axle and wear the flanges. Where there is trouble from either of these two causes, theory would dictate that in pressing on the wheels, a little lateral play should be allowed between the flange and the rail. This should be especially followed on a road where a small-sized axle is in use, and where the labor and

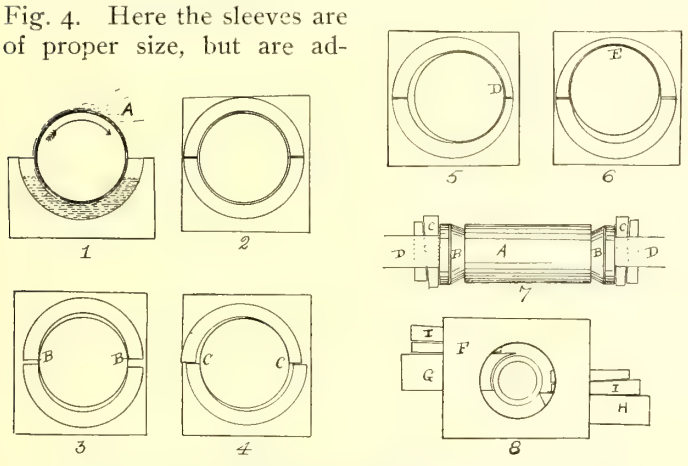
expense of changing the sizes of axles, reboring gears and motor frame boxes and probably the motor frame between the boxes as well, would be so great as to practically prohibit any change in the size of the axle.

Lubrication of Street Railway Car Bearings

BY J. F. HOBART

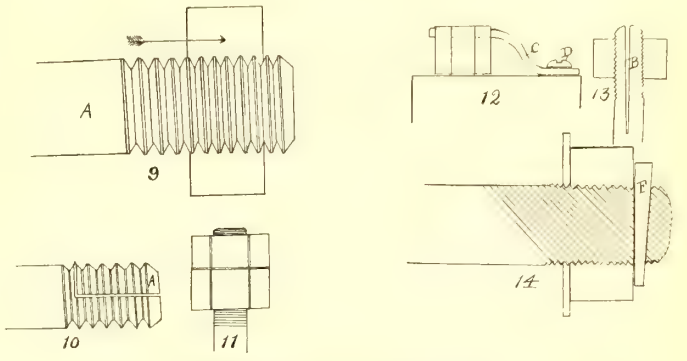
If a revolving shaft is set up in a reservoir of oil after the fashion shown in Fig. 1, the shaft will take on film after film of oil until the centrifugal force begins to throw the oil off as at *A*. From three to a dozen films of oil will form, according to the conditions. This, as is known, is the theory of all journal lubrication. It is mentioned in this connection simply because the proper lubrication of street railway car bearings has often been prevented through defective mechanical factors. If the sleeves of the car journal fit the axle properly, as in Fig. 2, the oil films can form on the entire bearing surface, and friction, wear and heating are avoided. But sometimes the sleeves of the box are a little too small, so that the edges are in contact with the axle at *B B* Fig. 3, resulting in a scraping off of the oil films as fast as formed. Grinding, wearing, heating and loss of power follow. Oil loaded with grindings will soil the exterior of the box, and, as is often the case, the fault will be attributed to the non-efficiency of the lubricant. The remedy consists either in providing new sleeves of right dimensions or in turning down the small ones to right size.

Another character of defective work is represented in Fig. 4. Here the sleeves are of proper size, but are adjusted incorrectly, as the lower one is not in line with the upper. Two scraping surfaces are therefore produced at *C C*, and wearing, grinding, heating, etc., result. This evil is easily remedied by resetting the sleeves so as to have upper and lower even. The type of worn bushings, illustrated in Fig. 5 at *D*, is a familiar sight to all street railway mechanics. The flow of dirty oil, the rattling of parts, the irregularity of motion and loss of power through friction are the symptoms. Oil films may form readily enough on the contacting surfaces, but with one side of the bushings gone, as at *D*, the best lubricants obtainable cannot operate to advantage. The only remedy is to substitute new bushings or rebabbit the box, providing the box is of the kind that will permit this operation. The same remark is applicable to illustration No. 6, in which the top sleeve is worn at *E*. This is frequently noticed in car bearings, and frequently can be fixed by merely putting in a new upper sleeve, the lower one being all right.



GOOD AND DEFECTIVE BEARINGS AND METHOD OF TRUING BEARINGS

Barrel bushings often cause trouble by expanding or losing their shape through heating. Fig. 7 shows a good way to true such bearings. The bearing *A* is held by means of coned collars, *B B*, on either side. These collars are loose on the shaft *D* and are held tightly against the ends of the bearing by means of steel keys *C C*, the latter being driven into seats cut in right places in the shaft. The bearing is now in condition for truing in a lathe, as the shaft *D* can be secured in the chuck. For a cutting tool, the form shown in Fig. 8 can be used, which tool is available for truing many round shapes. The form *F* is of tool steel and is cut out at one side for the cutting tool *H*, and at the other for the straddling tool *G*. Both tools are held in place by means of keys *I I*.



METHODS OF LOCKING NUTS

So much depends upon the adjusting nuts and set bolts in street railway car journals that a brief discussion of them in this connection may be advisable. Necessarily the threads of bolts taper toward the end from which the thread was cut, and if the bolt is struck at *A*, Fig. 9, with a hammer, it will be observed that the nut, unless prevented by something, will turn a little at each blow. After several blows it will be seen that the nut has moved a little in the direction of the arrow. If the blows are continued, the nut will follow the thread and finally drop off from the end of the bolt. This tendency is overcome, of course, by tightening the nut against something, as the cap of the box, for example. Railway men have considerable trouble with loosening nuts and bolts, owing to the jar. Several ways to prevent nuts and set-screws loosening of their own accord are shown next. Fig. 10 shows a split-bolt tip. The split part *A* is cut from an ordinary bolt by means of a hack saw. The loose piece assumes the form of a wedge and will usually prevent the nut from working loose.

The two-nut, or lock-nut form, illustrated in Fig. 11, is too well known to need describing. The pivoted spring *C*, as shown in Fig. 12, has also been employed with good results. The spring is set-screwed to the cap of the box at *D*. The head of the cap-screw is grooved and the spring slipped into this groove as shown, thus preventing the screw from turning of its own accord. The divided shaft is shown in Fig. 13. The shaft is simply cut down about an inch below the seat of the nut. The sides are sprung out a little, and when the nut is in position, the expansion of the sides tends to retain the nut in place. The keyed form is shown in Fig. 14, in which the place for cutting the key-way is nicely calculated, and when the key *F* is in place the nut is firmly secured from turning off.

A recent compilation in the "Railroad Gazette" places the number of accidents of all kinds on street railways in the United States for the year 1898 at 133; persons killed, 27; persons injured, 378.

Motor-Dynamos or Accumulators

BY ALTON D. ADAMS

It has been truly shown for electric car lines long enough to make the cost of feeders prohibitive, with an ordinary per cent of loss—that an accumulator plant at the end of long feeders may be cheaper to install and operate than a small additional generating plant. Were the only choice, in cases like the above, between an accumulator plant and an additional station, the battery up to distances of 10 or 15 miles would in most instances be selected, but the fact is that a third means is at hand to produce the desired result, and in most cases will be found more desirable than either of the other two; this means is the motor generator.

The accumulator has no power to furnish an increasing pressure in compensation for line loss, and when used to maintain pressure at the end of long feeders must be placed at the point where constant pressure is desired. This isolated position of the battery involves a constant outlay for interest on real estate or rent, and for attendance, though not to the same amount in a given case as would a new generating station.

The average efficiency of the battery under working conditions can hardly be expected to exceed 85 per cent, so that the line must deliver to the battery $1. \div .85 = 1.17$ times the energy required by the car motors. The average loss in the feeders between the generating station and the battery should be decided according to the cost of copper and of power, without regard to the battery, except that the loss of energy in feeders will be somewhat greater, their size being the same, when the battery is used, as 1.17 times the watt hours must be transmitted that would be required without the battery. The drop of pressure in feeders between the station and battery must be compensated for at the station, but this drop, at its maximum, will not be so great with as without the battery, because the battery furnishes current at times of maximum demand, being charged at times of minimum demand, the result being that the average amperes flowing through the feeder is greater, but the maximum current less with the battery in use. As the battery acts at the time of maximum demand, it is an addition to station capacity, but an expensive one, as the price of a battery, plus the value of real estate on which to install it, is quite a number of times that of a dynamo of equal capacity.

A motor generator must be installed at the station so as to raise the bus bar pressure enough to compensate for the drop in the battery feeder and to charge the battery. The battery at the far end of a long feeder may be charged and discharged alternately during the entire working time of the central station each day, or it may be charged only during the time of light load and no load on the trolley, and discharged during the entire time of medium and heavy load. It is also possible to send all of the energy transmitted by feeder into the battery and draw the entire supply for the trolley wire from the battery. The plan of intermittent charge and discharge will allow the smallest battery to be used and give the highest efficiency, as the least energy will then pass through the battery, and be subject to its loss, and the battery may always be nearly charged. It should be evident from the above that a battery at the far end of a long feeder serves simply to compensate for momentary fluctuations in pressure, as it does when used in the central station, but cannot supply a pressure to make good that lost in the feeder, a motor-dynamo being necessary for this last purpose.

Taking a case where the loss is any desired per cent in the feeder on the average, with no battery in use, it is clear that the addition of a battery must lower the efficiency of transmission between power house and trolley, without saving anything in the cost of feeder, the average loss in the feeder being at least the same as without the battery, and the battery loss being added to the average feeder loss.

The above facts may be illustrated by the case of a long feeder delivering current to the trolley wire at 500 volts, and with a loss in the feeder of 20 per cent at average load, with no battery in use. Since the average loss in this feeder is 20 per cent, the pressure at the power house must be $500 \div 0.8 = 625$ volts at average load, and no battery in use.

If the maximum load on this feeder is twice the average load, the pressure loss in the feeder at maximum load will be doubled, or $(625—500) \times 2 = 250$ volts, and the pressure at power house must be $500 + 250 = 750$ volts at maximum load. Since the volts lost in the feeder and the current or amperes flowing in it are each twice as great at maximum load as at average load, the capacity of the motor-generator must be four times as great for the maximum load as for the average load. The total power or energy lost in the feeder is equal to the average loss, that is, the loss at average load, and the maximum loss simply serves to fix the capacity of motor-generator necessary.

Suppose, now, a battery is installed at the trolley end of above feeder, and so arranged that all of the energy from the power house goes into the battery, the average efficiency of battery being 85 per cent. Taking the most favorable view for the battery, suppose the average ampere load on the feeder remains the same as without the battery, and that the loss in battery is entirely made up by increased pressure at the power house. Since the battery is to deliver 500 volts to the trolley with 85 per cent efficiency, the pressure at which current is delivered to the battery must be $500 \div .85 = 582$ volts, and the pressure at the power house at average ampere load on feeder, which is the same as average ampere load without the battery, must be volts lost in feeder, plus volts lost in battery, plus volts delivered to the trolley wire, that is $125 + 82 + 500 = 707$ volts at power house. The efficiency of transmission between the power house and trolley when no battery is in use is $500 \div 625 = .8$, or 80 per cent, while when the battery is used the efficiency of transmission is $500 \div 707$, equal to 70.7 per cent.

The loss between power house and trolley without the battery in use is 125 volts, and with the battery 207 volts, so that the loss with the battery is $207 \div 125$, equal to 1.65 times as great as without the battery. If it is desired to put the same total average loss with the battery in use, that is 207 volts, into the feeder with no battery in use, the relation between the area and weight of the feeders required for the two cases may be found as follows, when A = amperes flowing through feeder at average load in each case, L = total length of feeder wire in feet, and 11 = resistance in ohms of a mil-foot of the conductor. Then the areas of the feeders will be:

$$\text{C.M.} = \frac{\text{L 11 A}}{125} \text{ and } (\text{C.M.})_1 = \frac{\text{L 11 A}}{207}$$

$$\text{Therefore C.M.} : (\text{C.M.})_1 :: \frac{\text{L 11 A}}{125} : \frac{\text{L 11 A}}{207}$$

$$\text{C. M.} \frac{\text{L 11 A}}{207} = (\text{C.M.})_1 \frac{\text{L 11 A}}{125}$$

$$\text{C.M. } (125) = (\text{C.M})_1\ 207 \qquad \frac{(\text{C.M.})_1}{\text{C.M.}} = \frac{125}{207} = .60.$$

That is, if the battery is not used in above case, and the total average loss of 207 volts that would take place in the battery and feeder combined, concentrated in the

feeder, the area and weight of feeder will be only 60 per cent of what it would be with the battery in use. Should it be desired to maintain the same loss in feeder without as with the battery, the weight of feeder will remain the same, and as the efficiency of transmission is 80 per cent without the battery and 70.7 per cent with it, the amount of power required in each case when 1000 h.p. is delivered at the trolley is with no batteries in use, 1000 ÷ .8 = 1250 h.p. delivered to the feeder at the power house, and with the batteries 1000 ÷ .707 = 1413 h.p delivered to the feeder at the power house. When batteries are used, therefore, additional power to the extent of 1413 — 1250 = 163 h.p. must be applied to the feeder, beyond what would be required without batteries. Assuming the average power to be required during 6000 hours per year and that the cost of power is 1 cent per h.p. hour, the yearly value of the additional power lost by the use of batteries is found from 6000 × 163 × .01 = $9,780.00 per year.

As the above computations are based on the assumption that all of the energy on feeder from the power house goes into the battery, and is subject to the battery loss, the results obtained will vary from the above when only a part of the energy from the power house goes into the battery and the remainder directly into the trolley wire. In case but half the energy from power house goes into the battery, the possible saving in copper and the extra cost of power above found will each be reduced one half. In order to maintain a pressure of 500 volts on the trolley wire at the end of a long feeder, a motor-generator must be used to supply the entire loss of pressure between the power house and trolley, at the maximum load, whether a battery is used or not. The capacity of the motor-generator in any case must equal the maximum current in amperes on its feeder multiplied by the maximum loss in volts between the station bus bars and the trolley wire.

In the case above taken of 125 volts lost on feeder, at average load, with no batteries, assume the maximum load twice the average load in amperes, and let A equal the amperes at average load, then the capacity of motor-generator for average load is 125 A, and at maximum load, with twice the amperes flowing in the feeder and twice the volts lost in it, the capacity of motor-generator is 2 (125) 2 A = 500 A; that is motor-generators must be four times as large as needed at average load in order to maintain pressure of trolley wire for the maximum load.

When a battery is used at the trolley end of above feeder, as assumed, the load on the feeder need not rise above the average, and if all the energy is sent from the feeder into the battery, the total loss of pressure will be 207 volts, as computed, and the capacity of motor-generator must be 207 A, the amperes being the same as with average load and no battery.

For the assumed conditions, then, the motor-generator without battery must be 500 A ÷ 207 A = 2.41 times as great as when a battery is used.

The losses in the motor-generator will be about the same whether a battery is used or not, and while a larger motor-generator is required when no battery is used, the actual energy in kw. hours furnished by the motor-generator must be greater with the battery in circuit, and the same size of feeder, since the motor-generator furnishes the total loss, which is greater with the battery in use.

It should be held clearly in mind that the total loss for either system is the loss of *average load*, and though the loss fluctuates more between its highest and lowest point, so as to require a larger motor-generator without batteries than with them, the system without batteries has a smaller *average loss*, and is more efficient or else requires a smaller feeder.

Portable Electric Stone Crusher

A rapid and economical method of stone ballasting track has been in use for some time on the lines of the Scranton Railway Company, Pa. The method involves the handling of the stone only once by the use of a portable crusher. The general arrangement of the crushing and distributing car is shown in the accompanying engraving.

An ordinary single-truck freight car is equipped with a trolley pole, stone crusher and three No. 3, 30-h.p Westinghouse motors—two to operate the car and one to drive the crusher, to which it is connected by a 6-in. rubber belt. The car is loaded with stone from the quarry, and is then run to the point of the track which it is desired to ballast, the track having previously been left with exposed ties. The crusher is then set in operation by means of the stationary motor, and the pieces of stone fed into the jaws of the crusher, the broken stone dropping into place between the ties as the car proceeds slowly. The capacity of the car is 6 cu. yds. of stone, and that of the crusher is 50 cu. yds. in 10 hours. The crusher will receive stone 8 in. x 14 in. The weight of the crusher alone is 7000 lbs. After the car has passed the stone is raked into place and tamped under the ties by hand.



PORTABLE ELECTRIC STONE CRUSHER—SCRANTON

Changes in Washington, D. C.

Announcement has been made that the stock of the Metropolitan Railroad Company and the Columbia Railway Company of Washington has been sold to a syndicate organized for the purpose of effecting a consolidation of the electric lighting plants of the District of Columbia, the gas companies of Washington and Georgetown, and all the street railway lines in Washington.

It is understood the price paid for the Metropolitan property was in the neighborhood of $4,000,000, and for the Columbia about $1,000,000. It is understood the capital stock of the new combination will be not less than $25,000,000.

LETTERS AND HINTS FROM PRACTICAL MEN

Notes on the Standard Rules and Regulations as Reported by the A. S. R. A. Committee, III

Schenectady Railway Company,
Schenectady, N. Y., March 19, 1899.

Editors Street Railway Journal:

Continuing the comparison and analysis of the "Standard Rules and Regulations" of the A. S. R. A. committee, we wish to know:

Sixth.—Are they free from contradictions either within themselves or with one another? They are.

Seventh.—Are they in accordance with general usage, experience and observation? This point has already been discussed in the previous article (under the third head) and several instances given where they were *not*. There are one or two instances that need a more extended discussion, and the first and most important of these is the matter of "Bell Signals."

The matter of signals between the conductor and the man who runs the car (as he is called the "motorman" in the rules under discussion we will call him that) is an important one in a general set of rules, and if only one thing were made "standard" that one thing should be the bell signals. To a conductor or motorman who serves for any length of time on a road or roads where similar signals were used, they become a language to him; "two bells" are not two separate and distinct strokes on the signal bell—they are the words "go ahead" as plainly as if spoken by human voice, and when, for any reason, he has to work under another system of signals they are more confusing to him than a command in an unknown tongue.

To the traveling public, also, the ordinary and most-used signals become a like language, very often influencing their actions while boarding, moving around on, or leaving a car. Twice within the writer's knowledge has an unfamiliar signal nearly caused an accident to a passenger hearing and misunderstanding it. It may be urged in regard to the employee that a proper training of a few weeks under the new signals would eliminate the old ones from his memory, but the difficulty is that the long observation of certain signals becomes *more* than a memory; it becomes almost an *instinct*, and takes a long time to supplant with a new system. In a case which occurred under the writer's observation, a motorman who had been trained under "one bell, stop at next regular stopping point," was running on a road where "one bell" meant "stop instantly." He had been in training over two months under the new signals and yet, at a critical instant, when "one bell" had been given him as a signal he involuntarily obeyed the old signal, did not stop instantly, and had a bad collision. The same is true of the conductor—upon seeing the need of a certain action to be performed by the motorman his hand will involuntarily give the signal most familiar to him *at that moment*. To a lesser extent this principle is also true of the other traffic employees and of the traveling public, and illustrates the need of a standard and universal system of signals on all surface railways using bell signals.

It may be urged that to have a full and complete set of signals that can be used on any road is as impossible as to formulate a set of complete rules for the same. Such a complete set of signals is not necessary; all that is necessary is a set of signals for the "traffic messages" (between the conductor and the driver of the car or train) that are common to all surface roads. Special messages, due to peculiarities of the driving apparatus or to local conditions of track, traffic, or rules, can easily be added in each case—as will be shown later.

These standard signals should be easy to learn and ring, should be as simple as possible, and—if it is possible to do so—should be so arranged that awkwardly or incorrectly given they do not cause delays, complications nor accidents. Those requiring instant action should be the very simplest and quickest to give and receive, while those requiring action not so prompt may be more elaborate, and those demanding attention should be in the nature of alarms. At the same time there are a few signals like "two bells—go ahead," "three bells—come back," that are standard and universal, and will have to be recognized and left unchanged even if they somewhat disarrange the order and conditions as just noted.

The actual number of general "traffic messages" necessary to be used between the conductor and motorman is not very great, and can be easily covered with one, two, three or four taps of the signal bell, or with a few repetitions or combinations of these numbers. To find out what is really necessary in the number of these signals, let us see what are the necessary general messages between these two employees.

The car being stopped, the conductor may require the motorman

1. To start it forward.
2. To hold it stopped until some other than the regular starting signal is given.
3. To start it backward.

The car being in motion, he may require the motorman

4. To stop it instantly.
5. To stop it at some pre-determined point.
6. To get ready for a stop (*i. e.*, to shut off motive power or to slow down).

The car being either stopped or in motion, he may require the motorman

7. To come to his assistance.
8. *Not* to stop for passengers desiring to ride.

There are, therefore, at the most, only eight general signals necessary from conductor to motorman—three for use when car is stopped or stopping, three when car is in mo or is just starting, and two at any time. Four distinct signals—such as one, two, three or four taps of the bell, with a repetition of one of them as an alarm signal, will cover the whole ground. As already stated, two of these signals are already in universal use and must be considered standard, and there is *one* that is not standard but should positively be made so, that is the signal for "Stop instantly." Under the "bell signal rules" of the committee we find this given as "three taps of the signal bell while car is running." This is the practice of a number of street railways, many of them quite large ones, but nevertheless it is *not* a universal one, *nor is it the correct one*. It is an undisputed fact that it is necessary on any and every surface street railway to have a signal that will stop the car as quickly as possible; it is as undisputed a fact that on all such roads such a signal is liable to be a danger or emergency signal. It should, therefore, be the signal that is the simplest and quickest to give and to understand, that can be given in any emergency by any one within reach of the signal cord, that will be given correctly and in full, even if the signal apparatus is broken in giving it—and the only signal fulfilling this and all necessary conditions is that of "one bell"—or one tap of the motorman's, driver's or gripman's bell. Any other number or combination or repetition of numbers, given under the excitement of an impending or happening accident may be wrongly given, may be given so rapidly as to confuse or mislead the hearer, or may be misunderstood even if given correctly; but the single "*clang*"

gives no chance for mistake on the part of the giver, nor for misconception nor misunderstanding on the part of the receiver. In time of danger a convulsive and almost instinctive clutch at the bell-cord will give the desired signal —even if it breaks the apparatus—where the more elaborate and unnecessary "three taps" could not be given, completed nor understood.

It has been urged that on surface railways having fixed stopping points the use of "one bell" as a signal for stopping instantly would make many unnecessary stops during rush hours or at other times when the cars were so crowded that the conductor was not easily "get-at-able" by a passenger inside the car, as such passenger would be very liable to give "one bell' when his—or her—desire was only to have the car stop at its next regular stopping place. This is true, and until the new signals were thoroughly standard such a thing would very probably happen, but its frequent occurrence could be easily prevented in many ways, and as the proper signal became better known it would gradually cease. In any event, its occurrence could only cause delay; under no circumstances could it—on a well-managed road—cause an accident.

Therefore, with the above signals fixed, the others arrange themselves very quickly, and the necessary general signals from the conductor to the motorman would be as follows:

(1) One bell, while car is stopped, "Do not start until some other signal than 'two bells' is given."

(2) One bell, while car is running, "Stop instantly."

(3) Two bells, while car is stopped or directly after one bell or three bells have been given, "Go ahead."

(4) Two bells, while car is running, "Get ready for a quick stop."

(5) Three bells, while car is stopped, "Back car."

(6) Three bells, while car is running, "Stop at next regular stopping place."

(7) Four bells, at any time, "Do not stop to take on any passengers."

(8) A succession of quick single taps, or a continuous ringing of the bell, "Come to me instantly."

From the motorman to the conductor the same signals will need to have a different meaning, and from the fact that the same signal cannot be used for two different messages (depending on whether the car is stopped or moving), the signals will have to be a little more complex than those from the conductor to the motorman.

The motorman may desire the conductor

1. To come to him instantly.

2. To put on the rear brake or some other safety or car-holding or car-stopping device.

3. To shut off the motive power.

Or he may wish to inform the conductor

4. That he desires to back the car.

5. That the motive power is cut off from him.

6. That uncollected fares are on the front platform, or have entered car by front door.

7. That some switch, signal, or safety device, known to the conductor and operated by him, is not set or properly arranged.

There are, therefore, at the most, only seven necessary general messages from the motorman to the conductor, and, as stated, these have to be made up of not only single signals of one, two, three, or four taps of the bell, but also of repetitions and combinations of them. With these facts in view the necessary general signals from motorman to conductor would seem to be as follows, at any time and whether car is stopped or stopping, running or just started:

(1) One bell, "Come to me instantly."

(2) A succession of single taps or a continuous ringing of the bell, "Put on rear brakes (or any other safety or stopping or holding device)."

(3) Two bells, "Uncollected fare or fares on front platform, or have entered car by front door." This signal to be followed by slower single taps, giving the number of such fares.

(4) A succession of two bells, or double taps, thus: — — — — — —, "Motive power cut off from me."

(5) Three bells, "I wish to back the car."

(6) A succession of three bells, thus: — — — — — — — — —, "Switch or signal or safety device on line or track not set or not operating."

(7) Four bells, "Shut off motive power."

Any special or local signals can be added to the above lists by additional number of taps, or by other combinations of them than those used above.

The signals as suggested above are the result of a long course of inquiry and observation on this point and are believed to be simple, easy to learn, to ring and to understand. There is a good reason for each one, and for the arrangement as a whole, and the writer would be glad to have them studied and criticised.

No attempt has been made to deal with the signals made by the alarm, or foot-gong, as signals should never be made between the conductor and motorman in this way except in a case where the signal bell or bells are broken so that they cannot be used, and with a double system of bells on each car and with a few feet of bell cord, with "patent splicers" in the locker, there is absolutely no occasion for this to occur. The specific reason for not using the foot-gong as a signal between conductor and motorman is that the sound of the gong is liable to be so overpowered by outside noises as to be inaudible to persons on the car, and the strokes on the gong are also liable, if heard, to be confused with those of other cars passing, thus leading to confusion, mistakes and accidents. Outside its use as an instrument of warning and alarm, the gong should be used only as a signal to a car behind, in front, or passing; as an acknowledgement by the motorman of the receipt of the conductor's signals, and to ask permission of the conductors to start the car. For the first of these purposes there is no need of any general or standard set of signals, the use of the gong for this purpose will be entirely local and special, and can therefore be arranged by each road for itself. For the second of these purposes the use of the gong should be insisted upon, and should be made part of the general rule for "signals," as follows:

"He (the motorman) will always acknowledge the receipt of all signals from the conductor by repeating them *at once* on his gong, and *exactly as received by him.*"

This not only gives the conductor the opportunity to know that his signal has been received and correctly understood, but it lessens the chance of careless mistakes on the part of the motorman—such as receiving and understanding one signal and putting into effect another one—by making him repeat the signal himself and thus bring it more clearly to his own attention. It also calls the attention of a car or of vehicles or of pedestrians in front of the car to the signals and enables them to take advantage of it in crossing, not crossing, or getting off the car track. In case, also, that the motorman receives from the conductor a signal that it is impossible to obey, or that he *knows* is wrong, the reiteration of it on the gong will be the best and speediest method of calling the attention of the conductor to his mistake. For the third of these purposes—that of asking the conductor for permission to start, when for any reason the motorman has stopped without a signal—a part of the general rule for "signals" should be made to apply to it, as follows:

"If for any reason the motorman has stopped the car

without a signal from the conductor to do so or if the car has been stopped on signal from the conductor, and the motorman may desire for any reason to move the car, he must *in no case* start it until he has asked permission of the conductor to do so by ringing on his own gong the signal he desires, and *has received that signal from the conductor*."

The committee has given duplicate rules on this subject (No. 18 for conductors and motormen, and No. 12 for motormen), but has not included in either the matter of asking for the signal by the alarm-gong. With the gong used for these three purposes, the alarm and warning signals should be limited to a succession of rapid single strokes for an alarm warning, a succession of slow single strokes when running in a crowded or narrow street, or when turning a corner, and a combination signal, such as —— ——— for a cross-street warning.

Rule No. 10 for motormen reads—"Signals: Before reaching a curve the conductor will signal you by ringing your bell twice to go ahead if he has the trolley cord in his hand. Should you fail to receive the signal ring the conductor's bell twice. If you fail to get the go-ahead signal, stop your car until you do."

In the first place, the caption of the rule is misleading and incorrect, as its subject is "curves," and it has less to do with "signals" than many others of the rules not so headed. In the next place, there is absolutely no use for such a rule. The "right of way" around curves has been defined in a preceding rule, so it cannot be for that purpose that this rule has been framed. If it is on account of the fact that the overhead work on curves is in such bad shape that it necessitates the conductor hanging on to the trolley cord before the car can proceed around it, the sooner such road discharges its line boss and gets one that will build curves that *can* be run, the better. A rule is no substitute for proper and correct work, and in such a case it is a patch on top of a patch! If the object of the rule is to have the car stop at every curve in order to prevent a collision at the end of it, such object is an unnecessary one for a general rule. *All* curves are not dangerous, even on any one road all curves are seldom dangerous ones. Where curves on any road are dangerous, it will be the special province of that road to make its own special rules for the occasion—no general rule must try to *explicitly* cover local conditions.

Eighth.—Are they reasonable?

Ninth.—Are they just and equitable?

These two heads will be considered together, as most of the rules coming under one come also under the other.

The eleventh paragraph under "General Requirements" states that "All employees should make a deposit of at least ten dollars for the badge furnished them and twenty dollars for cost of uniform." If the idea is to reimburse the employer for the loss, destruction or injury of the badge, the exaction of a ten-dollar deposit for an article worth from fifty cents to a dollar and a half is scarcely reasonable, and is certainly neither just nor equitable. If the idea is to make the sum a *penal* one, it is still less reasonable, as any amount beyond the value of the article could not be collected by law, and its retention by the employer should certainly be resisted by the employee. The just and reasonable method is to make the amount of the deposit the exact cost to the employer of the articles entrusted to the care and used on the person of the employee —such as the badge or badges, the uniform buttons, punch, tickets, transfers, book of rules, etc. Anything further than this is unwise, unjust and unreasonable. Street railways fight tooth and nail against "exemplary damages" when applied to themselves; they should not, therefore, make a precedent by trying to apply them to their own employees.

As to the deposit for uniforms, the language of the rule does not show explicitly whether the committee believes in the railway furnishing the uniform or not. If the former is the case the idea is a mistaken one, as it is now the feeling of both officers and employees of street railways that the employees should always own their own uniforms. Leaving aside the fact that the province of street railways is the carrying of passengers, mail or freight, and not the running of second-hand clothes shops, no employee with any self respect likes to be forced to wear the second-hand and perhaps misfit uniform of another and mayhap dirty predecessor. Every trade necessitates an investment of some sort—of time or tools or materials—on the part of the person learning it, and the investment made by the conductor or motorman is the time given to learn the trade *and* the uniform. For the benefit of itself the employer has the right to require that the uniforms in use *are uniform*, and therefore it should prescribe their exact material and makeup. For the benefit of both itself and its employees, it should make certain that such materials and makeup are the very best for the purpose, and furnished at as low a cost as is possible under such conditions. This having been done, it has the right to insist that the seller of the uniforms be made secure in the payment for them and without responsibility to itself; therefore it has the right to exact a deposit of the exact cost of such uniform, and to pay the seller such cost, thus making certain the fact of payment. Further than this it cannot go in reason and justice, and further than this it owes the employee two other duties in the matter of uniform—*one* is, *not* to require the investment by the employee in a uniform until that employee's situation with the employer is an assured one; and the *other* is, *not* to make the uniform so odd in makeup or material that it cannot be used as "plain clothes" by the substitution of plain buttons and the taking off of the lace or bullion. In speaking of the uniform the cap is, of course, not included; its cost is inconsiderable; it is the one very distinctive feature of the uniform—in fact, in a crowded car it and the cap-badge are the only "outward and visible signs" of the employee—and it can therefore be made as distinctive as the taste of the employer may suggest, without reference to its private use and without financial injustice to the employee.

The single paragraph under "Receivers" and Rule No. 1 under "General Rules for Conductors and Motormen" shows that the committee does not believe in the Biblical maxim as to serving two masters—this point will be touched on later.

Rule No. 8 under same states that "in case of sickness word must be sent to starter at depot by special messenger. No telephone or telegraph messages will be accepted." There are several very minor reasons why this latter condition may be necessary, but they are so minor that the unreasonableness and injustice of the rule as a whole—and especially of a general rule—are apparent at once. The rule should be as follows: "Rule No. —; Absence from Duty.—No conductor or motorman will be excused from duty except his name is posted on the excused list, or except in cases of personal sickness, or of severe sickness or misfortune or death in the family, or for other *unavoidable* cause. In *any* event, he must send word to the starter in such manner as to reach him at least —— minutes before his time of going on duty, and before he goes on duty again he must file with ———————— a written statement of the cause of his absence and be excused by the starter."

This makes the matter a reasonable and equitable one. Under the rule presented by the committee an employee

may have his house burning or burned, his wife in the throes of childbirth or a child at the point of death, he may be drawn as a coroner's juror, detained as a witness, or locked up on a mistaken charge, and, under the rule, he will not be excused from duty. If he is personally sick he must hire a "special messenger" and send "word"—not a written excuse—by him, and all is well. It is true that this may cost him from twenty-five cents to a dollar, whereas a message by a relative, a friend, a fellow-employee, or by a neighbor's telephone would cost him nothing—but that is a small matter to a man who is sick or in trouble, and who is earning from a dollar and a half to three dollars a day.

Under the rule as suggested certain specific reasons and one general one are allowed as an excuse for absence without leave. The employee has, however, a duty to perform toward the employer, viz.: to notify him of his forthcoming absence in time to enable that employer to obtain and place a temporary substitute to perform his duties, and this duty of the employee *must* be fulfilled, but the manner of fulfilling it should not be made onerous nor unreasonable. To prevent undue advantage being taken by the employee of the allowances for absences he is required to present to a specific official a personally written and signed reason for his absence, this specific official to judge of the validity of his excuse, to verify it in case of doubt, to allow him to return to his duties in case he believes it to be bona fide, or to reprimand, suspend or otherwise punish him in case the excuse is not sufficient, valid nor true. The employer is protected in his rights and dues, the employee is treated reasonably and justly.

H. S Cooper.

(To be Continued.)

Formula for Train Resistance

London, March 4, 1899.

Editors Street Railway Journal:

The article in the February number of the Street Railway Journal on Mr. Lundie's new general formula for train resistance seems to call for some remarks from those interested in this subject.

Mr. Lundie's formula is characterized by two marked departures from existing formulæ. It says (1) that the first power of the speed only is involved, and (2) that for equal speeds the resistance involves a term varying inversely as the weight of the train.

With respect to the first; such a radical departure from the present method of estimating train resistance should be substantiated by full accounts of the experiments by which such results are obtained, so that it may be possible to follow the steps by which the conclusion is arrived at. Mr. Lundie gives two sets of plotted results, (a) twelve points being the average of results on a 21-ton car," and (b) ten points, being a "series of actual results, 82-ton train." One would have to know how the different experiments were made, and what governed the selection of the observations by which the twelve points (a) were obtained, before accepting this "average" as the basis for a "straight line" law, especially since the (b) series of observations do not agree with a straight line law, and indicate a law involving a higher power of speed than the first.

Mr. Lundie may have unpublished results which confirm his opinion, but those observations which appear in the figure referred to in the article do not all "cluster around straight line curves," and do not therefore justify the conclusion of the existence of a "straight line" law. In fact the (b) series of observations in Fig. 1 confirm the results of previous investigators, that a higher power of the speed than the first is involved. Those interested in this subject should examine the speed curves obtained by Messrs. Curtiss and Pond, and published in the "Street Railway Review" of July, 1896. These gentlemen made a series of experiments on the Buffalo & Niagara Falls Electric Railway by the "coasting" method, identical with that employed by Mr. Lundie.

With respect to (2), the article refers to Mr. Lundie's experiments on trains of different *weights*, without saying how the trains in question were made up. It would seem that the trains were made up of one, two, three, four and five cars, weighing about 20 tons each. If this were so, the resistance opposed by the air to the passage of the different trains would have an important bearing on the results.

Probably the most reliable experiments that have been made on the subject of the resistance offered by the air to the motion of trains are those made by Professor Goss of Purdue University, and published in recent numbers of the technical journals, *e. g.*, in the "Electrical Review" (London), of Oct. 7 last. According to Professor Goss, the resistances offered by the air to the motion of trains made up of one, two, three, four and five cars is proportional to the numbers 12, 13, 15, 17 and 19 respectively, for equal speeds, and varies with the square of the speed when the speed varies. Hence the resistance in pounds *per ton* is much less for long, and, therefore, for heavy, trains than for short, and, therefore, light, trains. Thus, in trains made up of one, two, three, four and five passenger cars, each 33 ft. long, and weighing 20 tons each, the resistances per ton at 20 miles per hour are 2.4, 1.2, 1.0, 0.8 and 0.7 pounds respectively. If similar calculations were made at other speeds we should find that the longer, and, therefore, the heavier, train had the smaller resistance per pound at all speeds.

It would appear, then, that if Mr. Lundie's experiments were made with trains made up of different numbers of similar cars, like those alluded to, there would be a difference of nearly 2 lbs. per ton between a 20 and a 100-ton train at 20 miles an hour in favor of the heavy train. It is difficult, therefore, to avoid the conclusion that the difference in the resistances found by Mr. Lundie for trains of different weights at equal speeds is not altogether due to the difference in weight, but mainly to the varying air resistance.

Speaking generally, it would seem that the second power of the speed is involved, at least for air resistance, and that for equal speeds the variable depends on the size and the number of the cars more than on their weight.

Chas. A. Carus-Wilson.

The following letter is from the chief engineer of a well-known steam railroad company:

Feb. 27, 1899.

Editors Street Railway Journal:

I have read Mr. Lundie's formula very carefully, and, while it seems plausible, I am not prepared to say that I think it will give a correct train resistance in all cases. I have had so much practical experience with tests for train resistance that I have about given up any hope of a general formula which will cover all cases. I do not doubt that Mr. Lundie's formula is correct so far as trains coasting is concerned, but I doubt very much if it will apply to the general and very varying conditions under which different railroads must operate. I know of one case of a test train where a consolidation engine, weighing about 120,000 lbs., was given its maximum loading over a

long grade of nearly 4 miles, which averaged practically 1 per cent for the entire distance. I have not the figures with me to show just how many tons or how many cars were hauled in each case, but in the first case we took out the heaviest loaded cars we could find, and we will say that the engine hauled 700 tons in sixteen cars. Then we began to take off some of the heavily loaded cars, substituting more cars with lighter loads, and found that the engine would not haul as many tons as it did with the heavily loaded train. Then, in the place of the light loads, we substituted empties, and we found that the engine hauled a still lighter load. This went on until we had reduced the train loading to nearly 600 tons; but when we came to take off all the loads and put on all empties we found that the engine would haul more than 700 tons. Now, this only applies in that one case, and I never saw it in any other; and it is just such things as this, which I have never been able to explain, and for which I have never seen any satisfactory explanation, that makes me doubt any general formula for train resistance. The conditions vary so much on the different railroads for curves, for grades, for wind and for many other things, that I believe each railroad, and, further than that, that each railroad division has got to work out its own train resistance from practical trials in order to arrive at anything satisfactory.

Chief Engineer.

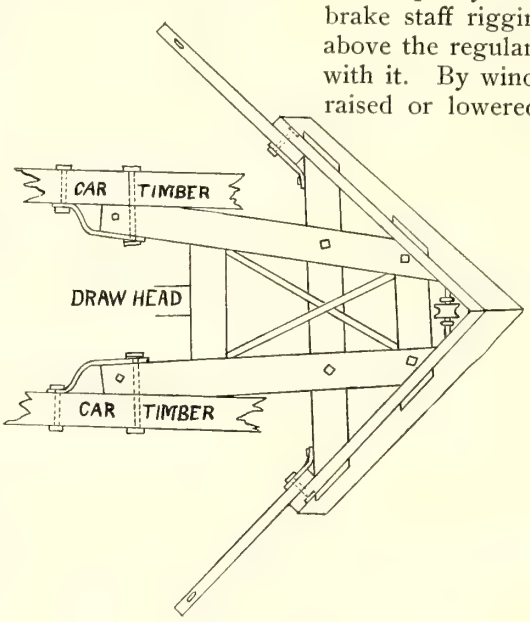


FIG. 1.—PLAN OF PLOW

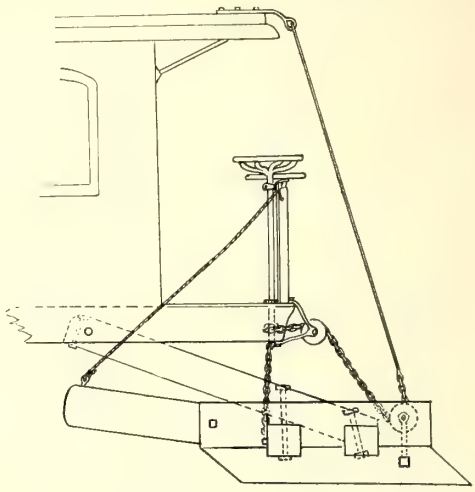


FIG. 2.—SIDE ELEVATION OF PLOW

A Cheaply Constructed Snow-Plow

New Paltz and Walkill Valley Railroad Co.,
New Paltz, Ulster County, N. Y.,
Feb. 21, 1899.

Editors Street Railway Journal:

Our homemade snow plow did such good work in opening up our road after the blizzard of Feb. 13 and 14, and was so simply and cheaply constructed that I believe the idea will appeal to other suburban electric road superintendents.

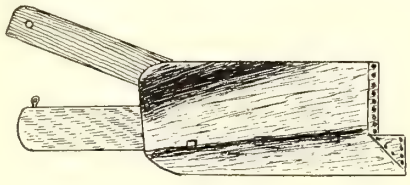


FIG. 3.—PLOW COMPLETE

The sides of the plow are made of 3 in. x 10 in. oak planks, two planks high, the lower planks sloping out, as shown in Fig. 1. The sides are 6 ft. long, and form an angle of 90 degs. at the nose. They are braced by two 6-in. x 8-in. yellow pine timbers (old ties). The back brace is provided with angle irons (not shown), which help hold the bottom side planks in place; two other ties were used for the arms, which are rigidly secured to the plow as shown. On these arms the plow is pivoted to the car body timbers. A header across the arms is so placed as to bear against the drawhead of the car, and thus take part of the pushing strain.

The hood of the car is braced by a pipe from the door header to the end of the plank, which runs the entire length of the car, on which the trolley bases are fastened, Fig. 2. At the end of this plank is secured a rod, which runs to the nose of the plow, where it is attached to a chain, which chain leads around a pulley at the nose and over a second pulley extended from the car platform to an extra brake staff rigging. The wheel of this staff is elevated above the regular brake staff wheel, so as not to conflict with it. By winding or unwinding this staff the plow is raised or lowered with ease. By this arrangement the nose rises faster than the back, which I find not a bad fault, as, when running, if the nose clears an obstacle the back portion will ride up over it.

The wings are of 3-in. x 10-in. oak, 4 ft. long, and are raised by ropes. They do good work in snow up to 3 ft., as they may be raised at an angle and slope the bank, but are not used in 5-ft. or 6-ft. banks.



PLOW IN USE

Fig. 3 shows the plow completed. The sides are covered with $\frac{1}{8}$-in. sheet steel 3 ft. high (made from an old smoke flue). The sheets were shaped by placing them on the track and running one of our 22-ton cars over them. The back upper corners are turned over, and are braced to the arms of the plow. A plow was placed on each end of one of our freight cars, which is equipped with four Westinghouse No. 49 35-h.p. motors and Christensen

air brake. This car was then loaded with 15 tons of railroad iron, and with it we had no trouble in running through snowbanks 5 ft. and 6 ft. high. Our road runs along a side bank nearly its entire length, and we had a continuous drift from 3 ft. to 6 ft. high. The plow opened up the whole road, except a portion in New Paltz, where we have a girder rail on which we could not get traction, and so had to dig this portion open. The rest of the road was of T rail, steam road construction. The accompanying photograph shows one of the largest banks the plow went through, without using a shovel. I estimate this plow saved our company $1,000 during this storm.

E. E. Hawkins, Superintendent.

Armature Hoists and Jacks

Montreal Island Belt Line Railway,
Montreal, Feb. 20, 1899.

Editors Street Railway Journal:

I inclose sketches of two very handy appliances used on our road. Fig. 1 consists simply of a pair of light wheels on which is mounted a frame carrying a chain hoist. This machine is used over the pit in handling motors, armatures, etc., or in transferring motors from one pit or track to another. This takes the place of an overhead crane or derrick. Fig. 2 is a hydraulic pump, and is somewhat similar to a pump described in your columns some time ago. It consists of a lower table mounted on four flat wheels, and an upper rising table lifted by an ordinary hydraulic pump. At each corner of the lower table is a 1½-in. pipe, which slides inside a 2-in. pipe on the corresponding corner of the upper table, keeping the two in line, and making the table very steady. The pump should have a lift of 2½ ft. The tables are of wood, and the entire machine is home made, excepting the jack. I may say that the jack is removable and can be used for jacking cars or any purpose. The wheels of the hoist are flat, so that no rails are required, and any pit can be served. The machine shown in Fig. 2 is all that is needed for the general handling of such motors as the G. E. 1000. With Fig. 1 and Fig. 2 together the G. E. 800 style of motor is easily manipulated.

In shops that are not provided with the necessary cranes, etc., these two contrivances will be found to make a very cheap and good substitute. C. H. W.

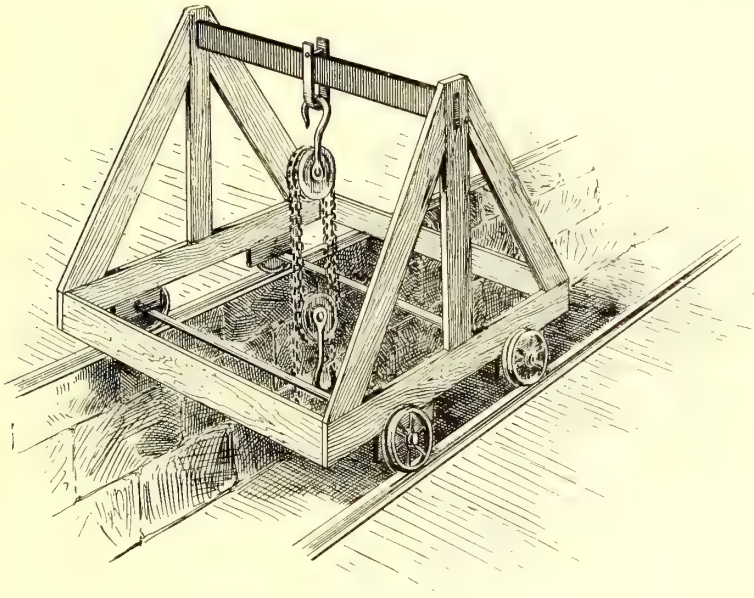


FIG. 1.—PIT HOIST

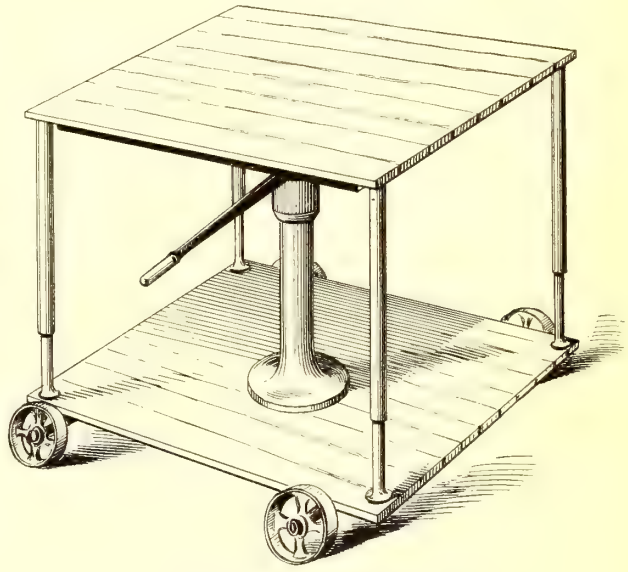


FIG. 2.—PIT JACK

The Man Behind the Controller

Philadelphia, March 6, 1899.

Editors Street Railway Journal:

Observing people who ride frequently in trolley cars have, no doubt, often wondered why there should be such great difference in the motion of different cars running on the same tracks. Sometimes, for example, a car glides along so smoothly that newspapers may be read with ease and passengers may enter and leave the cars without being jostled. At other times the same car (it may be) seems to be possessed with a spirit of evil, causing it to behave in a most erratic and incomprehensible manner, stopping with a violent jerk and starting with a sudden jump. The effect upon the unfortunate passengers, at least those hanging on to the straps, of this alternate jumping and jerking is most unpleasant, and often ludicrous to the observer who may have secured a seat. What is the cause of this strange misbehavior on the part of the otherwise admirable and usually tractable trolley car?

On one of the main lines of the system in a city which is, perhaps, more completely equipped with trolleys than any other—at least in the number of miles of tracks, which occupy nearly every street—there are two motormen, one of whom usually follows immediately after the other, but they do not always have the same cars; yet, constant riders on the road have learned by experience that a car operated by one of the motormen always glides along, in winter or summer, so smoothly that the skimming motion is positively pleasurable, while a car operated by the other motorman often reminds one in its actions of the famous "Swedish Movement Cure Apparatus." From daily observation of these facts it would appear that the difference in behavior of the cars, operated by the same electric force, is due to the difference in degree of skill of the motormen; in other words, the "personal equation" is a more important factor in the manipulation of these modern conveyances than is generally supposed. A well-known mechanical engineer has stated that the increased wear and tear upon the rolling stock, due to sudden and often needless application of brakes, and the waste of electrical energy by unskilled or nervous motormen, sometimes equals, if it does not exceed, the amount of wages paid to the skilled man.

By the aid of a little "inertia indicator," which may be carried in the pocket and rested on the window-sill of a

car, some interesting tests have been quietly made during the past few months without the knowledge of the motormen—or even of the company—which will go far to substantiate these statements when they shall have been compiled into tabular form.

It is a remarkable fact that in almost all large business corporations there appears to be a certain lack of close attention to small details such as this, and it has often happened, therefore, that economies and improvements which should naturally have suggested themselves to those most familiar with the business, have come from outsiders whose very unfamiliarity with the details seems to aid them, in that they are apparently more observant of such minor defects. As an illustration, a single case may be mentioned here.

Some time ago a daily commuter on a suburban steam railroad wrote a somewhat humorous communication to a newspaper calling attention to the annoyance caused to passengers by the constant slamming of the car doors by conductors and brakemen in cold weather. Nearly two years before that time he had expressed the same views politely in a communication to the proper official of the company without any notice having been taken thereof. Recently, however, several of the cars on this road have been equipped with silent air-cushion springs on the doors to the great delight of the passengers.

The conclusion to which this somewhat discursive note points is, that it would, doubtless, pay every large corporation catering to public patronage to employ some person (perhaps a bright woman) simply to examine into these "little things" and to see that every practicable improvement looking to the comfort and convenience of the patrons should be adopted. It is, in fact, largely owing to the introduction of many such little conveniences for shoppers that the modern department store owes its great financial success. A. E. O.

Electrical Resistance of Rails

Kioto Traction Company,
Kioto, Japan, Jan. 16, 1899.

Editors Street Railway Journal:

Your December issue contains a paper by Mr. A. B. Herrick on "Some Fallacies Regarding Electrolysis," which I have carefully read over with great interest.

In this paper he has tabulated some electrical resistances of different iron pipes and rails, of which those of rails are very useful to me, as well as to those who use their track as return circuit. However, I have noticed that his resistances of rails are greatly at variance with those which I have calculated to show a fair average.

I mention here my results in ohm per 1000 ft.

A 45. lb. rail	0.01104	ohm and single track of			45. lb. rails	0.00552	ohm
A 50. lb. rail	0.00993	"	"	"	50. lb. rails	0.00497	"
A 60. lb. rail	0.00828	"	"	"	60. lb. rails	0.00414	"
A 70. lb. rail	0.00709	"	"	"	70. lb. rails	0.00355	"
A 80. lb. rail	0.00621	"	"	"	80. lb. rails	0.00311	"
A 90. lb. rail	0.00552	"	"	"	90. lb. rails	0.00276	"

Mr. Herrick's resistance of single rail somewhat resembles that of corresponding single track, calculated by me, or, in other words, his resistance is only a half of mine.

When, several years ago, Mr. J. H. Vail read a paper on "The Importance of Complete Metallic Circuit for Electric Railways" before the National Electric Light Association (see the Street Railway Journal for March, 1894), he gave the following table:

	56 POUND RAIL.		70 POUND RAIL.	
	One Rail.	Single Track of Two Rails.	One Rail.	Single Track of Two Rails.
Area in sq. inches	5.4874	10.9748	6.8593	13.7186
Equal in area to circle whose diameter is in inches	2.642	3.735	2.95	5.90
Equivalent in cir. mils to	6,980,000	13,960,000	8,702,500	17,405,000
Resistance per foot B. A. units	.00000845	.00000422	.00000679	.00000339
Equivalent to copper resistance in cir. mils	1,175,000	2,350,000	1,463,000	2,926,000
Equivalent to copper rod whose diameter is	1.13	1.533	1.21	1.71
Safe carrying capacity of iron reckoned at ⅓ that of copper in amperes	390	780	488	976

NOTE.—In the above statement the areas of rails have been determined by use of the planimeter. The ampere capacity of iron has been based upon the most reliable data obtainable. The resistance of iron is taken as 5.63 times that of copper.

This table coincides quite closely with my results. These differences, though of only minor importance to the subject of Mr. Herrick's paper, are never negligible when investigating track resistance and conditions of rail bond, etc. I should like to hear from him as to how he got his results and to learn whose figures are the most reliable.

Ichiro Goto, E. E.

Mr. Herrick's Reply

The following is Mr. Herrick's reply to this letter:

New York, March 25, 1899.

Editors Street Railway Journal:

In answer to Mr. Ichiro Goto's communication I have to thank him for calling my attention to the omission made in transcribing this table. The resistances given are for 1000 ft. of single track, so for single rail resistance the value would have to be one-half that given. There are a great many values given for rail resistances, but no observers have as yet considered the element of temperature. A good steel rail has a temperature coefficient of about 0.48 per cent for each degree of centigrade rise.

The following values have been given for 90-lb. single rail for 1000 ft. in ohms:

Bell	.00666
Goto	.00552
McTigh	.00660
Vail	.00528
Herrick	.00521

The composition of the rail plays a very important part in this resistance. Generally speaking, an increase in carbon is accompanied by an increase in electrical resistance, but by a decrease in the temperature coefficient.

Albert B. Herrick.

Repair Records in Chicago

In June, 1897, G. W. Knox, electrical engineer of the Chicago City Railway Company, instituted a system for carefully checking and recording all cases of trouble with the electrical equipment on the cars of the road with which he is connected. The records of these electrical troubles are sent in by the conductors and motormen on whose cars the breakdowns occur, and Mr. Knox carefully investigates and verifies these reports by consultation with the barn foreman and repair men. The records are kept separately for each car house, of which there are four, and the electrical engineer is thus able to tell not only the different kinds of troubles that occur and the most common ones, but is also able to tell the relative efficiency of the different car houses in keeping their equipments in good repair. The following tables contain the records for the entire system only, and not for the different barns separately.

In Table No. 1 is shown the total number of each kind

of trouble with electrical equipments reported for the year ending Dec. 31, 1898, and also the percentage of each kind of complaint to the total number of all complaints reported:

Table No. 1—Repairs to Electrical Equipments.

	Total Number Cases Reported.	Per Cent Each Kind Repairs to Total Electrical Equipm't Repairs.
Repairs to Armatures	217	24.6
" Controllers	50	5.7
" Lights	24	2.7
" Wires	119	13.5
" Brush Holders	196	22.2
" Rheostats	12	1.4
" Miscellaneous	40	4.6
" Trolleys	193	21.9
" Fields	27	3.1
" Lightning Arresters	3	.3
Total Repairs to Car Equipments	881	100.0

Average number of cars operated 351.9.

Table No. II—Armature Repairs.

Nature of Repair.	Type A.		Type B.		Type C.		Type D.		Total Each Kind Armature Repairs.	Per Cent Each Kind Armature Repairs to Total Armature Repairs.
	Total Number Cases Reported.	Per Cent to Total Number Repairs on Same Type.	Total Number Cases Reported.	Per Cent to Total Number Repairs on Same Type.	Total Number Cases Reported.	Per Cent to Total Number Repairs on Same Type.	Total Number Cases Reported.	Per Cent to Total Number Repairs on Same Type.		
Turned	115	72.3	355	86.8	117	59.1	45	81.8	632	77.0
Grounded	16	10.1	19	4.7	20	10.1	3	5.5	58	7.1
Open Circuited	7	4.4	16	3.9	27	13.6	1	1.8	51	6.2
Burnt Out	7	4.4	7	1.7	19	9.6	2	3.6	35	4.3
Duck Head Off	5	3.2	0	..	1	.5	0	..	6	.7
Oil Ring Loose	3	1.9	4	1.0	5	2.5	0	..	12	1.5
Short Circuited	1	.6	3	.7	3	1.5	0	..	7	.8
Commutator Loose	1	.6	0	..	2	1.0	0	..	3	.4
Bands Off	4	2.5	4	1.0	2	1.0	1	1.8	11	1.3
Shafts Bent	0	..	1	.2	1	.5	0	..	2	.2
Shafts Loose	0	..	0	..	1	.5	2	3.6	3	.4
New Commutator	0	..	0	..	0	..	1	1.8	1	.1
Repairs of all kinds to armatures	159	100.0	409	100.0	198	100.0	55	100.0	821	100.0

Note.—Type "D" motors are in use on winter cars only and are in operation about half as many months in the year as the other types.

Table 2 gives the different kinds of repairs made upon armatures for each of the four different types of motors in use, together with the percentage of each kind of repairs upon each type of armature to the total number of the same kind of repairs upon the same type, and also to the total number of armature repairs.

Table 3 gives the total number of motors used and total number of armatures reported, as well as the comparative age of the motors :

Table No. 3—Miscellaneous.

	Type A.	Type B.	Type C.	Type D.	Total.
Total motors used	129	505	104	84	822
Total armatures repaired	159	409	198	55	821
Number of years motors have been in use	6	2½	4	3	....
H.p. of motors	25	25	30	25	....

New Construction in New Orleans

The New Orleans & Carrollton Railroad Company, which has recently purchased all the property and franchises of the Canal & Claiborne Railroad Company, is contemplating some important extensions to its system, including not only additions to its power stations, but also to its mileage and rolling stock. During the last month this company has placed, through its engineers, Mesrs. Ford, Bacon & Davis, orders for sixty G. E. 1000 double-motor equipments, an 850-kw. General Electric generator, a 1275-h.p. Allis-Corliss cross compound condensing engine with Allis condenser, and track and special work for 15 miles of track. The latter will probably be the heaviest T-rail construction ever laid for electric railway service.

The rail, which is of the A. S. C. E. section, 5¾ ins. high, will weigh 100 lbs. to the yard, and will be supplied by the Pennsylvania Steel Company, in 60-ft. lengths. A departure from usual New Orleans practice will be made in this track construction, which will consist of creosoted-plank flooring, supporting crushed stone ballast, upon which will be laid the 100-lb. rails on 6 in. x 8 in. x 8 ft. creosoted ties. The T rail special work will be supplied by the Pennsylvania Steel Company, and the girder rail special work by the Lorain Steel Company.

This company is about to order sixty new cars and 1000 h.p. of boilers. The generating apparatus will be installed in the Claiborne power station, and a double-track extension will be laid to connect the terminus of the Tulane avenue line with the terminus of the Carrollton line, thus making a loop or belt line between the two systems back of the city.

New Association in Virginia

A State association of prominent street railway and electrical men was recently formed in Virginia, and will be known as the Virginia Street Railway & Electrical Association. Its avowed object is the acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of street railways and electric plants, and the diffusion of this knowledge among the members of the association, with a view to promoting the street railway and electric interests, improving the service and reducing its cost; the establishment of a spirit of fraternity among the members of the association by social intercourse, and the encouragement of cordial and friendly relations between its members and the public. The constitution provides for an associate membership consisting of manufacturers and dealers in street railway and electrical supplies, engineers and contractors, etc. The officers of the association are: President, R. D. Apperson, Staunton; vice-president, E. R. Williams, Richmond; secretary and treasurer, H. P. Woodson, Lynchburg; executive committee, R. D. Apperson, Staunton; R. L. Williams, Norfolk; D. W. Flickwir, Roanoke; H. P. Woodson, Lynchburg; E. R. Williams, Richmond. The next meeting of the association will be held at Richmond May 16, 1899.

STREET RAILWAY JOURNAL

APRIL, 1899

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, HAVEMEYER BUILDING, 26 CORTLANDT STREET.

BRANCH OFFICES:
CHICAGO.....Monadnock Block.
PHILADELPHIA.....929 Chestnut Street.
LONDON.....39 Victoria Street, Westminster.
PARIS.....50 Boulevard Haussman.
COPENHAGEN.....V. Faber-Madsen, 9 Valby Langgade.
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Long Distance Telephone, "New York, 2664 Cortlandt,"
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / 25/ / 31 fr
Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

NOTICE.

Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, accounting, finance and invention.

Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL, *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

Address all communications to

The Street Railway Publishing Co.,
Havemeyer Building, 26 Cortlandt St., New York.

Notice of Removal

On April 15 the offices of the Street Railway Publishing Company will be moved from 26 Cortlandt Street to 120 LIBERTY STREET, New York. Our new offices occupy half of the eleventh floor of the Beard Building, which is in the center of the "Electrical District" of lower New York city, and is very conveniently located as regards the Sixth and Ninth Avenue elevated lines, the surface railways and all the North River ferries. As in the past, we shall be glad to have our subscribers and friends use our office as their headquarters during any visit to New York. Remember the new address, 120 LIBERTY ST.

The "automobile" has, almost in a day, emerged from comparative obscurity to a position of the utmost importance in the world of transportation. Until the past year, far more interest has been taken in automobile work abroad than in America, but now "operations," both in stocks and in physical accomplishments, are on the largest scale. Electric vehicle companies and compressed air "autotruck" companies, parent and territorial, have been formed in New York and several of the principal American cities, and capital is rushing into these new fields with ardor and enthusiasm. Disappointments may be in store for over-sanguine investors, but at the foundation of the automobile industry lies the indisputable fact that the horse power thus sought to be displaced is intrinsically costly to a degree such that almost any form of mechanical motive power, even if not theoretically high in efficiency, should show an advantage over horses warranting initial and subsequent expenditures for experimentation. In other words, it is quite probable that the pioneers in this industry will make enough money, even with imperfect apparatus in original installations, to purchase the new and better equipment of later days with further profit.

The possibilities of automobile work, particularly in the line of cabs, omnibuses, carriages, etc., should be regarded by street railway managers with close attention, if not with concern. Electric cabs in New York have become instantly popular and are in constant and pressing demand, the supply being so far totally inadequate for the requirements. Electric cabs will do double the daily mileage of horse cabs. They are under perfect control, running smoothly and silently through the streets, and weaving in and out among vehicles far more easily and with greater saving of time in blockades than can be done where horses are used, and it has been proven possible to equip these cabs with batteries small in compass, but powerful enough to propel the cab for from 20 to 25 miles. Fresh batteries can be placed in cabs within three or four minutes, and a new lease of life secured. Finally, the assumed advantage of electricity over horses has been, as usual, divided between the operator and the public, so that the public is getting a service far superior to the old and at a lower price. What has not been so far demonstrated, however, is the actual amount of this advantage over horses. No figures have yet been given out as to operating expenses of the cab service, and in the nature of things, some elements of these expenses cannot be known for a year or two to come. Depreciation of the batteries is one of these uncertain elements of expense, and the cost of maintaining the heavy and expensive pneumatic tires is another. But, all drawbacks and uncertainties aside, it seems probable enough that initial difficulties will be overcome and the industry will develop into a profitable one. Street railway companies will do well to investigate the financial opportunities afforded by a local electric cab service with a view to making such a service a part of a complete city transportation system under their control. One of the principal advantages of this action would be found in the possibility of greatly increasing the load factor of street railway power stations by operating them at their full capacity during the lighter hours of the day, using the surplus power for charging batteries for the cab system. By this means the cost of electric power per kw.-hour output can be greatly reduced, while a transportation profit far exceeding the power profit ought also to be possible.

The economical distribution of railway current over long distances can be effected by boosters, accumulators, or the use of polyphase apparatus, and with the increase in the number of long distance lines the question of determining which of the three methods is the most economical, under a given set of conditions, is an important one. Elsewhere in this issue a careful summary of the relative advantages of continuous current distribution from a number of separate stations and that of alternating current distribution from one central station is carefully considered by Mr. Parshall. The particular system studied is that of the city of Glasgow, but the same principles can be applied, with certain important modifications, to properties elsewhere. The relative cost of installation and maintenance is carefully considered, but the problem in Glasgow, as will be seen from Mr. Parshall's treatment of the subject, was largely affected by the determination to keep the potential drop on the return circuit within a maximum of $3\frac{1}{2}$ volts, or one-half that allowed by the British Board of Trade. This restricted the distribution from any one station to a maximum of $\frac{1}{2}$-mile radius, and as this limitation does not exist in the United States, and as the cost of labor and apparatus is somewhat different, the conclusion reached by Mr. Parshall would not apply directly to installations in America. In an article by another writer in this issue, the relative advantages of motor dynamos or accumulators is considered, from the standpoint of efficiency. The writer assumes the use of both methods of boosting under similar conditions, and then draws a comparison between the relative first cost and operating charges of the rotating booster and the accumulator booster. The increasing use of accumulators shows, however, that relative efficiency is not the only criterion for judging this problem, but that the effect of the battery in increasing the load factor, thus reducing the necessary station capacity for a given load, is a most important consideration. It will be remembered that an increase in the load factor with the same output not only reduces the first cost of installation, but also raises the mechanical efficiency of the station by making the load more steady, and thus rendering it possible to operate the engines more continuously at the point of maximum economy. In this connection we might say that the relative efficiency of station apparatus, operating under different load factors, with the highly varying momentary fluctuating loads which exist in electric railway stations, has never been so thoroughly discussed as many of the other problems in electric railroading. We hope in an early issue of the Journal to publish some statistics on this subject, taken from actual practice, and think that they will throw considerable light upon the subject of the possible economy of railway power stations.

The selection of schedules for high speed city transportation service is not, and should never be a mere matter of guess work, or be regarded as one of the incidental problems. It is, on the contrary, *the one great problem of the installation,* in comparison with which all others, including those of the details of the electrical equipment, are entirely subordinate. In order to operate any given property at a given frequency and a given schedule speed, a certain investment is required and certain operating expenses will be incurred. In a given range of possible schedule speeds, as, for example, 10 miles to 20 miles per hour, there will be maximum and minimum investments and maximum and minimum operating charges. The most careful detailed estimates, covering both investment and operation, should be made by trained engineers specially delegated for this work, and from their calculations when presented to the managers should be selected the schedules best adapted for the traffic conditions. Without such investigation, the electrical equipment of a high speed transportation line is a leap in the dark, and if as a result of insufficient study of the problem presented, a schedule speed be selected lower than what is economically possible to obtain, the disaster is private as well as public, and is likely to be accompanied with the most serious consequences in the matter of profits, particularly if a shrewd and far sighted competition exists, able to take advantage of all mistakes.

The New York Rapid Transit Proposition

The citizens of New York have reason to regard with almost complete satisfaction the proposition just made to the Rapid Transit Commission (given in full on page 230 of this issue) by counsel representing the Metropolitan Street Railway interests. For nearly a decade the problem of rapid transit in New York has engaged the close and anxious attention of the many able citizens on the commission, but their efforts have until now been fruitless, owing to causes more or less beyond their control, and New Yorkers had almost come to despair of any tangible results to their labors.

In the letter transmitting this proposition to the Rapid Transit Board, it is clearly pointed out that the reason why capital has not hitherto responded to the long continued invitation of the city to take the risk of constructing an underground road, is that there is not sufficient probability that such a road could be profitably operated without surface collecting and distributing facilities. These facilities the Metropolitan Street Railway Company alone has, and is therefore enabled to make a proposition which cannot be duplicated by any other transportation agency, or by individual capital. It is also made clear that the real obstacle to rapid transit lies in the congested district in the lower part of the city, and by localizing traffic in the streets of this district and putting all through or longer-distance business into the tunnel, the streets may be relieved of much of their burden, and better transit even on the surface may be secured.

It is hard to speak of a plan of this broad and far reaching character without enthusiasm. The "Metropolitan Syndicate" has given to the people of New York, in the last few years, many evidences of largeness of conception, breadth of view and generosity of action—qualities which, when found in any group of individuals dealing with questions of intense public interest, always bring about the greatest possible benefits to a community. This new proof of the ability and acumen with which transportation matters can be handled by those who understand thoroughly the financial and operating possibilities, is now superadded to the old. Who, in noting the halting and irresolute way in which such problems are dealt with in other cities of the world, can say that New York is not indeed fortunate

in having in its service private capital which, while always and necessarily seeking profits for itself, has, at the same time, so broad and generous a confidence that the people will respond almost immediately to the increase and perfection of transportation facilities, as to warrant enormous present outlays, upon which the more or less remote future must be called upon for dividends?

From an operating standpoint, the keynote of the entire plan lies in the specification of a ten-cent fare for express service, and from the public standpoint, the justice and wisdom of granting this concession cannot be for a moment denied, for not only are the express trains, as defined in the proposition, to be run at schedule speeds of from 20 to 30 miles an hour, which is extremely costly work, but it will always be within the option of the intending passenger to choose a five-cent fare ride over the same distance as that covered by express trains, and at an average speed which will doubtless be at least one-third greater than are the present Manhattan schedules. Moreover, the total traffic will be better distributed between express and local trains than is the case on the New York elevated roads at present, since those who can better afford to pay the higher price for "first-class" service may do so and leave better accommodations in the local trains for those who must use the latter perforce; and finally, the express train passenger has the privilege of using the surface cars, without additional charge, for reaching his very door.

It is now a part of the settled policy of the State of New York as expressed by general legislation to grant street railway franchises for twenty-five years only. It is obviously impossible to impose any such conditions upon an enormously costly enterprise of this character, and we feel that inasmuch as the Metropolitan Street Railway franchises are in themselves practically perpetual, having been granted many years ago before the passage of the general legislation just referred to, and inasmuch as almost the entire value of the proposition depends upon the surface connections with the Metropolitan Street Railway Company, the demand on the part of the latter for a perpetual franchise is not unwarranted, and will be favored even by those who are ordinarily opposed on principle to grants of this general character. The *quid pro quo* offered to the city is worth some sacrifice to obtain, and no alternative offer of equal advantage from other parties is a possibility. New York has sighed for rapid transit through so many years, that now when it is actually within reach on an equitable basis, it is inconceivable that it should be rejected on more or less theoretical grounds.

One other feature of the proposition, that of securing to the tunnel company and its lessees the right to use and lease what are practically subway rights, has excited comment and a little adverse criticism on the part of the press. It would be absurd to refuse this right, however, not only because by placing pipes, wires, etc., in a tunnel of this character, the best interests of the city are served; not only because the transportation profits, pure and simple, are problematical, as has been shown by the reluctance of capital to make to the city any proposition for the building of such a tunnel line, and therefore collateral profits should be permitted when not interfering with the city's best interests; but also because the financial interests which are making this rapid transit proposition to the city are owners of practically all the high tension subway rights so far given in the city, and have presumably a further right to construct new subways irrespective of that to be conferred upon the tunnel company.

The many complicated and important engineering problems which will be raised in this new transportation in New York city will be of widespread interest to the engineering public. The press of New York has done no more than justice in saying of the management of the Metropolitan Street Railway Company that the general public knows how well and quickly it carries through its work, and the fact that, doubtless after most careful estimates by its engineers, it is proposed to complete the four-track tunnel south of 104th Street, together with the three-track west side branch north of that street, in thirty-six months from the time that the franchises are perfected, is a commentary upon the possibilities which lie in thorough organization for the accomplishment of a given end. It is evident that there will be work in New York city for all who want it within the next few years.

The new rapid transit plans for New York city leave the present elevated railway system in a peculiar position. Hitherto its principal claim upon traffic has been its ability to carry passengers over the longer distances in the city with a decided time saving. Now its aggressive rival, the Metropolitan Street Railway Company, proposes to enter into competition with it for this class of traffic on a basis which can hardly fail to be effective. It cannot hope to run express trains on its elevated structure as rapidly as the underground express trains, it cannot hope to run its local trains faster than the underground locals, and it will have no collecting or distributing agencies on the surface unless it should acquire, or be acquired by the Third Avenue Railroad Company. It will still carry passengers, and many millions of them, and it still has its future destiny measurably within its own hands, though within far narrower limitations than ever before, but consummate wisdom and ability and a complete change of attitude toward the public will be necessary if even moderate financial success is to be attained. It has as competitors those who believe that more money is to be earned by increasing gross receipts than by reducing operating expenses, and to this end the best possible service of the public is none too good. If, as has been reported, it is not the intention of the Manhattan Company to greatly increase its present schedule speeds when electricity is adopted, but to depend more upon making a saving in operating expenses upon but slightly faster schedules, the Manhattan Company is out of the race and will remain so. If, on the contrary, it will wisely determine to give to the people of New York an elevated railway service such as has never before been seen in any city, there is some chance that a large proportion of the city travelers will prefer a ride in the air to the "hole in the ground."

Announcement was made last month of the incorporation at Trenton of the Consolidated Street Car Company with a capital of $18,000,000. It is said to be the combination of a number of the principal builders of street cars in the United States, and seems to be a confirmation of the rumors, which have been persistent during the last few months, that several of the builders of street railway cars were contemplating a general consolidation. The names of the companies whose properties will be acquired by the new corporation have not yet been made public.

Gross Receipts Per Capita and Per Mile of Track in the Principal American Cities

The accompanying table has been carefully compiled, with a view to showing the comparative patronage by the peoples of the principal cities of the United States of their street railway systems. The table covers the population served, the miles of track, the gross receipts, the gross receipts per mile of track, and the gross receipts per capita served.

NAME OF CITY.	Street Railway Systems. Population Served.	Number Included.	Miles of Track.	Gross Receipts.	Gross Receipts Per Mile Track	Gross Receipts Per Capita.
New York City—						
Manhattan and Bronx.				$	$	$
Elevated Lines	2,156,000	1	109	9,183,542	84,252	4.26
Surface Lines		8	368	16,044,332	43,597	7.44
Total		9	477	25,227,874	52,910	11.70
Brooklyn.						
Elevated Lines *f*	1,197,000	3	75	2,481,730	33,090	2.07
Surface Lines		4	412	8,522,142	20,684	7.12
Total		7	487	11,003,872	22,597	9.19
Queens.						
Surface Lines	128,000	..	92	491,969	5,347	3.86
Richmond.						
Surface Lines	65,000	..	59	293,004	4,966	4.51
New York City.		..	1,115	37,016,719	....	....
Elevated Lines	3,546,000	..	184	11,665,272	63,397	3.29
Surface Lines		..	931	25,351,447	27,229	7.14
Total		16	1,115	37,016,719	33,199	10.44
Chicago—						
Elevated Lines	1,875,000	3	70	2,766,982	39,529	1.48
Surface Lines		7	625	12,347,121	19,739	6.59
Total		10	695	15,114,103	21,747	8.06
Philadelphia	1,250,000	3	484	11,452,999	23,663	9.16
Eastern Massachusetts	1,250,000	39	894	12,330,666	13,793	9.86
Boston	*a* 788,000	3	349	9,106,108	26,091	11.56
St. Louis	*a* 675,000	10	302	5,836,242	19,324	8.65
Eastern New Jersey	*d* 603,000	11	400	4,863,897	10,216	8.07
Baltimore	600,000	1	354	4,020,900	11,357	6.70
Pittsburg—Allegheny	*ad* 528,000	15	390	4,351,694	11,160	8.24
Cleveland and Suburbs	520,000	7	330	3,386,000	10,261	6.51
Minneapolis—St. Paul	*a* 405,000	1	230	2,145,000	9,327	5.30
Cleveland City	400,000	2	204	2,927,000	14,348	7.31
Buffalo and Suburbs	400,000	14	300	2,276,546	7,590	5.69
Detroit	365,000	2	163	1,597,666	9,803	4.38
San Francisco	350,000	7	273	4,841,284	17,733	13.83
Lynn	*e* 319,000	1	154	1,431,936	9,299	4.49
New Orleans	300,000	7	187	2,219,089	11,867	7.40
Milwaukee	*a* 280,000	1	158	1,761,500	11,152	6.29
Providence	*a* 280,000	1	140	1,776,695	12,693	6.34
Washington	*b* 275,000	10	178	2,198,277	12,348	7.99
Louisville	*a* 275,000	1	140	1,297,394	9,264	4.72
Montreal	250,000	1	85	1,342,368	15,792	5.37
Troy—Albany	*a* 224,000	4	94	1,198,047	12,745	5.35
Kansas City, Mo	*c* 200,000	1	136	1,942,852	14,287	9.72
Indianapolis	*c* 194,000	1	100	978,964	9,790	5.05
Rochester	*a* 190,000	3	105	835,190	7,954	4.40
Toronto	180,000	1	110	1,210,618	11,000	6.73
Denver	167,000	..	..	.....	....	7.50
Toledo	*c* 145,000	1	99	921,998	9,313	6.35
Worcester	*a* 138,000	3	96	761,520	7,932	5.52
Columbus, O	*c* 135,000	1	64	680,173	10,628	5.04
Syracuse	130,000	3	61	482,243	7,905	3.71
Scranton	125,000	1	35	383,727	10,963	3.07
Albany	*a* 124,000	2	49	647,943	13,222	5.23
Atlanta	123,000	2	85	497,733	5,855	4.04
Fall River	102,000	1	34	306,115	9,003	3.00
Richmond	100,000	2	66	561,906	8,514	5.62
Nashville	*c* 100,000	1	47	493,186	10,493	4.93
Troy	*a* 100,000	2	45	550,104	12,224	5.50

a Including suburbs reached by street railway lines whose gross receipts are given. *b* Estimated. *c* Principal system. *d* Population partly estimated. *e* Comprising populations of twenty-one cities and towns tributary to the cities of Lynn and Boston. *f* Including receipts, mileage, etc., of New York and Brooklyn Bridge.

It is most difficult to obtain reliable figures of the population between census years, and the accuracy of those found in this table is by no means guaranteed. They are, in most instances, given on the authority of the Mayors of the different cities, and are usually based on some form of local census taken for police, school, or taxation purposes. Judging from past experiences, however, it is more than probable that next year's national census will show that these estimates are somewhat too high in many, if not in most instances. They are, however, the best figures obtainable at the moment.

Where a city street railway system can be isolated from its suburban connections, the population of the city alone and the mileage and receipts of the city system are given. In many cases, however, city lines operate in the suburbs also, and wherever this occurs the population of the suburban cities and townships connected by street railway lines with the principal city, together with the mileage and receipts of all suburban lines distinct from the central system, are also included. The number of street railway systems included in the group of cities is given in the third column.

"Miles of track" means total track mileage, counting one mile of double track as two of single, and including sidings, turnouts, etc.

"Gross receipts" means in nearly every instance receipts from passengers only, but occasionally it has been found impossible to separate the passenger receipts from the receipts from operation, which are slightly greater than the passenger receipts.

As street railway mileage and receipts are both theoretically functions of population, the cities and groups contained in this table have been arranged in the order of their population, the largest city of all, New York, being first in the list. By this means the peculiarities and apparent inconsistencies of the statistical results are quite clearly brought out ready for explanation.

The largest gross receipts per capita are obtained by the street railway systems in the following cities and groups:

	Population.	Gross receipts per capita.
San Francisco	350,000	$13.83
New York (Manhattan and Bronx)	2,156,000	11.70
Boston (and immediate suburbs)	788,000	11.56
Greater New York	3,546,000	10.44
Eastern Massachusetts	1,250,000	9.86
Kansas City (principal system)	200,000	9.72
Philadelphia	1,197,000	9.19
New York (Brooklyn Borough)	1,250,000	9.16
St. Louis	675,000	8.65
Pittsburg-Allegheny	528,000	8.24
Eastern New Jersey	603,000	8.07
Chicago	1,875,000	8.06

The largest gross receipts per mile of track are shown by the systems in the following cities and groups:

New York (Manhattan and the Bronx)	$52,910
New York (complete)	33,199
Boston	26,091
Philadelphia	23,663
New York (Brooklyn Borough)	22,597
St. Louis	19,324
San Francisco	17,733
Montreal	15,792
Eastern New Jersey	10,216

Strange to say, New York city, though by far the largest in the country, does not lead the list in point of gross receipts per capita, but this honor is reserved for San Francisco, which shows $13.83 percapita, as against $10.14 for Manhattan and the Bronx. On investigation it is seen that San Francisco has a very heavy density of traffic as compared with other cities of about the same size, but has a much greater mileage in proportion to its population than has New York. It is evident that the people of San Francisco are liberal in their patron-

age of the street railway system, and it is also a fact that while the traffic density in Greater New York is very large, there are immense areas of comparatively unsettled territory still to be served by street railways, and in spite of the great traffic density on the existing lines ($33,199 per mile of track), especially in the boroughs of Manhattan and the Bronx ($52,910 per mile of track), much more mileage is needed in Greater New York, and the city transportation systems are destined to show much larger gross receipts per capita.

In the boroughs of Manhattan and the Bronx, New York city, the elevated lines obtained (during the year ending June 30, 1898,) 35.4 per cent of the total traffic, leaving the remainder to the surface lines; in the same financial year the elevated lines of Brooklyn carried but 22.5 per cent of the total traffic. In both instances the returns for the present year now being made will doubtless show a considerable diminution of the percentage obtained by the elevated railways, with increasing competition from the surface lines. In Chicago the elevated lines are obtaining 31.5 per cent of the total traffic, a decidedly good result considering the different conditions under which they are working.

The seventy cities and towns of the "Eastern Massachusetts group" are earning as a whole $9.86 per capita, an extremely large figure considering the extent of territory covered and the excellent service given by competing steam railway suburban lines in this territory. It will be seen, however, by comparing the figures of this group with those of Philadelphia, which has a population almost exactly equaling that of "Eastern Massachusetts," that these large gross receipts per capita are due to the immense mileage in the area, and not to density of traffic on that mileage, the results per mile of track being for "Eastern Massachusetts" but $13,793, as against $23,663 in Philadelphia, and the track mileage being nearly double that of Philadelphia. It is almost equally remarkable that metropolitan Boston, which includes the city proper and about a dozen cities and towns immediately surrounding it, should have larger gross receipts per capita than Philadelphia, but as a matter of fact the territory contained within Philadelphia city limits is not greatly different in character from that of Boston suburbs, except that there are no such large population centers in the former as are found, for example, in Cambridge, Somerville, etc., in the latter.

The great manufacturing district which contains Pittsburgh, Allegheny and many small townships, has almost exactly the same population as is found in Cleveland and suburbs, but the character of the district is far different, nearly all the manufacturing interests being in and about the city proper of Cleveland, while in the Pittsburgh district they are scattered over the entire area of the group. The Cleveland suburbs are largely residential in character, and are situated at considerable distances from the city. For these reasons it is not surprising that in the Pittsburgh district the street railways should earn $8.24, as against $6.51 in the Cleveland district. San Francisco, New Orleans, Washington and Denver are earning considerably more per capita than Detroit, Milwaukee, Providence, Louisville, Montreal, Indianapolis and Rochester, cities of approximately equivalent sizes. Some of the reasons why San Francisco shows its remarkable earnings have already been given; another is the conformation of the city, which is peninsular in character, with the business district at one end of the peninsula and the residential and pleasuring sections far removed therefrom. Toledo stands out among nearly all the cities of its size as having large receipts per capita, but its receipts per mile of track are not extraordinary.

The effects of overbuilding of track are seen in the low receipts per mile found in Detroit, Rochester, Syracuse and Atlanta, and the smallest receipts per capita in the entire list are obtained by the street railway systems of Fall River, Scranton and Syracuse.

Rapid Transit in Dense Centers of Population

BY JOHN LUNDIE

The following important maxim has been well borne out by repeated experience—"Increase of good transportation facilities will carry with it its own traffic in a populous district."

An instance of the truth of this maxim might readily be appreciated by a study of the suburban traffic of the Illinois Central Railroad Company at Chicago. The southern part of the city of Chicago has within recent years been practically honeycombed by electric street car lines. In addition, the South Side Elevated Railroad has also been an important factor in seeking South Side traffic. Both the street car lines serving the territory near Lake Michigan and the elevated road have given remarkably good service, and as a result have obtained a traffic commensurate therewith. Notwithstanding, however, this apparent inroad on territory served by the Illinois Central Railroad, the suburban traffic of this road has continued to show a healthy increase. The reason for this has been that the management of the road has been alive to the exigencies of the situation, and has given a service at all times second to none. This by way of illustration of the above maxim.

In contrast to development of traffic by increase of good transportation facilities there could readily be pointed out numerous instances of loss in traffic by transportation companies through neglecting to recognize the needs, if not the rights, of the traveling public, by the short-sighted policy of restricting transportation facilities on the slightest indication of traffic being diverted to other channels, intending thereby to reduce expense so as to make a good financial showing in spite of the reduction of traffic.

Transportation service and traffic are mutually interdependent. Primarily, a service ought to be suited to a known or expected traffic, and thereafter the service ought to be conducted in such a manner as to seek and hold the appreciation of its patrons. Then the traffic will react on the service, and will justify its continued improvement by healthy increase.

Short-haul and long-haul traffic are only comparative terms; but whether the terms be applied to traffic on a trunk line or to that within the comparatively short distances covered by rapid transit lines in or near a great city, the principles governing the handling of short and long-haul traffic remain practically the same. Passenger traffic in a great city naturally follows the lines of least resistance. Thus, a passenger going only a short distance will almost invariably prefer even a comparatively slow, frequent street car service to that of an elevated road. Reluctance to undertaking the effort of climbing an elevated railroad stair, or the effort involved in consulting a timetable and waiting for a train, readily explain why short-haul traffic naturally becomes tributary to street car systems, even though private right of way systems may seem equally convenient.

From the standpoint of a transportation company the value of a service is its ultimate net revenue. This, however, is wholly dependent on the traffic which it is able to secure from the traveling public.

From the standpoint of the traveling public the induce-

ment to use any service is dependent, primarily, upon four principal conditions, viz.—*fare, frequency, comfort* and *speed*.

Comparing, for example, the street car lines and the elevated lines in New York City, it is at once noted that they have corresponding elements of fare and frequency. The element of comfort (which is an important one) might be said to be in favor of the elevated, but this is offset by the objection to stair climbing. Thus, it would appear that the elevated service has no advantage whatever over the street car service in the elements of fare, frequency, or comfort; so that there remains only the element of speed in its favor. Unfortunately, especially at times of heaviest travel—morning and evening—the speed of the elevated trains is so reduced as to tell severely against patronage which would otherwise belong to the service without question.

Were there only a few distinct centers of traffic distribution within the territory served by the elevated roads in New York City, so-called "express" service might secure and retain long-haul traffic. The centers of distribution, however, are practically scattered along the whole lengths of the lines.

"Express service" is only a relative term. As a matter of fact, all elevated service might be designated as "express" when compared with that of street cars. Stations on such lines are, or become, centers of distribution, and if the traveling public is distributed along a given length of the line with fair uniformity, the mistake must not be made of cutting out frequent stops without due justification; otherwise, the street car service will attract an undue proportion of longer haul traffic on the principle of its being the direction of the least effort to the passenger.

In seeking an advanced solution of the rapid transit problem in New York, it is to be feared that the question of competition between transportation companies is apt to unduly govern progress. The maxim before quoted as to "increase of good transportation facilities carrying with it its own traffic in a populous district" would be found to be a more certain guide to success in considering the interests of both the transportation companies and the public, than by simply watching "the other fellow" and trying to do just a little better than he is doing.

Street car service and high speed service ought to be complementary instead of antagonistic, and whether the lines are owned by different corporations or by the same, there ought to be but one policy, viz., that of offering unquestioned transportation facilities on both classes of service. It being understood that elevated or similar service is essentially for the handling of comparatively long-haul traffic, such service to be successful must cater to the appreciation of its patrons. It may be said broadly that the only excuse for the existence of an elevated structure is the possibilities which it presents for high speed. Such possibilities do not exist with street cars. It is thus apparent that speed is the one prerogative of the elevated lines, or of lines having a private right of way, and it is by virtue of this element of speed that such services may expect to retain or increase the traffic naturally tributary to them.

Rapid transit is the most important element in the building up of a residence territory comparatively remote from a business center. Were the owners of property in an outlying district the owners of a railroad they could not afford to do otherwise than adopt the highest practicable rate of speed on the line, as, by so doing, the values of property would be thereby increased, approximately in proportion to the speed, seeing that outlying points would thus be virtually brought just so much nearer to the business center.

There is naturally a physical limit to the speed which can be made over any line, with given station distances, gradients, curvature, or other restrictions to free running, whether such restrictions be natural or arbitrary. A change of motive power is not by any means *per se* a panacea for the loss of traffic by express lines of transportation which have lost the right to the term express, unless such change of motive power should conduce to improved service. Thus, to operate elevated lines electrically on the schedule rates of running existing with steam operation might be rather an apparent than a real economy, and might readily illustrate the remark heretofore made as to attempting to recoup lost traffic by reduction in expense, instead of by improvement of the service. Operation electrically, after the novelty of the thing had worn off, could not of itself be expected to increase traffic. Speed is the one element of paramount importance which should place the express lines where they ought to stand, as most important factors in the necessary transportation facilities radiating around a great center of population.

In seeking to reach a decision as to motive power a consideration of variations in speed is all-important The expression "schedule speed" is apt to be rather confusing, unless the points between which the run referred to is made are stated. In considering the subject of variation in speeds it is well to bear in mind some simple definitions, which, while seemingly perfectly understood, are sometimes confused one with another.

Schedule speed may be defined as the average rate of running between any two points, obtained by dividing the total distance by the difference in time between that of starting from one point and that of arriving at the other, inclusive of all intermediate stops.

Average running speed is, of course, somewhat higher than schedule speed, and is obtained by dividing the total distance by the difference in time between that of starting from one point and that of arriving at the other, deducting the time consumed in all station stops.

Maximum speed is the greatest speed attained between any two successive stops, and for the same average running speed may vary within very wide limits.

The two extremes in performing any given average running speed are—

1. Accelerating up to the point of braking.

2. Accelerating as rapidly as possible to something above the average speed, and then either coasting, or practically holding this speed to the point of braking.

In the first case it is evident that the maximum speed must be very much higher than that in the second case, in order that the total distance may be covered in the same time. Thus, it is necessary to make a careful study of variations in speed in the performance of any given schedule, as on such variations depend—

(*a*) The necessary weight on the driving wheels required to give sufficient adhesion for acceleration.

(*b*) The power and capacity of the necessary motor equipments.

(*c*) The total energy to perform the movement.

In the case of the first method mentioned, viz., accelerating up to the point of braking, in making a given distance in a given time, the least powerful motors are required, but, on the other hand, the maximum amount of energy is used in performing the service.

In the case of the second method, viz., accelerating as rapidly as possible to something above the average speed, and then either coasting or practically holding this speed to the point of braking, the most powerful motors are required, but the minimum amount of energy is used. Thus, the consideration of the advisable acceleration to be given to trains in performing a given service is

governed, in a great measure, on the one hand by the capacity of motor equipments required to perform the service, which increases as the acceleration becomes greater; and, on the other hand, by the amount of energy required to make the run, which increases as the acceleration becomes less.

The first cost and subsequent operating expense of motors and power stations are not, however, the only factors of expense which vary with speed and method of train movement. For a given starting schedule on any line, *i. e.*, for given train intervals and given numbers of cars per train, the net car mileage on the line will simply be the total number of cars started multiplied by the length of the round trip. This is independent altogether of the speed which the trains make, as the number of cars passing a given point in a given time remains constant. As the speed is increased the same train schedule can be performed with a smaller number of cars; and while the car mileage remains the same the net car hours (being the net car mileage divided by the schedule speed) will vary inversely as the schedule speed.

As the wages of motormen and trainmen are practically on a time basis, it is evident that as the speed is increased these elements of cost of train operation will diminish in inverse proportion. This also is true with such elements as train lighting and heating. Cost of regulation and other matters also require careful consideration.

It will thus be seen that in order to reach a satisfactory decision as to improved service along modern lines, there are many elements to be considered, even before that of so-called motive power itself is taken up, and, in fact, the purely electrical engineering problems involved in a change of motive power are but one element in the economics of train movement calculated to serve given or prospective traffic requirements.

The management of any transportation enterprise of this character will naturally ask the following questions:

What object is to be attained by making a change in transportation methods?

What is to be the influence on revenue by making changes in a service?

What are such changes going to cost for varying conditions of service?

What is it going to cost to operate under the varying conditions of service suggested?

Satisfactory answers to these questions will involve a full knowledge of the whole range of possibilities of high speed operation. With this information before those whose money is to be spent, a decision can readily be reached as to advisable changes from a politic or an economic standpoint. On the other hand, the mere assumption that electric operation of a service, however applied, will solve the rapid transit problem, might, if carried out under certain conditions, be wofully disappointing.

The New York City Rapid Transit Proposition of the Metropolitan Street Railway Company

For several years past the Board of Rapid Transit Railroad Commissioners appointed by the Governor of the State of New York to consider the burning question of rapid transit on Manhattan Island have labored faithfully, though without result, for the accomplishment of the purpose for which the board was created. Their last proposition was that the city of New York should itself construct a tunnel and lease the right to operate it to private capital for a term of years, by which means it was hoped that through the city's excellent credit the fixed charges might be kept at a minimum. This proposition failing, others were made to the Manhattan Railway Company, looking to the extension and increase of facilities of the elevated railway system, but the Manhattan Company refused to accept the plans and suggestions of the commission, and again failure was met.

On March 27 the Rapid Transit Commissioners received from the counsel of the syndicate which owns a controlling interest in the Metropolitan Street Railway Company the following remarkable proposition:

To the Board of Rapid Transit Railroad Commissioners:

Gentlemen—We are authorized to make the following proposal in behalf of clients interested in the Metropolitan Street Railway Company:

They are willing to organize a new corporation, hereinafter called the Tunnel Company, which shall agree with satisfactory guarantees of performance to build with private capital and maintain and operate the underground rapid transit road on the route and plans of the commission, with some possible modifications in detail, as to space for stations, places of access, width of tunnel, etc., which may be suggested by engineers and approved by your board, and upon the following terms:

1. The road to be constructed in two sections.

(*a*) The first section, from the southern terminus to a point between Fort George and the ship canal, to be constructed immediately, the work to be commenced within three months and to be completed within thirty-six months after the right is acquired.

(*b*) The second section to comprise the remainder of the entire route on both branches, to be commenced as soon as the net earnings from the operation of the railroad upon the first section shall be sufficient to pay 5 per cent upon the actual cost of construction and equipment, and to be completed within twenty-four months thereafter.

Reasonable provision to be included in the contract for extensions of time in case of litigation or other delay for which the Tunnel Company is not responsible.

2. The railroad to be operated in connection with the Metropolitan Street Railway and to be leased to the Metropolitan Street Railway Company in perpetuity, or for a term practically equivalent thereto, for a rental to the Tunnel Company of 5 per cent upon the actual cost of construction and equipment.

3. The fare on all cars or trains, except those hereinafter described as express, to be five cents. This to include all cars or trains run on the outside tracks. All passengers carried for five cents to be entitled to be carried over the surface lines of the Metropolitan Street Railway Company for an additional three cents. Conversely, all passengers over the surface lines of the Metropolitan Street Railway to be entitled to be carried over the tunnel road on cars and trains, other than express, for a fare of three cents in addition to the present surface railway fare.

Such carriage of passengers over the joint lines of the Metropolitan Street Railway Company and the new road to be by continuous car passage as well as by transfers, unless it shall be determined that the running of the same cars on both roads would unduly interfere with the capacity or speed of the tunnel road.

Track connections with the surface lines for the continuous passage of cars to be made (or special transfer stations to be established):

(*a*) At or near Thirty-second Street for the Lexington Avenue, Second Avenue and Thirty-fourth Street and Long Island Ferry lines by bringing in tracks from those lines through private property to be purchased by the Tunnel Company between Thirty-second and Thirty-third Streets and Fourth and Lexington Avenues.

(*b*) At or near Forty-second Street for the Madison Avenue line.

(*c*) At or near Fifty-ninth Street for the Eighth Avenue line and the Fifty-ninth Street crosstown line.

(*d*) At or near Fifty-fifth Street for the Columbus Avenue line and the Boulevard and Amsterdam Avenue line.

Special provision is to be made for delivery of passengers to and taking passengers from the lines of the steam railroads using the Grand Central railroad station at Forty-second Street, and joint traffic arrangements to be made with the New York & Harlem, New York & New Haven and New York Central (provided those companies consent) for carriage of passengers between all points on their lines within the city limits and the southern terminus of the new road.

4. Express trains to be run on the tracks marked as express tracks on your plans, and upon them the fare to be ten cents, provided that the passengers upon all such trains shall be entitled to be transferred to and carried on all other cars or trains on the new road without payment of any additional fare; and to be transferred to and carried upon all connecting lines of the Metropolitan Street Surface Railway without the payment of any additional fare; and that passengers on all other cars and trains on the tunnel road shall be entitled to be transferred to such express trains on the payment of five cents additional fare; and that passengers on all connecting surface lines of the Metropolitan Street Railway shall be entitled to be transferred to and carried on said express trains on the payment of five cents in addition to the present street surface railway fare.

No train to be deemed an express train except one which is scheduled to run and, barring accidents, does customarily run, over its entire route below Ninety-sixth Street at the rate of 20 miles an hour, and for at least two miles below Forty-second Street at the rate of 30 miles an hour.

5. Provision to be made for a third track on both the eastern and western branches above Ninety-sixth Street, so that express trains may be run down in the morning and up in the evening over the entire road.

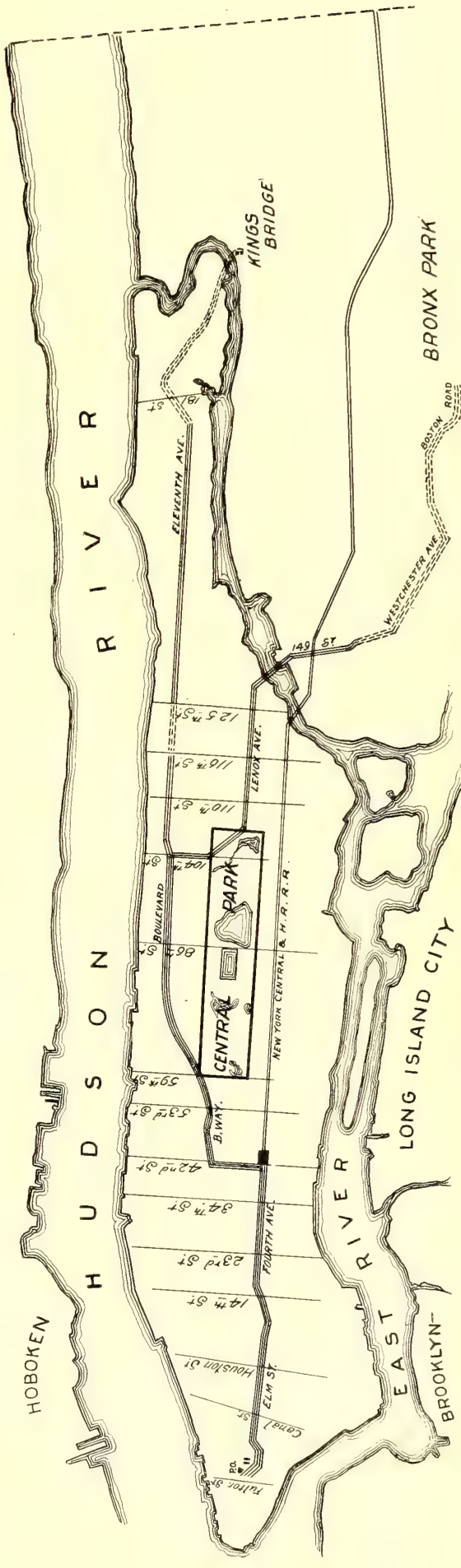
6. The new company to be entitled to use the side galleries and other spaces in the tunnel not necessary for railroad purposes for any wires, tubes or conductors authorized by law, belonging either to itself or others, and to receive to its own use any rentals which may be derived therefrom.

7. The city to receive as compensation, in addition to the services rendered and in lieu of all other charges upon the franchise granted hereunder, an annual rental equal to 5 per cent on the gross receipts from the operation of the new road; provided that whenever any such payment shall leave the receipts insufficient to pay the rental of 5 per cent on cost of construction and the operating expenses, including taxes, the percentage to be paid shall be abated accordingly.

8. The real and personal property forming part of said railway to be exempt from taxes until it pays 5 per cent, as provided in section 15 of the rapid transit act, with the amendments proposed by the commission in the bill now pending before the Legislature.

9. Adequate station room to be given under City Hall Park, without interfering with the surface, except for access from the street and park, which is to be given by sufficient stairways. Similar provision to be made for underground stations, and sufficient access from the open spaces at the junctions of Broadway with Seventh and Eighth and Columbus and Amsterdam Avenues.

In all matters not covered by the present construction plans, such as crossings and connections with surface lines, not heretofore contemplated by these plans, the construction to conform to the requirements of the commission's engineers in all matters relating to the public safety or to the use of any portion of the streets, avenues or public



Underground sections are shown by solid lines, viaduct sections by dotted lines.

PROPOSED ROUTE OF RAPID TRANSIT RAILWAY, NEW YORK

places of the city. All sewers, pipes or other sub-surface structures now in the streets, and which may be interfered with by the construction of the tunnel, to be relocated and provided for at the expense of the Tunnel Company, in accordance with your plans and to your satisfaction.

10. The cost of construction to be deemed to include the cost of all private property purchased for connections, stations, etc., and a fair proportion of the costs of any power houses, machinery, or other plant constructed or acquired for the joint operation of the new road and the surface roads of the Metropolitan Street Railway Company, the expenses of organizations, plans and contracts and interest during construction. The accounts, vouchers, and payrolls showing the cost of construction and the earnings of the new road to be at all times open to your inspection.

11. The earnings of the new road to be ascertained by taking all the fares received for the separate business of that road and by an equal division between the new road and the Metropolitan surface road upon all joint business. In case any difference should arise between the Tunnel Company or the Metropolitan Street Railway Company and your board, or the city of New York, under the contract, the question to be submitted to the determination of three arbitrators, one to be selected by yourselves, one by the Metropolitan Street Railway Company, and the third chosen by the two so selected.

This proposal is subject to the approval of the stockholders of the Metropolitan Street Railway Company in the manner provided by law. Very respectfully,

Root, Howard, Winthrop & Stimson.
Jay & Chandler.

New York, March 27.

Accompanying this memorandum was the following letter of explanation giving the company's reasons for making the offer:

POSITION OF THE METROPOLITAN EXPLAINED

Alexander E. Orr, Esq., President Board of Rapid Transit Railroad Commissioners:

Dear Sir—We inclose a memorandum of the terms upon which gentlemen interested in the Metropolitan Street Railway Company will undertake to form a corporation to construct the underground rapid transit railroad, on the route and plans proposed by you, and to provide for its maintenance and operation in connection with the Metropolitan Street Railway system. The memorandum has been submitted to the Metropolitan Street Railway directors and has their approval.

You will perceive that the plan contemplates the construction of the road by private capital, and giving transportation on it without any additional charge beyond the cost of transportation, to all passengers on the Metropolitan system of roads, which now extends through about 250 miles of streets, and carries about 900,000 passengers daily. The only exception to this practically free use of the tunnel road would be in the case of express trains, running for long distances without stops, and therefore without the short-haul business, from which alone the profits of street railroads are now made, and running at a high rate of speed, which necessitates greater headway and fewer trains, and therefore smaller returns. As to this class of business a fare is stipulated, which would be practically a fare of five cents for the use of the tunnel road, added to the fare of five cents upon which the same passengers would be entitled to travel over the surface lines.

The regular fare provided for passengers not desiring to use the surface roads is five cents.

This plan results from the following considerations, suggested to our clients by their experience in street railroad transportation in New York:

1. That the reason why capital has not responded to the long-continued invitation of the city to take the risk of constructing an underground road is that there is not sufficient probability that such a road, in view of its great cost, could be operated profitably on an independent basis as a trunk line without branches or feeders.

2. That such a road, without any means of collecting and distributing passengers over surface lines, would afford only very partial and unsatisfactory facilities to the people of the city, most of whom would either be obliged to walk long distances to reach the stations, or pay double fares on independent surface lines.

3. That since the introduction of the underground system of electric traction, the real obstacle to rapid transit is to be found in the congested condition of the streets in the lower part of the city, and that if the same electric cars now used, or similar cars connecting with them, could be propelled swiftly through a tunnel from Harlem to the City Hall, the tunnel road being used as a trunk line, while the surface roads are used for local traffic and the collection and distribution of passengers for the trunk line, real rapid transit would be attained.

4. That while the tunnel road itself would afford to the most northerly districts of the city the convenience they have so long sought, its combination with the surface roads would give much needed relief to the great population extending from Forty-second Street to Harlem, and especially to the residents between the line of the Central Park and East River, who would otherwise receive little benefit from the new road.

5. That the close connection of the underground road from the City Hall to Forty-second Street with the New York Central, New York & Harlem and New York & New Haven Road at that point would, in effect, make a rapid transit route from the City Hall to every point within the city limits on the four lines of the railroad companies mentioned.

6. That the increase of business which would result from the increase of facilities thus afforded would probably justify the assumption of a burden by the Metropolitan Company for the construction of the new road, which would be altogether beyond the possibility of profitable investment if the road were to be built and operated independently; and that the Metropolitan Company could probably operate the new road more economically and effectively than any independent company, and might thus make a profit where such another company would fail.

7. That the special facilities which the Metropolitan Company now has as lessee of the New York & Harlem's right to the Fourth Avenue tunnel between Thirty-fourth and Forty-second Streets, and through owning or controlling large tracts of land immediately available for use, and especially in the possession of plant for the production of power, containing provisions for large increase of future requirements, and which it has been engaged for years in construction, put that company in such a position that it can have a rapid transit road in actual operation long before that would be possible for any one else, even if any one else were now willing to undertake it.

It is now several years since the people of this State adopted a new policy regarding city railroads by repealing the statutes which prohibited, and passing laws which favored, the consolidation of street railways on condition that greater facilities should be afforded to the public in the way of transportation over the combined lines without additional fares. The result of the new policy in this city as compared with the former system of numerous inde-

pendent lines presents a most remarkable exhibit of public benefit. The Metropolitan Company is now carrying upon transfers for which no payment is made, over lines which would, under the old system, have been entitled to two separate fares, about 400,000 passengers daily. The money which would be paid by the people of the city for this service, which they now get for nothing, would, if the old system still continued and the people received the same service, amount to over $7,000,000 annually. The average fare paid to the Metropolitan Company for each single ride, such as would have been given for five cents under the old system, is now but three and one-half cents per passenger. What this means to the business of the city, in the convenience of access to its stores for the purposes of trade, in the freedom of its working people as to the selection of their homes without being tied down to the immediate locality where their work is to be done, in the equalization of rents and in the convenience to the public generally, it is impossible to estimate. The plan which we propose is but a continuance of the same wise policy.

We are satisfied that this offer presents to the people of the city advantages superior to any plan hitherto suggested and fully commensurate with any benefits to be derived by the new company or by the Metropolitan Street Railway Company, and that it will produce for New York a system of urban transportation far better than that now existing in any great city of the world. The difficulties and risks involved are such that no one can safely assume them without popular support, and we make the offer in the belief that the people of the city of New York will regard the arrangement proposed as fair and advantageous to them, and will be ready to give it their genuine approval and support. Very respectfully,

Root, Howard, Winthrop & Stimson.
Jay & Chandler.

H. H. Vreeland, the president of the Metropolitan Street Railway Company, said the proposition is the final word of the company on the subject.

"This is the second proposition we have made to the Rapid Transit Commission," he said, "and our letter to them contains our final decision in regard to the plan of an underground rapid transit tunnel. On our part the case is closed, and we are waiting for the verdict. There cannot be any haggling over the proposition, so far as we are concerned, for we have examined the whole project in all its details, and have decided exactly what we are able to do. This has been embodied in the communications to the Rapid Transit Commission, and our conclusions and offer are before them to accept or reject. The proposition before them is final.

"The details of our plan are fully explained in the letters to the board. If our offer is accepted, we shall endeavor to use the tunnel for the through traffic first, and for as much local traffic as can be accommodated in it without interrupting or delaying the express traffic. Whether there will be any objection to the grant of the franchise in perpetuity I cannot predict, but if the matter is considered practically a person must see that it would be ridiculous to ask us to risk so great an amount of money on a short leasehold."

Asked if the control of the rapid transit tunnel by the Metropolitan Company would not lead to the absorption by that company of all lines of other companies in the boroughs of Manhattan and the Bronx (including the elevated system), Mr. Vreeland said: "I believe that eventually all of the railway transportation lines on Manhattan Island will be under the control of one company. It may be the Metropolitan Street Railway Company, or it may be some other company. It seems to me that conditions and circumstances are tending in the direction of concentration of control. If there is to be a perfect system of passenger transportation on this island such as the people want, it naturally must be under one management. Of course, I cannot foretell what is going to happen years hence, and know of no definite plans beyond the fact that the Metropolitan Company stands ready to carry out its proposition to construct and operate the tunnel.

"Is it not significant that in all the years that underground rapid transit has been discussed here in New York no combination of capitalists has been able to figure out financial success in the project? It is the Metropolitan Company's peculiar position that enables it to undertake this great work with hope of financial success. We already have 228 miles of surface lines in operation, and each succeeding year the pressure of traffic is increasing. At certain hours of the day we are unable to carry all of the people who want to ride. It is by making the proposed rapid transit tunnel a part of our system—the trunk line, if you please—that we are able to see a profit in its construction and operation.

"The tunnel road will undoubtedly relieve the surface lines of practically all the long-haul traffic, thereby enabling us to carry all of the short-trip passengers on our surface lines at all hours of the day. At the present rate of increase in traffic, the relief thus afforded by the tunnel will, two or three years hence, be an actual necessity. You can readily see, therefore, that the operation of a great trunk line tunnel, with express and local trains, in connection with our otherwise far-reaching system, would naturally lead to the control of the passenger transportation facilities of this island by one concern."

President Vreeland said that if the franchise for constructing the tunnel was given to the Metropolitan Company, he thought that cars could be run through at least one section of the tunnel within two years from the time of beginning work. "I do not mean," he said, "that we would build the tunnel a section at a time, for we should begin the work at several different points and push it as expeditiously as possible all along the line. But in case one section should be completed before the others, it would not be necessary for the completion of the whole tunnel to begin the running of cars. There is where one great advantage of the Metropolitan Company as the constructor of this tunnel is manifested. We have sufficient electrical power to enable us to operate cars in any part of the tunnel just as soon as a section can be opened. For instance, should the sections between the City Hall and Thirty-second Street be completed before the sections further up town, we could make a physical connection between the tunnel and our Lexington Avenue line and run cars through the tunnel and over the surface lines from City Hall to Harlem.

"The Metropolitan Street Railway Company owns the block bounded by Fourth and Lexington Avenues and Thirty-second and Thirty-third Streets. The grade of Lexington Avenue is so far below that of Fourth Avenue that, by an easy incline, connection between the surface line and the tunnel could be made at this point. So you see that the people of New York would be able to enjoy the advantages of partial underground rapid transit without waiting until the entire tunnel is finished. In most cases, as different sections of the tunnel were completed, they could be operated in a similar manner.

"As has already been stated, the transfer system as it now prevails on the Metropolitan lines would be applied to the tunnel, with the exception that three cents additional fare would be charged for each transfer to and from the tunnel. This extra charge we feel bound to make in order

to get a profit out of the operation of the tunnel. On all local trains in the tunnel, however, the fare will be five cents. I do not believe that any reasonable objection can be urged against our charging extra for the fast express train service in the tunnel."

Mr. Vreeland reiterated that work would probably be begun in the construction of the tunnel within three months after the details of the franchise have been closed up by the contracting parties. He said: "We know just what kind of ground we have got to cut through, and just how many feet of rock must be blasted. All of this information has been ascertained by competent engineers, and the data and specifications on which to proceed with the work are at hand."

RAPID TRANSIT BOARD MEETS

The Board of Rapid Transit Commissioners held a special meeting March 29, at noon, in the rooms of the Chamber of Commerce, for the purpose of considering the proposed memorial to the Legislature and the amendments to the rapid transit bill, which the proposition to build the underground road by means of private capital has made necessary.

The commission considered very fully the proposed memorial and amendments, and took such action as will result in the placing of both before the Legislature by the evening of March 30. After the discussion of the memorial, the following resolution was offered by Mayor Van Wyck:

Resolved, That it is the sense of this board that it is in the public interest that, in addition to the powers already possessed by the board, the Legislature should grant to the board the power to contract for the construction and operation of the Rapid Transit Railroad by private capital.

This resolution was unanimously adopted.

Mr.Starin then offered a resolution that the president and secretary be authorized to execute the proposed memorial as drafted in behalf of, and under the seal of, the board, and to forward the same to both houses of the Legislature. This motion was also carried.

Proposed New Subway in Boston

A new subway, beginning approximately at the Boston end of the Harvard Bridge and extending along the water front back of the Beacon Street houses, up under Beacon Hill to Scollay Square, with convenient entrances and exits, has been proposed by Mayor Quincy of that city in a hearing before the State legislative committee on metropolitan affairs.

Such a subway would cost about $2,500,000, and would do away with the necessity of running surface cars on Marlboro Street to accommodate the people of the Back Bay. With a surface line on Boylston Street and a subway along the southerly shore of the Charles River, the residents of that section bounded by Arlington Street, Boylston Street, Massachusetts Avenue and the Charles would have ample facilities for reaching the business portion of the city. More than that, the proposed subway would entirely relieve the congestion which now exists in and about the present subway.

Into the new tunnel would be sent the electric cars which come across the Harvard Bridge from Cambridge, and also those from Newton, Brighton and Allston, which now run down Beacon Street to Massachusetts Avenue, where they go on the same track used by the Cambridge cars. Every one of these cars, under the conditions which now exist, continues its course down Boylston Street and into the subway at the Public Garden. All these cars could be run in the new subway. Thus the old one would be relieved of more than half of its burden.

There would be no longer any agitation for the replacing of car tracks on Tremont Street. Such a step would not be necessary.

The construction of this subway is but one, although it may be in some ways the most important, feature of a plan for the improvement of the south bank of the Charles River. The subway would not have been suggested if it had not been for the esplanade which is to be built back of the houses which face on Beacon Street. Under that esplanade the subway will be.

This esplanade has been for a long time contemplated. Last year a bill providing for the construction of such a plat was presented to the Legislature. This measure, which provided for the erection of a new river wall 40 ft. north of the present wall, and for the filling in of the space between the two walls, was advocated by Mayor Quincy, assented to by the adjacent landowners, who were to pay about one-half the cost, and approved by the harbor and land commissioners. But the Legislature of 1898 referred the bill to the next General Court, the Legislature of this year. Mayor Quincy now proposes to build the esplanade 75 ft. wide, and under it to construct the subway.

Blood's Formula for Train Resistance

Owing to a typographical error which occurred in the article by Mr. Blood, on train resistance, in the last issue of the Journal, after the page was read by the editors, the exponent n of the speed M in the third term of Mr. Blood's general formula, was omitted, although the formula is correctly given later on, when a value is selected for n. The correct reading for Mr. Blood's general formula is, therefore, as follows:

$$R = B + W M + A\frac{M^n}{T}$$

Where

R = resistance.
M = speed.
T = weight of train.
B = journal coefficient.
W = wheel and rail coefficient.
A = air resistance coefficient.
n = exponent of air factor, which should be determined by experiment.

So the smaller companies, while they may not be quite as extensive as some of the more prominent ones of this association, certainly are just as wide and broad in their possibilities of growth and development as any that are now recorded upon our roster.—From address at the Atlanta, Ga., Convention, 1894.

From these comparisons, we see that with the lives assumed, cypress will cost 48 per cent more than creosoted timber. Oak will cost 92 per cent more than creosoted timber. Pine will cost 111 per cent more than creosoted timber.—From paper read at the Montreal Convention, 1895.

Sans Souci Park, Chicago

Chicago has a grand system of public parks, large and small, located in all parts of the city, and with a connecting system of boulevards which is the pride of every resident. The large parks are all situated advantageously to the street railway companies, and it is doubtless that this fact has heretofore deterred the street railway companies from creating amusement resorts such as have been established in other cities.

Sans Souci Park, which is now in preparation, is the first amusement resort of any magnitude in Chicago which has for its object the stimulation of street railway traffic. It is located on the Wabash Avenue line of the Chicago City Railway and well out toward its terminus. The Sixty-first Street electric line of the Chicago City passes along one side of the park, and the Alley L and Illinois Central are within a block. The park and buildings will cover the entire block, extending east from Cottage Grove to Langley Avenue between Sixtieth and Sixty-first Streets. This location will be remembered as being at the southeast corner of Washington Park, and at the entrance of the Midway, which is now one of the most popular boulevards of the city. In summer the surrounding drives are filled with bicycles and carriages. It is doubtful if there exists within the city limits a better available location for a street railway park.



FIG. 1.—FLOWER VASE PARTLY COMPLETED

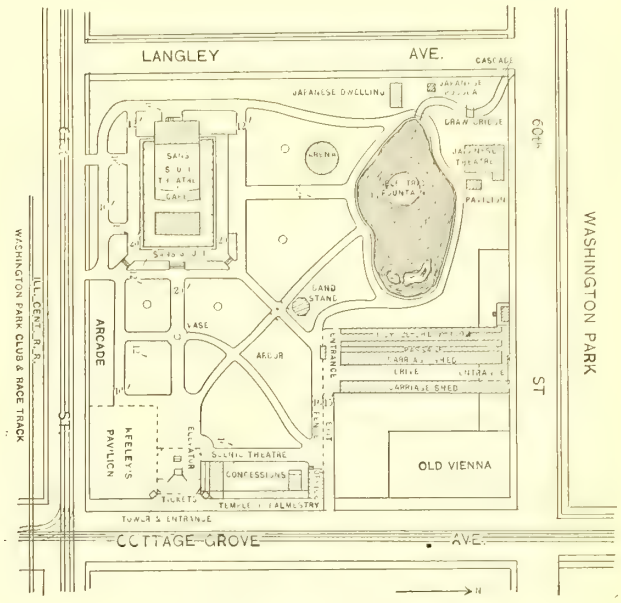


FIG. 2.—PLAN OF PARK

The park is square, with an inclosed area of nearly ten acres. The buildings and rubbish which occupied the ground were all removed, except "Old Vienna," itself a summer resort, which stands on one corner; the lease to the present occupants of "Old Vienna" has yet two years to run, after which the building will be removed and the park extended over the space occupied.

The park has been laid out with fine walks, the general arrangement of which, with entrances, buildings, etc., is shown on the diagram Fig. 2. The lawns, which are now covered with a heavy coating of manure, will soon be sodded. There were originally no trees on the ground, but a goodly number have already been transplanted. A strong high fence will surround the park, and a small admission fee is to be charged.

The principal attractions will be the Sans Souci open-air theater and café and the electric fountain. The pavil-



FIG. 3.—THEATER BUILDING AND BAND STAND

ion, or theater building (Fig. 3), is an attractive two-story frame structure, painted white, except the roof, which is of red tile. The extreme dimensions of the building are 145 ft. x 180 ft. In the eastern end the lower floor will be occupied by a buffet, 50 ft. x 70 ft., and directly over

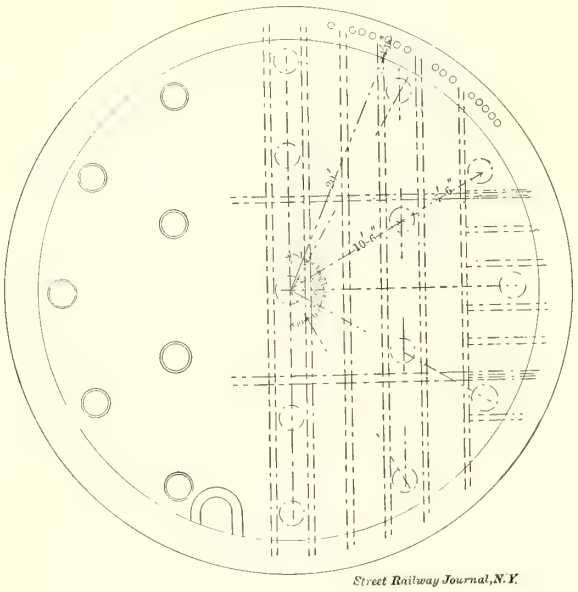


FIG. 4.—PLAN OF ELECTRIC FOUNTAIN

this, in a room of the same size, will be the kitchen. At the other end of the building is a stage 30 ft. x 42 ft., dressing rooms and large, well-furnished public lavatories. In the center of the building is the auditorium of the theater. It connects with the broad porticos on either side, which are continuous on three sides of the building. The stage is in full view of the verandas and the promenades connecting them; visitors will be free to view the performances from the verandas, but a charge will be made for the reserved chairs in the parquet and balcony, which are inclosed by a light railing. The seating capacity of the pavilion, exclusive of the theater auditorium, is 2500; the latter will be furnished with 850 chairs. Accommodations for seating nearly as many more people will be made in the park surrounding the band stand and fountain.

Judging from the popularity of the small fountain in Lincoln Park, it is expected that the electric fountain at Sans Souci will prove a great attraction. This fountain, a plan of which is shown in Fig. 4, is circular in shape, with a diameter of 48 ft. The outer wall is laid with blocks of steel slag, and this is surrounded by a small lake, as shown in the plan (Fig. 2). The fountain is one of the largest ever constructed, and will have eighteen wells.

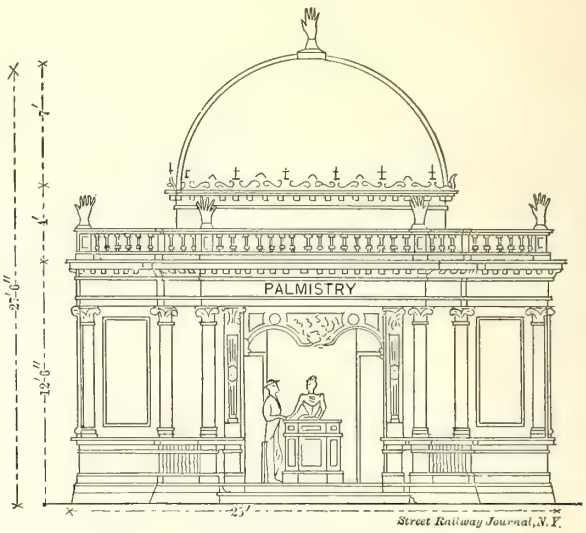


FIG. 5.—THE TEMPLE OF PALMISTRY

The operating machinery will not be controlled, as is usual, by attendants in the base of the fountain, but from the power house. This is a small building, 16 ft. x 20 ft., three stories high, built at the edge of the surrounding lake. In the basement will be installed two Quinby screw pumps, with a capacity of 1000 gals. per minute. Each pump will be direct connected to a 75-h.p. Westinghouse motor. Current for operating the motors will be taken from the trolley circuit.

On the second floor of the power house will be a switch board with some 380 push buttons, the manipulation of which will vary the colors of the fountain, and small controlling valves for governing the Crane hydraulic lift valves, which in turn govern the water display. The manipulation of the fountain will require the attention of but one attendant. The third floor of the power house, with stairways leading up to it, will be an open pavilion. It is the intention to operate the fountain each evening during the summer months.

The fountain was designed by Messrs. Moore and Riley,

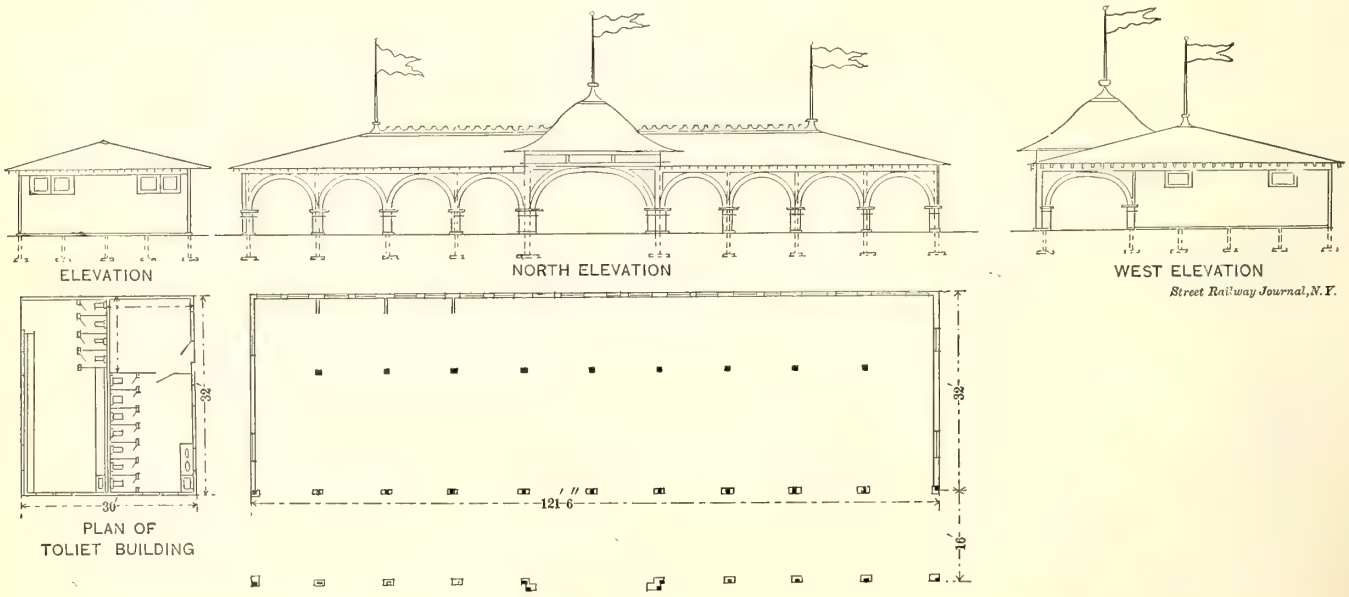


FIG. 6.—PLAN AND ELEVATIONS OF ARCADE

of the Chicago City Railway, and the machinery and parts have nearly all been made in the company's shops. Its cost in round figures is $25,000.

The band stand, which is shown in Fig. 3, is octagonal, 24 ft. in diameter. Band music will be a practically continuous feature of the park's attractions. Fig. 1 shows a large flower vase that is being erected. In one corner of the grounds will be located a Japanese theater and tea garden. Two of the principal buildings at the park will be the "Arcade" and the Temple of Palmistry, plans of which are shown in Figs. 5 and 6. The Arcade will be a well-constructed building, 121 ft. 6 ins. long x 48 ft. wide. It is proposed to sublet floor space in this building for various booths and attractions, as photograph galleries, candy stands, cane, knife and shooting galleries, etc. No partitions will be built in the building at first, but these will be added to suit the different tenants. The Temple of Palmistry is a neatly-designed pavilion, and will be used for telling fortunes and reading characters.

The park has been promoted by the Chicago City Railway Company, but W. H. Carter is the proprietor and manager.

Attractions for Parks

The Biograph

The increasing number of street railway parks makes the subject of park amusements particularly interesting to street railway companies, and for this reason a number of those attractions, which have proved most popular, have been described in these columns. In this series some particulars of the biograph will undoubtedly be of interest, as this machine, which has been so successful as a theatrical attraction for the past four years, last summer entered the field of summer parks and demonstrated its crowd-drawing qualities in a notable way.



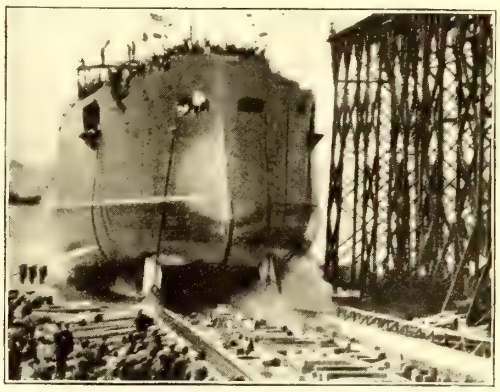
PRESIDENT MCKINLEY AT CAMP WYCKOFF

At the Denver City Park the American biograph was shown, last summer, as a free attraction by the Denver Consolidated Tramway Company. Park Commissioner Gallup is quoted as saying that the biograph attracted to the park between 300,000 and 500,000 people. In the Denver City Park the screen was placed upon a barge moored out in a lake, the projecting apparatus being placed upon the shore. In this way the pictures were viewed by an immense crowd, and during the intermissions between the biograph shows the screen was rolled up out of the way and the barge utilized as a band stand. It is not necessary to darken the park or to do away with any of the illuminations, as the biograph requires only a darkened screen.

There are many strong arguments in favor of the biograph as an attraction for summer parks. It draws a large number of people who, for various reasons, are not interested in ordinary vaudeville entertainment, and, at the same time, its pictures are so varied that it appeals forcibly to the regular summer park patrons. It is claimed for the biograph that on consecutive evenings it gave the same programme on the Bowery and at the Waldorf-Astoria in New York city; in each case the audiences showed the same enthusiastic approval. In parks where refreshments are sold, the biograph commends itself particularly as an attraction which augments the ordinary café trade. A crowd seated about tables or promenading can enjoy the pictures as well as one seated in a hall, and no amount of conversation or laughter can interfere with the success of the programme. Of course, the biograph is equally adapted to indoor work. It is to be recommended particularly, however, as a free outdoor attraction for the purposes of drawing crowds and holding them. In order to do this two shows are given, one at 8 o'clock, at the conclusion of which it is announced upon the screen that another and entirely new set of pictures will be shown at 10 o'clock. This method has always proved very successful. The biograph should not be confused with other moving picture projecting machines. It operates on a much larger scale, throwing a clear, steady picture 30 ft. sq. and uses a film 2¼ ins. wide, which is said to be seven times greater than that used in other apparatus. The American Mutoscope Company, of New York, which owns and operates the biograph exclusively, is affiliated with similar companies in London, Paris, Berlin and other foreign capitals, and the films obtained by any one of these companies is at the disposal of the others; thus the American Mutoscope Company has been enabled to show in America such scenes as the Victorian Jubilee Parade, the Coronation of Queen Wilhelmina, of Holland, the Inauguration of President Loubet, of France, etc., even before the illustrated papers have had their illustrations. The engravings which are shown herewith give an idea of the variety of subjects and of the general character of the pictures shown by the biograph.



A ROTARY SNOW PLOW IN ACTION



LAUNCHING THE U. S. BATTLESHIP ILLINOIS

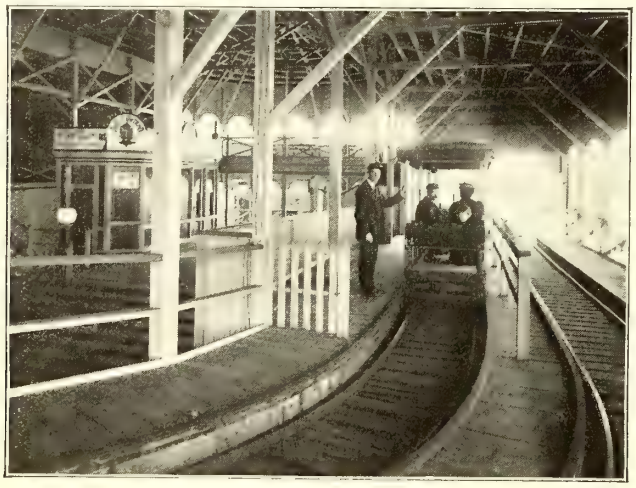
Scenic Railway at Coney Island

One of the most popular attractions at Coney Island, itself one of the most popular pleasure resorts in the world, is the scenic gravity railway. This is situated near the west iron pier, and although somewhat out of the way in its location, it has nevertheless been discovered and patronized by over a million people during the past three seasons, and it is a noteworthy fact that those who take this ride never fail to express their appreciation of this amusement.

The structure consists of four parallel tracks, each one about 800 ft. long, making a total ride of about 3200 ft. The tracks are built with alternate elevations and depressions, giving the cars a wavy motion which is novel and agreeable. At the outer end of the railway is a large auditorium through which the four tracks pass, and it is here that the scenic effects are produced. The railway depends for its popularity on the surprise and wonderment occasioned by the suddenness with which the scenic effects are

brought into operation. This is accomplished by making the approaches and exits to the rooms in which the scenic features are located, long dark tunnels. The tracks for several feet before reaching these rooms are carefully bonded and are at all times connected with a source of electricity, but the circuit is not closed, and there is, of course, no current in the rails. As soon as the car approaches these points, however, the wheels and axles complete the circuit from one rail to the other and immediately the car is surrounded by a brilliant illumination disclosing on all sides the most weird and surprising scenery. The car dashes through this illumination and suddenly all is darkness again. The scenic effects on the four tracks are different, so that the excitement is kept up during the whole trip. Some of the scenes installed are shown herewith.

Every precaution is taken to make the operation of the cars absolutely safe, powerful track brakes being placed upon each car. In addition to this, an automatic safety signal block system is in use, making rear end collisions impossible. Each car is in charge of a competent attendant.



STARTING ON THE RIDE



WINTER SCENE





VIEWS IN ONE OF THE CAVERNS

This scenic railway was installed and is owned by the L. A. Thompson Company, of New York, it being one of a number of these attractions which this company has installed throughout the country. In addition, this company has built scenic railways at Bergen Beach, Woodside Park, Philadelphia; Toledo, Ohio; Riverside Park, Baltimore; Midland Beach, Staten Island, and Chester Park, Cincinnati. Orders are also being received from foreign countries, a complete railway with all the necessary materials, accessories, etc., having just been shipped to Para, Brazil.

Dramatic and Vaudeville Attractions

The difficulty of obtaining good vaudeville and dramatic attractions at short notice for parks, summer gardens, etc., has led Daniel Packard, of New York city, to open a general headquarters for this class of artists.

Mr. Packard has the addresses of and is in business relation with a very large number of the leading musicians, singers, lecturers, pianists, magicians and vaudeville artists in the country, and is prepared to furnish entertainments for one evening, or for any length of time, of any class desired. He will furnish a quartette, a singer, a magician, a minstrel first part, a singing soubrette, or an entire vaudeville or opera company. He has had twenty years' experience in organizing summer attractions, and has given special attention to the requirements of open-air theaters. He supplies all the necessary costumes and music, and attends to all the rehearsing and preliminary arrangements.

Large Contracts in New York

The Third Avenue Railroad Company, of New York city, in addition to the contracts mentioned in the Street Railway Journal for January, 1899, has recently awarded the following: St. Louis Car Company, of St. Louis, 100 cars; Peckham Truck Company, of New York, 100 pairs 14-B short wheel-base trucks and 60 pairs Peckham maximum traction trucks; Standard Air Brake Company, 160 Standard air-brake equipments; E. F. DeWitt & Co., Lansingburg, N. Y., sand boxes for 160 cars; Hale & Kilburn Manufacturing Company, Philadelphia, car seats.

Municipal Ownership in Detroit

The Michigan Legislature on March 23 passed a bill providing for the municipal ownership of street railways in the city of Detroit. The bill states that three commissioners shall be appointed by the Detroit Common Council to arrange the terms of purchase, which are to be ratified by the Common Council before the agreement is closed.

It is understood, however, that the Detroit companies' franchises are so worded as to prevent the carrying out of the provisions of the new bill.

LEGAL NOTES AND COMMENTS*

Edited by J. Aspinwall Hodge Jr., and Robert Ernest, of the New York Bar

Bribery and Perjury in Accident Cases

The role of Cassandra is neither grateful nor popular. Even the pessimist, who confines himself to a doleful view of existing conditions and does not attempt to prophesy or to point out the probable result of growing tendencies, is not generally listened to with favor, and often is not credited.

But both the existing conditions and the tendency to corrupt practices in the trial of negligence cases, especially in the courts which are crowded with them in the large cities, is becoming so apparent and notorious that it is felt that a note of warning will not be out of tune with the general knowledge and thought of our readers.

A somewhat extensive inquiry addressed to a number of lawyers who, in our large cities, devote their time, some of them to the defense and some of them to the prosecution of negligence cases, especially against street railways, has resulted in a practically unanimous verdict that corrupt practices are increasing. A difference of opinion emerges only when the inquirer seeks to obtain an opinion from men, who look at the matter from different standpoints, as to whether the plaintiffs or the defendants are the greater sinners.

Our own view of the matter is, that, where a great volume of business is transacted of any sort, and one side or class of men seek to attain their ends by trickery or fraud, that the other side will, in a very great number of cases, seek to justify themselves in stooping to similar means on the ground of self-defense and self-preservation. It has been the experience of most men in the profession that the plaintiffs' attorneys are generally the first to sin, and have the least excuse. They deal oftentimes with ignorant people; they have but few cases as compared with the attorneys for the railways; they come into personal contact with both client and witnesses, and they can give personal attention to details and, presumably, can secure, at first hand, reliable information as to the honesty and justice of their cases. It takes a very stupid lawyer, who can give his attention, personally to the investigation of an accident case, to be deceived by witnesses who propose to perjure themselves for the benefit of the plaintiff.

On the other hand, the temptation offered to an attorney, especially if he be poor, to make sure of a large verdict, in a flimsy case, is great, for the stake is large, and the whole matter is of so speculative a nature as to present the attractions and temptations of a gambling transaction, with what seems to be a small fortune in view in case of success, and actual loss in case of failure.

Now and then the public is apprised of the facts, which are more surprising and startling to them than to the lawyer, who often suspects, from what he sees in the courts, trickery and dishonesty he cannot prove.

Recently in New York a case came before one of the trial courts where the plaintiff's attorney placed witnesses on the stand who testified; that an employee of the defendant was driving a large truck, heavily laden, through a crowded thoroughfare, and by his side sat a boy some seventeen years old; that the plaintiff, an infant, was standing in the middle of the street, watched by his mother on the sidewalk; that the wagon ran over the child, and that at the time the driver was reading a book, while the boy at his side was holding the reins and driving.

The defendant's testimony was to the effect, that the driver had the reins and had no book, and that he called to the child, and that thereupon the mother rushed into the street and the accident happened. The jury brought in a verdict for ten thousand dollars in favor of the plaintiff, who had been severely injured. After entry of judgment the attorney for the defendant learned that one of the witnesses for the plaintiff had stated in conversation that he had sworn falsely at the trial. Investigation followed, which resulted in the indictment and arrest of this witness, and of several others, who confessed, some to the district attorney and some to the attorney for the defendant, that they had been guilty of perjury at the trial; that some of them had not been near the scene of the accident at the time it happened, and that the others gave a perverted account of what they saw. They stated in their confessions that the plaintiff's attorney read to them a carefully prepared version of the accident, including an account of the book and of the boy having the reins in his hand, and they testified to what had been read to them, and not to what they had seen.

Meanwhile an appeal from the judgment had been taken to the appellate court, and the verdict had been sustained; but the judgment of affirmance was not entered promptly by the plaintiff, and a rather interesting state of facts must be recited as the cause of the delay.

It appeared that the attorney for the plaintiff had a large financial interest in the case, and in several other actions (for loss of service, etc.) arising out of the same accident. To save expense, the plaintiff had brought his action as a poor person, and the plaintiff's attorney had made the necessary agreement to prosecute without compensation, but after the decision of the appellate court he refused to enter up the judgment of affirmance until the guardian of the infant plaintiff would agree that he should receive full costs, allowances, expenses, and several thousand dollars out of the verdict.

These facts were presented to the judge who presided at the trial, and the defendant's counsel made a motion that the judgment be vacated and a new trial ordered. In granting the motion the court severely criticised the plaintiff's attorney, and in his written opinion stated that he believed that the plaintiff's attorney not only knowingly presented perjured testimony to the court and jury, but actively participated in its manufacture. The indictment of the attorney for the plaintiff by the grand jury followed, and he is now awaiting trial.

Where facts of this character become known or are suspected there is a strong temptation on the part of the defense to look solely to their own convenience and financial interest, and be satisfied with a release, while there are the strongest and most potent reasons on the score of public duty to impel them to go to much inconvenience and some expense in bringing matters of this character to the attention of the criminal, as well as the civil courts, as was done in this case.

The other side of the question we have already suggested, and we infer from investigations that we have made that practices of this sort, especially in some of our Western cities, have resulted in defensive measures on the part of large corporations which are not always compatible with the strictest integrity. There are hangers-on about the court houses in some large cities who seem to be constantly in conversation with the jury panel, and who have no apparent means of livelihood, but who always seem to be flush of money. Coincident with their presence about

* Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

the court house are stubborn jurymen, who, in cases of clear liability, cause disagreements. The zeal of the adjuster (who is in a way a sort of detective and open to the same sort of temptation that makes a detective's testimony of doubtful value), is in great part to blame.

We regret to notice that the accident departments of some of our large railway companies stir up bad blood and give the attorney for plaintiff good cause for complaint which bears fruit in his justifying himself, to himself if to no one else, in departing from professional ethics. The counsel and the accident adjusters of the railway company should not set up by their conduct a low standard of professional tactics, if for no other reason than because it is bad policy. We refer to the growing practice of settling cases after suit is brought, behind the plaintiff's attorney's back. The counsel for the company excuse themselves to their brethren at the bar by saying that they cannot control their client, the company, and its adjusters —an excuse which, if ever available, certainly is not valid until they have exhausted every effort to compel the company to be as righteous as they desire, and have a right to expect, their opponents to be.

But it is believed, that the loss departments of most of our street railways are run upon the very sound proposition that "Honesty is the best policy." The courts and jurors and the character of the counsel who ordinarily are employed to try the cases for our street railways is so high, that the adjuster who tries trickery or bribery in order to attain success as a shrewd employee must not only fool the court and jury, but must fool the shrewd and honest counsel under whose direction he is supposed to act.

Where any other policy prevails it must in the end arouse such a wave of popular indignation as to be reflected, if nowhere else, certainly in enhanced damages in cases wherein the plaintiffs recover verdicts from indignant juries. H.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

ALABAMA.—Electric Railroads—Injury to Telephone Company—Injunction.

1. While prior occupancy of a street by a telephone company may not confer superior privileges over an electric railway company seeking to construct a line in such street, it may be considered in denial of the latter's usurpation of superior rights in said street.

2. To entitle a telephone company to enjoin an electric railway company from operating a line, under a legislative grant, on a street occupied by the former, damages in the nature of an abuse of the franchise, and not mere incidental damages, must be proved.

3. An electric railway company will be enjoined from erecting its wires in a street in such a manner as to short-circuit the wires of a telephone company, and prevent messages being sent over them, where such damages can be avoided by a proper construction of the line, as such damages would be continuous, and tend to a multiplicity of suits.

4. And for the further reason that a court of equity will interfere to keep such corporations within the line of their authority, and prevent such damages.—(Birmingham Traction Co. vs. Southern Bell Telephone & Telegraph Co., 24 So. Rep., 731.)

ILLINOIS.—Municipal Improvements—Assessment—Property Subject.

1. Under City and Village Act, art. 9, authorizing special assessments for local improvements on property contiguous thereto, the tracks and right of way of a street railroad company in a public street may be assessed for contiguous local improvements therein; and this, even where its franchise is only an easement for a term.

2. Revenue Law (Rev. St. 1893, c. 120), sec. 15, providing that the track, road, or bridge of street railroad companies shall be deemed personal property, and assessed as such in the town or district where located or laid, does not prevent the assessment of the track and right of way of a street railroad for contiguous local improvements.—(Cicero & P. St. Ry. Co. vs. City of Chicago, 52 N. E. Rep., 866.)

ILLINOIS. — Municipal Corporations—Ordinances—Constitutionality—Contracts—Ultra Vires.

1. Under Rev. St. p. 219, sec. 3, providing that a city may permit the construction of a street railway upon such conditions as it deems best for the public interest, a city may require a street railway to pay an annual tax on each mile of its track as a condition to its right to construct and operate its line.

2. It will not be presumed that because an ordinance, authorizing the construction and operation of a street railway, requires the payment of a license fee on each car, that another provision, requiring the payment of an annual tax on each mile of its track, is an improper attempt to raise revenue for the municipal government.

3. An ordinance requiring defendant street railroad to pay an annual tax on each mile of its road, as a condition to its right to construct and operate its line, does not deprive defendant of its property without due process of law, in contravention of the fourteenth amendment to the constitution of the United States and sec. 2 of the bill of rights of the State constitution.

4. An ordinance requiring defendant to pay an annual tax on each mile of its track is not in conflict with Const. art. 4, sec. 22, prohibiting the enactment of special laws where a general law is applicable, though the ordinance applies only to defendant, and not to other street railway companies.

5. Defendant, who accepted a license to construct and operate a street railway, and received its benefits, cannot, as against the city, avoid payment of an annual mileage tax on the ground that the license imposing it was ultra vires of the city.—(Chicago Gen. Ry. Co. vs. City of Chicago, 52 N. E. Rep., 880.)

KENTUCKY.—Taxation of Corporate Franchises—Repeal of Statute—Conclusiveness of Finding of Board of Valuation.

1. Ky. St. secs. 4273-4275, enacted prior to the present constitution, so far as they authorize the board of equalization to equalize assessments upon any other basis than that of the cash value of the property assessed, are in conflict with Const. sec. 172, and Ky. St. sec. 4020, enacted thereunder, and were to that extent repealed thereby.

2. A corporation, whose franchise has been assessed at its fair cash value by the board of valuation and assessment, cannot complain of the inequality caused by the fact that other officers have, in violation of the constitution and statutes, assessed property at less than its fair cash value.

3. The question as to how far the value of the franchise of the corporation is affected by the fact that it is to exist only for a limited time is for the board of valuation and assessment, and its finding as to that matter is final and conclusive.

4. In fixing the value of the franchise of a corporation for assessment, it is proper to deduct the value of the tangible property of the corporation assessed in the State from the value of the capital stock; and, in fixing the value of the capital stock, the board may take into consideration the gross and net earnings of the corporation.—(Louisville Ry. Co. vs. Commonwealth, 49 S. W. Rep., 486.)

NEW YORK.—Conversion—Judgment—Satisfaction—Title of Property.

1. Where the owner of coupons in the possession of another elected to waive their return, and sued as for conversion, and recovered judgment, which was satisfied, the coupons became the property of the wrongdoer.

2.—Evidence—Presumption.—Possession of coupons by the person liable thereon, where there was evidence they were unpaid, raises no presumption that they were received under any agreement preventing the owner from collecting them.

3.—Same—Burden of Proof.—Where, in an action on coupons, plaintiff showed that they had been duly issued by defendant, that plaintiff had become the owner of them, and that they were not paid, the burden was on defendant to show whether any defense existed against the right to recover; and this, though the coupons were in defendant's possession.

4.—Judgment—Notice—Estoppel.—Where the person ultimately liable on coupons was served with notice of the commencement, trial, entry of judgment, and appeal of an action involving their ownership, value, and existence as legal obligations, though not a party, he is concluded as to these issues in a subsequent action on the coupons.

5.—Limitation of Actions—Bonds—Coupons.—Interest coupons of bonds therein described are not outlawed until the bonds are, though they are detached from the bonds.—(Kelly et al. vs. Forty-second St. M. & St. N. Ave. Ry. Co., 55 N. Y. Suppl., 1906.)

NEW YORK.—Bills and Notes—Defenses—Want of Consideration.

1. Where a note was given in settlement of a suit for the infringement of certain patents, apparently valid, and both parties acted in good faith, the maker cannot avoid payment on the ground of want of consideration, because the patents were subsequently adjudged void in another suit.

2.—Same—Payee's Right to Sue.—The fact that the payee of a

note, given in settlement of a pending suit, was not a party thereto, does not affect his right to recover thereon.

3.—Same—Consideration.—A note was given in settlement of a suit for the infringement of patents on electric car equipments to a company not a party to the suit, which also agreed to promptly furnish the maker any trolley equipment it might require. Held, that though the patents were invalid, there was a sufficient consideration for the note moving from the payee in this additional agreement.—(General Electric Co. vs. Nassau Electric R. Co. et al., 55 N. Y. Suppl., 858.)

NEW YORK—Location—Objections by Landowners—Waiver.

1. Railroad Law, secs. 6, 90, provides that a street surface railroad corporation, before constructing its road, shall file a map and profile of the route, and notify occupants of lands over which the route passes; that any occupant may, within fifteen days after notice, apply to a justice of the Supreme Court for relief against the route designated, and alteration of the same; and that the corporation shall not proceed to condemn until the fifteen days have expired, nor until final determination of any application for change of route. Held, that an occupant who fails to object to a proposed route within fifteen days cannot afterwards attack it.

2.—Same—Petition for Condemnation—Sufficiency of Description.—If the center line of a proposed street surface railroad extension is staked out on the ground, or otherwise ascertainable by inspection, without reference to the map of the route, or already known, it is a monument that may be referred to in the "specific description of the property sought to be condemned, and its location by metes and bounds," required by Code, sec. 3360, subd. 2.

3.—Same—Right to Condemn—Agreement with Owner.—Where an adult asserts undivided ownership in land sought to be condemned by a street surface railroad company, and several infants claim an interest therein, and there are liens on the property, the company may resort to condemnation proceedings, under Railroad Law, sec. 90, authorizing that course when the company is "unable to agree" for the purchase of the land.—(Stillwater and M. St. Ry. Co. vs. Slade et al., 55 N. Y. Suppl., 966.)

NEW YORK.—Municipal Corporations—Proceedings to Open Street—Notice.

1. Syracuse City Charter, sec. 167, provides that notice shall be given of the application for the appointment of commissioners to ascertain and report the compensation to be paid to person, owning or having an interest in property proposed to be taken for a street and shown to be benefited. Held, that notice to a mortgagee of a railroad might be dispensed with in a proceeding to take railroad property, where the mortgage is so insignificant in proportion to the value of the road that the lien will not be impaired in the slightest degree by the proceeding.

2.—Same—Statutes—Partial Invalidity.—The fact that said section does not provide, in express terms, that notice shall be given to the owners of property taken and not benefited, does not permit the city to take lands without due process of law, as against owners of lands benefited.—(In re Opening of Oneida St., City of Syracuse vs. Syracuse, B. & N. Y. R. Co., 55 N. Y. Suppl., 959.)

NEW YORK.—Streets—Obligations to Pave.

1. General Railroad Law, sec. 98 (Laws 1890, chap. 565), as amended by Laws 1892, chap. 676, providing that every street surface railroad corporation, so long as it shall use any of its tracks in any street in a city, shall keep in permanent repair that portion of such street between its tracks, the rails of its tracks, and two feet in width outside thereof, as and whenever required by the local authorities to do so, applies to every street surface railroad company, whether incorporated prior or subsequent to the act.

2.—Same—Exemption.—The omission, in a charter of a street railroad company, of a provision compelling it to pave streets along its tracks, does not vest in it or its successors a perpetual exemption from such obligation subsequently imposed by the Legislature under the power given it by Const., art. 8, sec. 1, providing that all general laws creating corporations may be altered from time to time.

3.—Same—Vested Rights.—The term "vested rights" relates to property rights only, and does not embrace an immunity or exemption created by an omission, in a statute incorporating a street surface railway company, to impose a liability on it to pave parts of streets occupied by its tracks.

4.—Same—City Council—Power to Exempt.—A city council has no power to exempt a street railroad company, by contract or otherwise, from the provisions of General Railroad Law, sec. 98, as amended by laws 1892, chap. 676, requiring all street surface railroads to pave certain portions of streets occupied by their tracks.

5.—Same—Exemption Contract—Legalizing Statute—Constitutionality.—Laws 1893, chap. 231, legalizing a contract between the city of Binghamton and the Binghamton Railroad Company exempting it from part of the provisions of General Railroad Law, sec. 98, as amended by Laws 1892, chap. 676, requiring it to pave certain portions of streets occupied by it, is not void as a grant to the company of an "exclusive immunity" forbidden by the constitution.

6.—Same—Repeal.—Nor was such legalizing act repealed by implication by Laws 1893, chap. 434, sec. 90, passed a month thereafter, providing that the general law requiring street railroad companies to pave certain portions of streets along their tracks shall apply to every corporation, however organized; nor by Laws 1895, chap. 933, which, in amending the general railroad law in other unrelated respects, necessarily re-enacted section 90.

7.—Same—Validity.—Laws 1893, chap. 231, legalizing a contract between the city of Binghamton and the Binghamton Railroad Company, exempting the latter from liability to pave parts of streets occupied by it, was not void because it validated a contract void for want of power in the city to make it, since the Legislature may confer such power by retrospective legislation.—(Wood vs. Common Council of City of Binghamton et al., 56 N. Y. Suppl., 105.)

SOUTH CAROLINA.—Municipal Corporations—Laying Railroad Tracks in Street—Consent of Abutters—Condemnation.

Under Acts 1894, p. 1002, sec. 14, authorizing the town council of Gaffney City to close up, widen, or alter a street by condemnation in case the abutters refuse consent, the council has no authority to permit a railroad to lay its tracks in a street, where consent was refused, without condemnation and compensation.—(Wilkins et al. vs. Town Council of Gaffney City et al., 32 S. E. Rep., 299.)

TEXAS.—Municipal Corporations—Change in Grade of Streets—Delegation of Authority—Liability to Abutters—Council—Proceedings—Committees—Joint Tort Feasors—Evidence—Instructions.

1. Where a railroad company raises the grade of a street through a contractor, pursuant to authority granted to it or to the contractor by a city acting under the power conferred by charter to alter the grade of streets, the city alone is liable to an abutter for damages resulting from the change.

2. An alderman testified without objection that he gave a railroad company authority to change the grade of a street, "for the council recommended it," and that he "suggested the matter to the council, but *could* not state how the vote stood there." Held, that the question whether the council authorized the change was for the jury.

3. The necessity of submitting the question to the jury was presented by a request to charge the erroneous proposition that such authority might be given without a formal order passed by the council in session.

4. A street committee of a city council has no authority to authorize a railroad company to change the grade of a street, unless conferred by charter or by the council.

5. Where a railroad company raised the grade of a street through a contractor without authority from the city, and the contractor authorized the engineer of the company to specify where the dirt should be placed, and the engineer gave directions thereunder, the company and the contractor were not joint tort feasors, so as to preclude the latter from recovering over against the former in an action by an abutter for damages.

6. The Denison City Charter provides that the council shall hold regular meetings; that its voice shall be ascertained by vote; and that the city secretary shall attend every meeting, and keep accurate minutes of the proceedings, and record votes. Held, that authority to change the grade of streets, which is conferred on the council by charter, cannot be granted by the consent of each member of the council individually. The council must act as such.—(Denison & P. Suburban Ry. Co. vs. James et al., 49 S. W. Rep., 660.)

LIABILITY FOR NEGLIGENCE.

ILLINOIS.—Contributory Negligence — Instructions — Error Cured—Damages—Pleading.

1. Where plaintiff did not begin to alight from defendant's car until it had stopped, and when it stopped she was holding on with both hands, and had one foot to the ground, and the car jerked after she put the foot on the ground, and before she had time to lift the other foot, she exercised ordinary care.

2. If an instruction that if plaintiff, while alighting from defendant's car, was using reasonable care, and defendant negligently caused the car to be set in motion, and plaintiff was thereby injured, the jury should find defendant guilty, is objectionable in omitting the question whether the negligence of plaintiff was the proximate cause of the injury, the objection is obviated by a subsequent instruction that, if plaintiff was negligent in alighting, and such negligence was the cause of the injury, a verdict of not guilty should be returned.

3. If such instruction is objectionable in not defining "reasonable care," the objection is obviated by a subsequent instruction

that a person attempting to alight from a street car is bound to use ordinary care to avoid injury, under any and all circumstances, and if she fails to use such care, and is injured by reason thereof, she cannot recover.

4. In an action for personal injuries, a recovery for any disability rendering plaintiff less capable of attending to her business may be had without an averment of special damage, where plaintiff is a common laborer, since the damages necessarily result from the injury.—(North Chicago St. R. Co. vs. Brown, 52 N. E. Rep., 864.)

INDIANA.—Special Verdict—Objections—Injuries to Trespassers—Constitutional Law—Title of Act—Jury Trial.

1. The question of the validity of a special verdict is not raised by an objection to the filing of defendant's request for a special verdict, where no demand was made that the jury be directed to bring in a general verdict, and no objection was made on the return of the special verdict, nor any request that the jury be sent back with instructions to make a general verdict.

2. Where a boy, being unable to get on an open electric car, stands upon the side of the car, on which strips extend to prevent the egress or ingress of passengers, placing his foot on the boxing of the axle, and rides thereon for some distance without paying a fare or offering to do so, and without being asked for his fare, he not being seen by any employee of the railroad company, though he had money in his pocket with which to pay such fare, if asked for it, and falls off and is run over by the wheels of the trailer, the railroad company is not liable for injuries received, the place where the boy was riding being very dangerous.

3. Plaintiff, while so riding, was not a passenger to whom the carrier owed a safe carriage and immunity from injury.

4. The fact that plaintiff was a child about nine years old did not make him less a trespasser on the car, if the other facts compelled the conclusion that he was wrongfully on the car.

5. Act March 11, 1895, amending the practice act, and providing for special verdicts, sufficiently expresses the subject in the title, "An act to amend section 389 of an act concerning proceedings in civil cases, approved April 7, 1881, and designated as section 546 of the Revised Statutes of 1881."

6. Act March 11, 1895, providing for special verdicts, which act, except as to form, did not change the law governing special verdicts as it had existed in the State since 1852, is not unconstitutional, as violating the right of trial by jury.

7. Where an application for a special verdict is made under Act March 11, 1895, and 144 interrogatories are submitted to the jury, covering every material fact, exclusion of others tendered, calling for mere opinions and for conclusions of law, was proper.

8. Where a special verdict is requested, no instructions are proper, except such as are necessary to inform the jury as to the issues, the rules for weighing evidence, who has the burden of proof, and whatever else may be necessary to enable the jury clearly to understand its duties.—(Udell vs. Citizens St. Ry. Co., 52 N. E. Rep., 799.)

INDIANA.—Defective Street—Duty to Repair—Special Finding—Presumption—Contributory Negligence—Instructions—Review.

1. It cannot be presumed that a person injured did not exercise any care, from a special finding that the evidence did not show "what care" he was using when the injury occurred.

2. In the absence of knowledge to the contrary, one driving over a street is entitled to presume that it is in a reasonably safe condition for travel.

3. One injured by reason of a defective street, which he knows to be unsafe, is not guilty of contributory negligence, if he uses care proportionate to the known danger.

4. On an issue as to what would constitute constructive notice of a defect in a street, the court charged that a very short time might be sufficient, considering the location, character, and permanence of the defect, "and such other things as throw light on the question," and added that what the facts were and the interferences to be drawn therefrom were for the jury to determine, under all the evidence and circumstances. Held, in view of the closing clause, that the instruction was not erroneous, as authorizing the jury to consider facts not shown by the evidence.

5. Since a street railroad company is bound to so maintain its tracks as not to impair the safe condition of the street, whether required by ordinance or not, an instruction that, if a street railway company accepted an ordinance imposing such obligations, a violation thereof rendering the street dangerous would be negligence, which, if the proximate cause of another's death, who was exercising due care at the time, would render the company liable therefor, was not error.

6. A verdict of a jury cannot be disturbed on appeal where there is some evidence to support it.

7. It is not error to refuse requested instructions covered by those given.—(Citizens St. Ry. Co. et al. vs. Ballard, 52 N. E. Rep., 729.)

LOUISIANA.—Contributory Negligence—Infants—Motoneer—Damages—Personal Injuries.

1. A plaintiff's act or omission, when only a remote cause, or a mere antecedent occasion or condition, of the injury inflicted, is considered not to be contributory negligence.

2. A child of three and one-half years is, of itself, incapable of contributory negligence.

3. No man should be in charge of an electric car as motoneer, running along populous thoroughfares of a city, who has not the full and complete use and sight of both eyes.

4. No doctrine or rule exists here that the negligence or imprudence of a plaintiff, while not of the proximate character to defeat his recovery, may yet be looked to by the jury or court in mitigation of damages.

5. Nevertheless, this court has constantly exercised its reasonable discretion of increasing or diminishing the sums awarded for damages, according to its judgment, operating on the facts, prompted in given cases.

6. It has never been the intention to fix by rule specific sums for different classes of injuries, nor for varying grades and duration of anguish and suffering.

7. In this respect, each case is considered independently, on its merits, and on the state of facts peculiar to it, a due regard, however, being always had to the proper observance of a reasonable uniformity of jurisprudence on general lines.—(Rice et ux vs. Crescent City R. Co., 24 So. Rep., 791.)

LOUISIANA.—Injury to Passenger—Contributory Negligence.

1. The West End passenger train of the defendant company came to its stopping place on Canal Street, where it was when plaintiff walked up to the train, and turned to the right, in order to board the smoking car at the end of the train. An electric car of the defendant company ran on its track, which was near the steam train. The projection of the electric car and the projection of the steam train (toward each other) made very narrow the path upon which plaintiff was walking, with his back to the electric car, by which he was knocked down, and greatly injured. The rule as to looking and listening had no application. About midday, defendant's motorman did not see plaintiff, who was walking in front, in a dangerous position, because of his advancing car. It was his duty to keep a sharp lookout, and see pedestrians at the place on their way to board the cars. No gong was sounded, and no alarm.

2. There was no proper care on the part of the employee in charge of the defendant's electric car. Such care and diligence must be exercised at dangerous places on a railway, to avoid inflicting injury, as the proper manning of a car requires.—(Conway vs. New Orleans City & Lake R. Co., 24 So. Rep., 780.)

MASSACHUSETTS.—Liability for Injuries—Acts of Fellow Passengers—Knowledge of Passenger's Infirmity.

1. A carrier is not liable to a passenger for injuries received by the fall of another passenger, who was jostled by the conductor while removing a drunken passenger from the car in the exercise of due care.

2. Where a passenger was injured through the carrier's attempt to remove a drunken passenger from the car, the carrier, if liable at all, was liable only for the consequences of the injury, and not for any fright or other injury suffered by the passenger through the drunken man's presence, or the attempt to remove him.

3. The conductor's knowledge of a passenger's infirmities does not increase the carrier's obligations to her.

4. A carrier whose servants committed a battery on a passenger is liable for all damages sustained by him, even though the injury to a normal person would have been less.—(Spade vs. Lynn & B. R. R., 52 N. E. Rep., 747.)

NEW YORK.—Negligence of Driver.—The failure of the driver of a horse car to observe a boy when he slipped on the track, on a dark night, four feet in front of the horses, at a part of the road not a crossing, does not justify an inference of negligence.—(De Ioia vs. Metropolitan St. Ry. Co., 56 N. Y. Suppl., 22.)

NEW YORK.—Injury to Person Near Track—Question for Jury.—Evidence showed that plaintiff was standing on a crosswalk between the tracks of a street railway, preparatory to taking a south bound car, when he was struck by a north bound car, which was in full view of him while approaching. The drivers were instructed to slow up or stop when approaching a car near or on a crosswalk receiving passengers, but the driver of the north bound car approached the place where plaintiff was standing, without checking his speed. Plaintiff, being about to take the south bound car, was facing in that direction, and did not notice the approach of the other car. Held, sufficient to authorize the submission of the case to the jury.—(Boentgen vs. New York & H. R. Co., 55 N. Y. Suppl., 847.)

Arguments Against the Vestibuling of Cars.

The following interesting letter was addressed by John W. McNamara, general manager of the Albany Railway, to the committee of railroads of the New York State Assembly, arguing against the passage of several bills pending before the railroad committee in relation to vestibuling or inclosing platforms of cars of street railways:

To the Honorable Committee of Railroads of the Assembly:

Gentlemen.—The Albany Railway respectfully opposes the passage of any of the proposed measures providing for the vestibuling or inclosing platforms of its cars, for the following reasons:

I. The Appellate Courts of the several States of the United States and the Supreme Court of the United States have laid down the law in relation to the care to be exercised by persons or corporations operating street railways. According to the several decisions, the operator of a street car, especially if it is impelled by cable or electric power, is bound to keep a constant watch for persons and vehicles on the street, and although he is not bound to anticipate that foot passengers will attempt to cross otherwise than at regular crossings, and he, therefore, need not maintain quite the same degree of vigilance, he is always held responsible for failing to see even persons crossing at other places if he would have seen them had he been in the exercise of ordinary care.—Sherman and Redfield on Negligence (5th ed.), section 485c.

1. This being the law, street railway managers are obliged to select able-bodied, competent operators of their cars. The operator must be able-bodied, and physically able to promptly control all the appliances usually on cars for the purpose of starting and stopping them. His eyesight must be good, so that he may be able to see obstructions on the track, or at points along the line see those who are about to cross the track. His hearing must be good, so that he may be able to hear all signals given to him by the conductor and promptly obey them; and the warnings and signals of pedestrians or persons desiring to board cars. He must be able to speak, and preferably to speak the English language. His habits must be good. No one known to habitually use intoxicating liquors can legally be employed as the operator of a car.—Railroad Law, section 42, and Liquor Tax Law, section 41. Penal Code, section 420.

II. The law requiring the utmost vigilance on the part of those operating street railways is being constantly enforced by the courts in actions brought by persons suffering damages either to person or property. It would seem, therefore, unjust to require street railways, first, to take the greatest care in the selection of the operators of its cars and the greatest vigilance on their part, and then, second, to compel them to place such operator in such position that having ears he cannot hear, having eyes he cannot see, and having a tongue and voice he cannot use them. That is just what each one of the bills we are considering requires street railways to do. It requires the operator to be inclosed in a vestibule, so that his ability to see and hear and make himself heard is abridged.

1 As cars are now operated in Albany, the operator is in a position where he can be seen by all persons traveling on the street; where he himself can see all persons who are crossing, or attempting to cross, the track upon which he is driving his car; and he is in a position to hear warnings given to him by others; and is also in a position to give warning himself to those who may inadvertently place themselves in danger.

2. It is not saying too much to say that hundreds of persons have been saved from serious injury by reason of the ability of the operators of the cars of the Albany Railway to make themselves heard.

III. The experience of electric railways and other railways using vestibules is that the vision of the operator is very much obscured, and the percentage of accidents happening by reason of this interference with vision is consequently larger.

1. It is impossible to keep the glass portion of the vestibule clear in cold, foggy or stormy weather. It is found at night that in order to enable the operator of the car to see at all, it is necessary to cover the front part or front windows of the car proper with a curtain. The effect of this, of course, is to prevent the passengers riding in the car from seeing the operator. For aught they know, he may have been taken with a fit and be lying senseless on the platform.

2. The hearing of the operator of a car while inclosed in a vestibule is very much impaired by reason of the resonating effect of the vestibule. All the noise made by motors and wheels on the track seems to be concentrated and intensified in the vestibule.

3. The conductor of the car, who occupies the rear part, is handicapped by the vestibule. If the trolley goes off, which is quite a common occurrence on all overhead trolley roads, it is necessary for him to get off the car to put the trolley on.

4. The present platforms enable persons to see the conduct of the driver, both from the inside of the car and from the outside of the car, during an impending accident. Many an operator of a car has been able to prove his great vigilance by aid of the testimony of persons standing on the sidewalks or sitting in the car which he was operating, when, if he had been inclosed in a vestibule, as these bills propose to inclose him, it would be impossible for him to do so.

5. The motion of his hands in throwing off power and putting on brakes is plainly visible. If he were inclosed in a vestibule, no one would be able to see whether he made any effort to stop the car or not.

6. The open platform enables inspectors of operation to readily see the position and condition of the operator.

IV. Unless, therefore, the Legislature is prepared to relax the rule of law established by the courts, and give the operators of street railways the same right to operate their cars as is now enjoyed by steam railroads, they, the railways, should be permitted to manage the operation of their cars in such a way as to secure the least possible damage to the persons and property of others.

V. The reason given by the proponents of the several bills for their passage, namely, their sympathy for those engaged in operating cars, does not take into account the much larger number of persons interested in preserving their lives. For instance, the number of operators of cars employed by the Albany Railway does not exceed one hundred and fifty, while the population of the cities through which the cars of the Albany Railway are operated exceeds two hundred thousand. It is, therefore, a question whether it is better to conserve the health and comfort of one hundred and fifty persons who may be exposed to wind and storm for a few days in each year, or to jeopardize the limbs and lives of thousands of people who have occasion to use the streets through which the cars run.

1. The Albany Railway and the Watervliet Turnpike and Railroad Company have operated street railway cars in the city of Albany and vicinity since 1863. During that time there is no record that any operator of either a horse or an electric car contracted any disease while operating such cars which caused his death or hastened his death. The fact is that the drivers of cars are among the healthiest of the employees of a street railway.

2. The lives of persons run down by street railway cars are as precious to their fathers and mothers, or, in the case of parents, to their children, as the lives of the operators of street cars are to those who are related to them. With all the care which it is possible now to exercise, many annually lose their lives by reason of being struck or run over by street cars. It would seem, therefore, that any legislation which tends to increase the number who thus annually lose their lives should be restrained and withheld.

3. It is well known that pedestrians and drivers of vehicles on streets through which street railways are operated rely upon the vigilance of the operators of street cars to warn them of the approach of the car, and to stop the car if necessary to prevent a collision or accident.

4. A car with a human being in plain sight on an open platform seems less like an engine of destruction than a car with an inclosed platform, the operator of which is concealed from those using the streets as pedestrians or drivers of vehicles.

VI. The fact that the operators of street cars—motormen and gripmen—want vestibules; or the fact that corporations owning railways do not want them, should not influence the decision of the question.

1. Many who advocate the vestibuling of cars do so simply from the standpoint of sympathy for the operator of the car. All other considerations are ignored or forgotten.

2. It is barely possible that some operators of cars may desire vestibules, forgetting for the moment how a vestibule would handicap them in the operation of their cars.

VII. The question, therefore, whether any of the bills providing for the vestibuling of cars, or the modification of any of them, should be reported by your committee is respectfully submitted to you for consideration on all the facts which have been laid before you.

Dated March 2, 1899.

A subscriber to the Street Railway Journal wishes to purchase about 450 horses.

Annual Reports

ATLANTA CONSOLIDATED STREET RAILWAY COMPANY, ATLANTA, GA.

The report of this company for the year ending Dec. 31, 1898, is as follows:

Receipts from passengers	$404,529
Receipts from other sources	3,868
Total receipts	$408,397
Operating expenses	222,441
Earnings from operation	$185,956
Deductions from Earnings.	
Interest	$108,682
Taxes	10,433
Net income	$66,841
Per cent, operating expenses to total receipts	52.4

Balance Sheet. Dated Dec. 31, 1898.

Assets.		Liabilities.	
Plant	$4,446,380	Capital stock	$2,000,000
Cash	232,623	Funded debt	2,250,000
Material on hand	15,066	Bills audited	14,930
Unearned insurance	715	Suspense	6,800
Bills receivable	758	Pay rolls	10,439
		Dividend	904
		Profit and loss (surplus)	412,468
Total	$4,695,542	Total	$4,695,542

INTERURBAN ROADS.

The following annual reports of five of the leading interurban roads in the country will be of interest:

TWIN CITY RAPID TRANSIT COMPANY, MINNEAPOLIS, MINN.

Year Ending Dec. 31, 1898.

Receipts from passengers	$2,145,093
Receipts from other sources	25,623
Total receipts	2,170,716
Operating expenses	1,019,392
Earnings from operation	$1,151,324
Deductions from Earnings.	
Interest on funded debt, and dividends on preferred stock	$713,454
Taxes	64,214
Net income	$373,656
Per cent, operating expenses to total receipts	46.96

CINCINNATI, NEWPORT & COVINGTON RAILWAY COMPANY, CINCINNATI, OHIO

Year Ending Dec. 31, 1898.

Gross receipts	$681,672
Operating expenses	302,201
Earnings from operation	$379,471
Fixed charges	318,144
Net income	$61,327
Per cent, operating expenses to total receipts	44.3

CLEVELAND, PAINESVILLE & EASTERN RAILROAD COMPANY, CLEVELAND, OHIO

Year Ending Dec. 31, 1898.

Gross receipts	$105,360
Operating expenses	58,880
Earnings from operation	$46,480
Interest	25,000
Net income	$21,480
Per cent, operating expenses to total receipts	55.8

LORAIN & CLEVELAND RAILWAY COMPANY, CLEVELAND, O.

Year Ending Dec. 31, 1898.

Gross receipts	$73,037
Operating expenses	33,665
Earnings from operation	$39,372
Interest	35,000
Net income	$4,372
Per cent, operating expenses to total receipts	46.

AKRON, BEDFORD & CLEVELAND RAILROAD COMPANY, CLEVELAND, OHIO

Year Ending Dec. 31, 1898.

Gross receipts	$96,054
Operating expenses	65,171
Earnings from operation	$30,883
Interest	19,221
Net income	$11,662
Per cent, operating expenses to total receipts	67.8

QUARTERLY REPORT OF BROOKLYN HEIGHTS RAILROAD COMPANY, BROOKLYN, N. Y.

Quarter Ending Dec. 31.

	1897.	1898.
Receipts from passengers	$1,297,346	$1,439,848
Receipts from other sources	66,203	20,558
Total receipts	1,363,549	1,460,406
Operating expenses	766,538	886,579
Earnings from operation	$597,011	$573,827
Fixed charges	569,108	535,002
Net income	$27,903	$38,825

Change in Brooklyn, N. Y.

The Brooklyn Rapid Transit Company has secured control of the Brooklyn Union Elevated Railroad, formerly the Brooklyn Elevated Railroad Company. It is stated that transfers will be given to passengers from the surface cars to the elevated trains, and also that the elevated will be equipped with electricity in the near future. The property of the Brooklyn & Brighton Beach Railroad Company has also been recently purchased by the Brooklyn Rapid Transit Company, and it is reported that the purchase of the Kings County Elevated Railroad will soon be consummated.

Changes on the Manhattan Elevated Railway

It has been officially announced by the directors of the Manhattan Elevated Railway Company, of New York, that the third rail system will be employed when the road is equipped with electricity. In addition to the changes in officers mentioned in the last issue of the Street Railway Journal, L. B. Stillwell has been appointed consulting electrical engineer for the company. Mr. Stillwell has been for about six years in charge of the electrical plant of the Niagara Falls Power Company at Niagara Falls, N. Y.

NEWS OF THE MONTH

The South Bend Street Railway Company, of South Bend, Ind., was fined recently for placing salt upon its tracks to clear them of snow and ice. It is claimed this was in violation of a city ordinance.

A curious accident happened on March 19 on the electric railway at Yarmouth, N. S. In order to clear the tracks of snow and ice two motor cars were started, one immediately behind the other and touching, but not coupled. While proceeding in this way under full power, the bumper of the rear car in some way got under the back bumper of the front car and lifted it. Immediately the front car left the track at an angle on a slight declivity, and rushed at full speed onto the sidewalk and part way into a brick building, tearing away a heavy iron pillar and considerably damaging the contents of the building. There were no passengers on the car at the time.

A bill has been introduced in the Missouri Legislature prohibiting the municipal authorities of cities in that state from granting franchises for constructing street railways along the streets of cities except upon petition of the people owning one-half of the frontage along such streets.

The consummation of the consolidation of all the street railways in Buffalo and vicinity was effected on March 22. A new company, to be known as the International Traction Company, has been formed, and it is stated a new mortgage for $30,000,000 will be issued. J. P. Morgan & Co., of New York city, are the prime movers in the deal. The companies affected by the consolidation are as follows: The Buffalo Railway Company, the Buffalo Traction Company, the Buffalo, Bellevue & Lancaster Railway Company, the Buffalo & Niagara Falls Electric Railway Company, the Buffalo & Lockport Railway Company, the Niagara Falls Park & River Electric Railway Company, the Niagara Falls & Clifton Bridge Company and the Lewiston & Queenstown Heights Bridge Company. It is stated that the Buffalo Railway stock was purchased for $100 per share, the Buffalo & Niagara Falls at $75, and the Buffalo & Lockport at $50.

The Joliet Street Railway Company, of Joliet, Ill., has voluntarily increased the wages of all its employees 10 per cent. The action was taken as the business of the company has rapidly increased and the prospects for the coming year are better than ever before.

One of the best examples of rapid and healthy growth of a street railway system is given in the case of the Milwaukee Electric Railway & Light Company. The management of this property have made their plans on broad lines, and the result is that tracks have either actually been constructed or franchises have been secured for making one of the finest interurban systems in the country, with cars running in and connecting all the prosperous manufacturing towns along the lake between Milwaukee and Chicago.

A large brewing company has recently been incorporated at St. Louis and will immediately proceed to the erection of an extensive brewing plant. Among the schemes included in this new organization is the running of electric refrigerator cars upon the street railway system, thus doing away with heavy hauling wagons.

The employees of the Keokuk Street Railway & Power Company, of Keokuk, Ia., went on strike recently, owing to a new order requiring them to work longer hours at the same rate of pay.

The management of the New York & Queens County Railway Company, of Long Island City, has decided to adopt the service stripe system for its employees. There is some discussion among the men as to whether they prefer stripes on their sleeves or brass buttons to mark the years of service.

On Wednesday evening, March 15, Alexander Wurts, of the Westinghouse Company, delivered a lecture on lightning arresters before the Cleveland Electric Club, at the Electricity Building of the Case School of Applied Science. The lecture being a popular one, the hall was well filled with an appreciative audience. Mr. Wurts spoke of the decadence of the lightning rod as a means of building protection, and said that they were now rarely found except on very old buildings, or on a few very high buildings or towers, like the Capitol at Washington and the Washington Monument. The lecture was illustrated by practical experiments, and showed in detail the steps that led up to the use of non-arcing metal in the construction of lightning arresters, or lightning diverters, as the lecturer said they should more properly be called.

The Cleveland Electric Railway Company has let the contract for a funeral car, which will be rented for $10, and will be run over any line in the city. The car will be divided into two compartments, one for the coffin and the other for the mourners.

The postmaster at Hartford, Conn., has devised a street railway mail box, which will be used experimentally on the lines in that city. The box is strongly made of cast-iron, and is attached to the rear dasher in such a way that letters may be dropped therein whenever the car stops. It is thought that this system, if adopted, will greatly reduce the time of delivery of letters addressed to local points.

The meeting of the Franklin Institute at Philadelphia on March 28 was devoted to the subject of electric railways. The following papers were discussed: "The Multiple Unit System of Electric Railways," presented by Frank J. Sprague; "The Electric Inspection of Street Car Equipments," by Albert B. Herrick; and "Some of the Larger Transportation Problems in Cities," by Edward E. Higgins, editor of the Street Railway Journal.

The Cincinnati & Hamilton Electric Street Railway Company, of Hamilton, Ohio, has published a neat descriptive folder and time table of its lines between Hamilton and College Hill, Cincinnati. The pleasures of a trip over this road are told in an interesting manner, and a number of points of interest along the line are briefly mentioned. The folder contains a number of advertisements of local firms.

In the course of a recent conversation with a prominent supply man, he stated that the water from the Chicago River contained less scale-forming ingredients than any other water he ever saw used for steam boiler purposes.

A curious incident occurred in the final transaction completing the filing of the mortgage of the United Railways & Electric Company, of Baltimore. The mortgage is for $38,000,000, and about $25,000 internal revenue stamps had to be attached to the original copy. The revenue officer at Baltimore was unable to supply the stamps and had to secure an extra supply. The mortgage was printed in pamphlet form, with every other page blank, and the revenue stamps covered half of the blank pages and the margins of half of the printed pages.

The Meadville Traction Company of Meadville, Pa., has just commenced the erection of a large pavilion and summer theater at its Oakwood Park. The pavilion will be 136 ft. x 74 ft., and two stories high. It will have an iron truss roof, arched at the center, with a tower at each corner of the building. Verandas 12 ft. wide will surround the entire building at both stories. The theater will be on the ground floor, and will be 100 ft. x 50 ft. The theater will be tastefully finished with comfortable seats and everything necessary to make it pleasant and attractive. A ballroom 100 ft. x 50 ft. will be built on the second floor, and the ceiling of the theater and floor of the ballroom will be supported by separate sets of joists, so that the progress of a ball will in no way interfere with the play or opera. The balance of the building not occupied by the theater and ballroom will be taken up with offices and reception rooms.

The Brooklyn Heights Railroad Company is considering the advisability of making two rates of fare from the bridge to Coney Island. It is thought that a great many people would prefer to pay ten cents fare and avoid the large crowds going to the beach on pleasant days, and the company is therefore thinking of introducing a ten-cent fare in addition to the five-cent service.

The city officials of Syracuse, N. Y., and the managers of the Syracuse Rapid Transit Railway Company have not been on very good terms of late. The city made a number of demands which the company refused to consider. The Mayor then gave notice that he would enforce every ordinance touching the speed of the cars and their sanitary condition, and would bring into effect many laws which have for a long time been considered dead letters. On the evening of March 26 there was a snowfall of over 6 ins. at Syracuse, and this gave the Mayor an unlooked-for opportunity. The next morning the company had out its snowplows and pushed the snow from the tracks, piling it up along the street beside the tracks to a considerable height. An old ordinance states that snow shall be carted away, and as this was not done the commissioner of public works was ordered to get out his men and shovel the snow back on the tracks. So effectually was this carried out that in less than an hour after the order was issued almost the entire system was tied up.

Street Railway Accountants Association

The next annual convention of this association will be held simultaneously with, and in the same building as the meeting of the American Street Railway Association, at Chicago, Oct 17-20 Papers will be read on the following important subjects: "Car Mileage," "Blanks and Forms," "Materials and Supplies Accounts," "What Does the General Manager Want to Know from the Accounting Department?"

The secretary of the association has recently received the following letter showing that the department of blanks and forms has become a reality and is appreciated. The letter reads: "I am sending you to-day by express the blanks loaned to this company by the department of blanks, and I desire to say I am most gratified as I found among the blanks sent me precisely the ideas for which I had need."

A New Foundry at Schenectady

The great Schenectady (N. Y.) works of the General Electric Company have been constantly expanding from year to year with a steady increase in the company's business, and the pressure upon these shops has been such that hardly had the new extensions been completed before their increased capacity has been reached and it has been proven that the total requirements have again been underestimated. The latest addition to the works is an immense foundry, which was opened for work on Jan. 5 last, after a period of construction extending over about ten months. Large as this foundry is, and however confidently it was expected to fulfill the company's requirements for some years to come, it is, even so soon, worked to nearly its full capacity many days, and the prospects for extensions within a year to come seem good.

As many novel and interesting features have been included in this new building, a somewhat detailed description of it and of its equipment will be of interest to manufacturers and to such street railway companies as are doing their own repair work on a large scale.

The immense main building in which the melting, moulding and pouring are done in undivided space is 140 ft. x 503 ft. Separated from this building is the cleaning room wing, 120 ft. x 103 ft., in which all the cleaning and drying of castings is done. By having this cleaning done away from the main foundry, the possibility that flying chips and dust may reach the moulds and interfere with perfect castings is avoided. Exhaust rumblers are provided for carrying all dust outside the buildings, and there are complete arrangements for opening windows and ventilators in the monitor so as to thoroughly clear out the atmosphere. The result is that there is very little of the characteristic "foundry smell" in the building. Also attached to the main building is a large lean-to 38½ ft. x 243 ft., and a small lean-to 11ft. x 152 ft. The height of the side walls is nearly 24 ft. and of the main gables 58 ft. The entire structure contains 3,250,000 cu. ft. of air space.

The most prominent characteristic of the foundry is the magnificent light obtained in all sections through the large area of skylight surface, namely, 23,336 sq. ft. It was determined to depart from the usual practice of dark and dingy foundries and to avoid the use of artificial light as much as possible. The skylights are composed of glass mounted around wire netting in such a way as to make breakage difficult, and the dropping of glass from the netting, even in case of breakage, practically impossible. The glass is also lightly ribbed to secure better diffusion of light. For artificial lighting, one arc light is provided for every 2600 ft. of floor space, and this makes good night work entirely possible.

The transportation facilities within the building are unusually perfect. Tracks are laid through the main and many of the side aisles, and tram cars can pass to almost any part of the floor, conveying supplies of all kinds, such as sand, coke, pig iron, scrap iron and the smaller castings. Two immense electric cranes span the center aisle, and five others operate in the building, while eventually there will be six jib cranes put in position for local work, and portable jib cranes will also be used.

The equipment of the foundry consists of the following apparatus:

Three Calliau cupolas of 18, 11 and 7 tons melting capacity per hour, respectively.

Seven ladles of 15, 10, 6, 4, 3½, 2, 1½ tons capacity, respectively

One Root blower, capacity 660,000 cu. ft. of air per hour at 95 r.p.m.

Nine exhaust rumblers.

One Buffalo Forge Company heating fan, blast wheel (steam coils 27,500 sq. ft. surface), 14 ft. diameter x 6 ft. wide.

One Buffalo Forge Company heating fan, blast wheel 14 ft. diameter x 7 ft. wide.

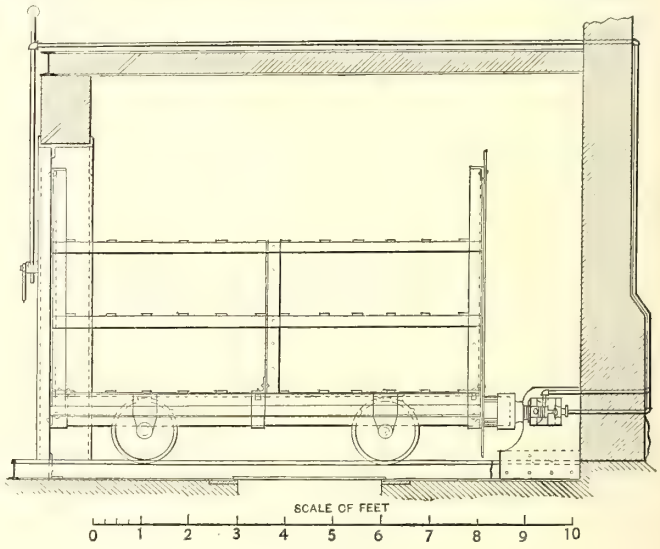
One 2200 lbs. hydraulic elevator.
One Sellers sand mixer.
One 10-ton Fairbanks' scales.
One 40-ton Morgan crane, 65 ft. span.
One 10-ton Morgan crane, 65 ft. span.
One 10-ton Morgan crane, 47 ft. 2 ins. span.
One 7-ton Box crane, 32 ft. span.
Three 5-ton Box cranes, 32 ft. span.
Three 5-ton jib cranes, 21 ft. swing.

ELECTRIC MOTORS

One 60 h.p. for cupola blower.
Two 35 h.p. for heating fans.
One 50-h.p. for rumblers and wheels.
One 7 h.p. for cupola rumbler.
One 7 h.p. for flask making.
One 3 h.p. I. B. for sand mixer.
One C. P. 10, for air compressor.
One G. E. 51, for 40-ton crane.
Two G. E. 52, for 40-ton crane.
One 5 h.p. I. B. for 40-ton crane.
Two G. E. 52, for 10-ton cranes.
One 5 h.p. I. B. for 10-ton cranes.
Four L. W. P. 5, for 5-ton and 7-ton cranes.
Four 3 h.p. I. B. for 5-ton and 7-ton cranes.
Three L. W. P. 5, for jib cranes
One 5 h.p. I. B. for coke conveyor.

The loading floor of the cupolas in the cupola room is large enough to make room for an ample quantity of coke, pig and scrap iron, which is brought from the yards, weighed on the lower floor and conveyed to the loading floor by an elevator. All the small work done in the foundry is carried around in cupolas, the object being to avoid the necessity of carrying small ladles by hand for any great distance. The larger ladles are conveyed by electric cranes to the more distant portions of the shop.

The core ovens of the foundry are unique in that through special



CORE OVEN

methods, their capacity is hardly one-quarter that ordinarily required for a foundry of this size. The ovens are kept at the baking temperature day and night, and the process of baking can be carried on at all hours instead of, as usual, at night. This is accomplished as follows: There are four large doorways to the core ovens. Through these pass tracks which end outside a few feet away from the oven. Over these tracks passes a car containing shelves or racks, on which the cores are placed ready for baking. This car terminates at each end in a large door which completely fills the opening in the core oven so that when the car is inside the oven, one of its ends closes the opening, and one is outside the other end. In this way the only chance for the escape of the hot air of the oven is in the short time when the car is passing in and out. These cars are worked by compressed air and the operation of moving in and out is very rapidly accomplished.

The foreman's office is elevated and is so located as to command the entire floor of the main building, so that the entire operations of the foundry are in plain sight. There are extensive lavatories in one of the wings of the foundry, provided with shower baths, basins and wire lockers, one for each workman. Altogether, this is one of the most complete and perfectly appointed foundries in existence to-day.

The structural iron for this foundry was supplied by the Hilton Bridge Construction Company, of Albany, N. Y.

Report of the Glasgow Corporation Tramways

The following report on the proposed power station and methods of distributing electrical energy was submitted under date of Feb. 28, 1899, by H. F. Parshall to the sub-committee on traction and works of the Glasgow Corporation tramways committee

REPORT.

Complying with your request of Feb. 6, I have studied the conditions under which the Glasgow tramways have to be worked, and beg to submit the following report as to the most efficient and economical method of generating and distributing electricity for the overhead trolley system of electric traction:

1. Increase of Traffic with Electric Traction.—You are at present working in Glasgow 380 cars by horse and 27 by electric traction. Having reference to your proposed extensions and the usual growth accompanying the conversion of horse traction systems into electric traction systems, 600 cars may be taken as a reasonable number to provide for in your generating and distributing arrangements. In fixing upon 600 cars as a basis, it might be well that I should emphasize the fact that such an increase in the number of cars is not unusual, and that the above contemplated service is not excessive. In the city of Boston, U. S. A., which is of somewhat less population and of not greater area than the city of Glasgow, double this number of cars is being operated at a profit. It would be a short-sighted policy to install a system of generation and distribution which did not provide for such a growth as has been found usual, for, when the traffic has grown beyond the capacity of the plant originally installed, it is commonly found that provisions for an increased supply of water cannot be made except by an expenditure greatly beyond that which would have been originally required had the first arrangements been adequate.

2. Capacity of Generating Plant.—The consumption of power per car mile varies in different cities with the conditions of the permanent way, frequency of stops, gradients, etc. In your city the track construction adopted is admirably suited for electric traction, since the rails are of the best possible cross section, and of ample weight. The policy of charging low fares which you have adopted increases the number of passengers carried per car mile, as well as the number of stops, the result being that the amount of power which would be consumed in Glasgow is greater than that which is consumed in many other cities.

From actual measurements taken on your present electric traction works, I find your average consumption of power at the car is 7.2 kw., or 9.65 h.p. I have gone over the other lines in the city, and, having considered your traffic arrangements, have concluded that the above figure is a fair one to take for the whole system in general.

Taking, therefore, 600 cars as the number to be reckoned upon, the amount of power to be delivered to the car for average working conditions is, approximately, 5800 h.p. In traction systems the ratio of the average to the maximum load varies greatly at different hours of the day, on account of the stops for passengers and the number of passengers carried, also on different days according to the weather and other conditions. I have before me the load curve of a number of cities, and from these, as well as from your own experience, conclude that 60 per cent should be added to the average working load to provide for the maximum load that would occur under normal working conditions in Glasgow. This means that the capacity of your machinery must be such as to deliver 9250 h.p. to the cars, or, allowing for loss in transmission and distribution, approximately, 11,500 electrical h.p. must be generated as a maximum working load at the power station. Taking 85 per cent as the ratio of electrical h.p. at the bus bars to the indicated h.p. of the engine, the engine capacity for the maximum working load would amount to, approximately, 13,500 h.p. Allowing a safe margin for spare plant, an aggregate of 17,000 indicated h.p. will be required in the generating station.

3. Conditions of Electrical Distribution.—Having determined the amount of power required for working the tramway system, it remains to be decided, having regard to the distribution of cars and frequency of service, whether the supply of energy to the cars can be more efficiently controlled and economically supplied from one central point or from several points. I have come to the conclusion that, in order to meet the conditions obtaining in Glasgow, you would require several centers of distribution, for the following reasons: 1. The distances to which energy has to be conveyed are so great and varied as to preclude an economical supply of 500 volts. 2. The maintenance of your own property in gas and water mains, and the conditions to be complied with in regard to difference of potential on the rails specified by the Board of Trade, would entail in the case of a single center of distribution an elaborate and complicated return system, involving great outlay in cables and machinery, which would necessarily require subdivision into several comparatively small units in order to meet the varied conditions and the distances to which the cables would need to be carried.

The importance of this point—that is, as to the working of the earth circuits under safe conditions—will be apparent when it is considered that in many American cities incalculable damage has been done to gas and water pipes owing to electrolysis, which is brought about by the current straying from the rails. The amount of current that would be returned through your rails in Glasgow to a central point would be sufficient to eat away 50 tons of iron per annum from the pipes, which is a sufficient demonstration that the earth return is a point of primary consideration, if not the primary factor, in determining the nature of your distributing system. This becomes more evident when we consider that the maximum voltage drop allowed by the Board of Trade is 7 volts, and that in some of the central streets in Glasgow, with the increased traffic contemplated, the drop would amount to 15 volts per mile, or double that which is allowed by the Board of Trade. Practice has demonstrated that, under such conditions as those existing in Glasgow, a maximum voltage drop of not more than one-half of that permitted by the Board of Trade, namely, 3½ volts, is all that should be entertained. In other words, having reference to the safe conditions to be maintained in the track and return, in many cases in Glasgow the current should not be taken for more than half a mile from any point of distribution. Being satisfied that more than one center of distribution is an economical necessity, I find, upon further investigation into the distribution of cars throughout the system, that your present requirements can be fulfilled from five centers of distribution.

4. High-Tension Generating Station, with Sub-Stations, vs. Several 500-Volt Generating Stations.—Having determined the probable increase in traffic, the amount of power necessary to meet the demand, and that at least five centers of distribution are necessary, it remains to decide whether the energy can be the more economically supplied from a single station generating polyphase currents at high voltage, to be transformed into continuous currents at 500 volts in a number of sub-stations, or from the same number of generating stations, suitably located, and generating continuous currents at 500 volts. I have no hesitation in advising that, under the circumstances, the first, viz., the three-phase high-tension generating station, with sub-stations, is the more advantageous from every point of view.

The following is a summary of the advantages of the three-phase system over the other:

(*a*) Less capital expenditure in buildings, generating plant, and in real estate investments.

On the one hand, you have to provide a site for a generating station, in the choice of which there is a considerable latitude, inasmuch as there are several sites available at such a distance from the center of Glasgow that the power can be economically transmitted at moderate cost in transmitting mains, and where you will be able to obtain the advantages of good coal delivery by more than one railway system, and also to provide for extensions. Another consideration of importance is that the sites now used as car sheds and stables are suitably located for sub-stations. No alterations would be required in the existing buildings, and the transforming apparatus would only occupy a small portion of that at present available.

On the other hand, the separate generating stations scheme would involve the purchase of four or five sites, the choice of which would be limited, if fixed with due regard to the proper working of the tramway system and suitable railway sidings for coal supply.

(*b*) The three-phase system has the advantage of less working cost and repairs. On the one hand, there is a skilled staff at the generating station, together with the unskilled labor at the several sub-stations. On the other hand, there is a skilled staff at each of the generating stations, which are equal in number to the sub-stations. It has been conclusively shown at Niagara, Dublin, Middlesboro, and other places, which have now been working a sufficient length of time so that reliable conclusions can be drawn, that rotary converters require less attention than ordinary 500-volt railway generators, and that no skilled labor is required.

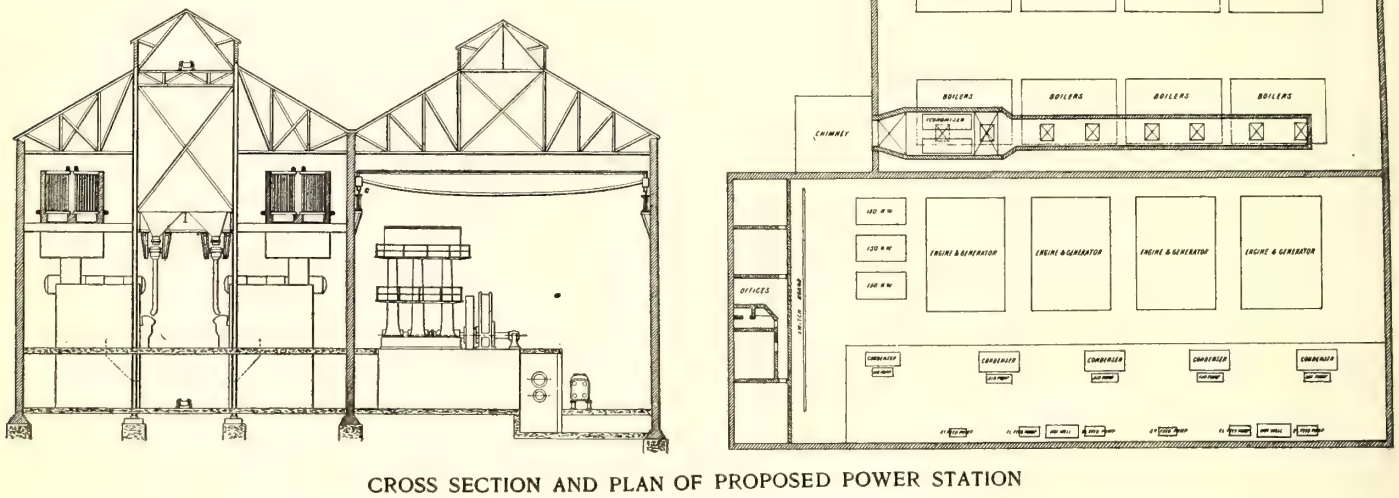
There will also be a saving in supplies and repairs, owing to the use of a few large steam generating units instead of numerous smaller ones. The concentration in load also effects a saving in fuel and water. Also better facilities as to coal-handling arrangements can be afforded in a single large station than in several smaller ones. I have made a careful comparison between the two

systems, both as regards fixed charges and working costs, and append the statement to this report.

(*c*) The three-phase system has greater flexibility, and is better adapted to the requirements of future extensions. Should your lines extend further in any direction into the country, sub-stations can be installed at any convenient point or points. These sub-stations do not require special buildings; and to show the small space occupied, I may say that the 2500-h.p. stations of the Central London Railway are contained in two vertical cylinders, each 22 ft. in diameter and 100 ft. below the surface of the ground.

(*d*) In considering the transition from horse to electric traction the question of time is of great importance. The single generating station which I have recommended can be installed and put in working order more quickly than several stations. The loss through delay can be estimated upon the basis of your present working. The cost for horse traction is 3½d. per mile, on a mileage of 9,000,000 per annum; taking the working cost for electric traction on the same basis as to maintenance, etc., the saving, assuming no increase in traffic, amounts to £112,000 per annum.

In addition to the above, in installing a multiphase station you would be following the very latest and most approved practice, and you would have a type of plant that would be less likely to be superseded than a 500-volt type of apparatus, and which would have to be installed in several minor steam generating stations. This is clearly demonstrated by the experience gained in New York, Chicago and Brooklyn, where under the original arrangements the area was served by several small stations. It has been found that these small stations can be worked with greater economy by multiphase currents transmitted from a single generating station. I have before me the works cost of some of these installations, and there can be no doubt as to the economy gained.



CROSS SECTION AND PLAN OF PROPOSED POWER STATION

5. Recommendations as to the Nature and Arrangement of Plant in Generating Station.—In the event of my recommendations as to a single generating station being adopted, the following further recommendations as to the arrangement of the plant may be of use: For your traction purposes there would be consumed in Glasgow, approximately, 26,000,000 of Board of Trade units per year, or, approximately, four times as much as that generated by the largest lighting company in London. Owing to the small ratio between the average and maximum load—that is, to the load factor common to traction systems—this amount of electricity would be generated in a plant of nominal capacity of not more than one-third at which it could be generated in a lighting station, owing to the machinery working at its full capacity for many hours per day. In Glasgow you would be working the cars, approximately, sixteen hours per day, at full service, and four or five hours per day additional at one-third service. This distribution of load for so many hours per day would be very satisfactory, in that your generating station could be designed with but few units working at the best economy during all hours in the day. I find that four generating sets would give the best result—three of these to be worked during normal conditions of load, and the fourth unit to provide for abnormal conditions and emergencies.

With regard to the engines, I would recommend the use of three-crank tandem compound engines, provided with massive fly-wheels so as to give a uniform turning moment, and to provide the maximum effort for fluctuations of load. In order to obtain the best results these engines should not work beyond 75 r.p.m., and should be specially constructed, having in view the nature of the load and the conditions peculiar to an electric traction system.

The engines should be direct connected to tri-phase generators of the fly-wheel type, with rotating magnets and stationary armatures. Machines of this type have been constructed, with entirely satisfactory results, for as high a working pressure as 13,000 volts. Having reference, however, to the comparatively short distance of transmission, and the small investment in copper required, 6500 volts is a satisfactory working pressure, all conditions considered, and the calculations as to the cost of the three-phase machinery and transformers are made up on this supposition.

The station should be provided with a coal conveyor, so that the coal would be automatically conveyed from the railway trucks, or other means of transport, and distributed to different boilers, or stored in bunkers.

The station should be designed with electrically-driven auxiliaries throughout, thereby securing the greatest possible economy. The switching arrangements in the generating station would be comparatively simple, owing to the small number of generating units, and to the feeders being comparatively few in number, depending on the number of the sub-stations.

These suggestions are embodied in a plan and elevation annexed hereto.

The method of distributing the energy from a single station need not occupy much space in this report. The method you have already adopted in Glasgow, namely, of drawing your cables into ducts with manholes approximately 100 yds. apart, represents the best practice in electric traction. You will find that at a density of from 400 to 600 amps. per square inch, according to the distance, high-tension cables can be run through the same set of ducts, but where they enter the same manhole, the manhole should be of ample size, so that the high-tension cables could be carried on one side, and clear the low-tension cables.

6. Comparison of Lighting and Tramway Plants.—In reporting upon the generation of power for the tramway department, it is scarcely possible to avoid reference to the question of joint supply of electricity for the two purposes of traction and lighting. I find that on a large scale the two systems can be kept separate with advantage, owing to a difference in the nature of the plant and in the supply of power. The following are points which militate against a joint supply from lighting stations:

(*a*) On many days in the year the maximum load in lighting, and that in traction, occur at the same time, so that the same maximum total capacity in plant has to be provided, whether or not the supply is from a common station.

(*b*) Owing to the difference in the nature of the loads, the capital cost for a given watt-hour production is three or four times as great for lighting as it is for traction. In other words, the traction plant is worked at its greatest capacity three or four times as many hours in the year as the lighting plant; consequently it can be of a more substantial type with advantage.

(*c*) The machinery of a different type is commonly used for lighting, and the switching appliances are absolutely different. In the Glasgow lighting stations numerous small high-speed engines are in use; such engines are unsuited for the generation of current for your electric traction purposes. I have yet to find the engineer of extended experience in dealing with traction matters who

would propose the use of high-speed engines for such loads as you have to consider in Glasgow for electric traction.

(*d*) The electrical arrangements for electric lighting are necessarily much more complicated and elaborate than is the case for electric traction. Electric lighting has to be carried on with reference to the delicacy of the human retina; in other words, the voltage at the point of consumption has to be regulated to a nicety. In electric traction the same conditions do not obtain, since uniform acceleration and speed of the car can be obtained to the satisfaction of the passenger within a much greater range of voltage.

(*e*) From a business point of view the different conditions in electric supply are sufficiently shown by the difference in cost of energy between electric traction and electric lighting. The cost of energy for electric traction, owing to its better load factor, would not be more than 25 per cent of that for lighting. The present cost of electric lighting in Glasgow is 1.26d. per Board of Trade unit, which compares favorably with that of lighting for other cities. This figure is 4.8 times as high as would be expected in the traction service outlined. When you consider that in Edinburgh, according to published accounts, current is generated cheaper than in any other city in the United Kingdom, and when even the cost is 2.95 times that which I predict for your traction system, the difference in the nature of the load is apparent.

(*f*) It has been suggested that economy in staff will be gained in a joint station. This does not apply provided the tramway business is attended to as a business by itself. In the station which I have outlined this staff will, as I have said, be regularly employed during sixteen hours of the day at practically full load, and for five more hours at one-third load, so that the staff would be fully occupied during the hours of working. Owing to the difference in the nature of load, a different class of attendants would be required for the two classes of work.

7. Combined Stations Elsewhere.—A combined station for lighting and traction was the subject of consideration by the Bristol Tramways and Carriage Company, Limited, and by the Corporation of Sheffield. I was asked to report on the former installation, and found that there would be direct disadvantages in such a joint supply. This report subsequently received the indorsement of Lord Kelvin and the late Dr. John Hopkinson. The general absence of such combined stations sufficiently indicates that they are not in demand, as does also the fact that plant of a type now commonly used for lighting, which was originally installed for traction purposes, has been superseded by slow-speed machinery. There are two prominent examples of such plant which have been from time to time discussed, viz., the one at Toledo, Ohio, U. S. A., and the other at Hamburg. The former makes use of the slow-speed engines of a type suitable for electric traction. To the main shaft of these engines are coupled direct connected railway generators. The fly-wheels of these machines are connected by a rope-drive to countershafts, from which are driven several different types of machines, principally alternators and arc-lighting machines. The station is exceptional in character, wasteful in floor space, and employs a method of driving lighting machines which has been generally superseded in England, and could not be followed out except by mechanical arrangements which are necessarily wasteful and objectionable. The station originally worked in Hamburg has been the subject of frequent comment. This station did supply current for both lighting and traction. The plant, however, was of a type specially suitable for electric traction, and liberal use was made of storage batteries. This station has now been replaced by two stations, one supplying the energy for the electric tramways, and the other the energy for the electric lighting. It will therefore be seen that the installations above referred to cannot be considered as suitable examples to be followed by Glasgow. The established practice the world over for such large installations as you are considering is to separate the traction generating station from the lighting station.

8. Conclusion.—The conclusion arrived at in this report may be summarized as follows: Having regard to the nature of your tramway system as a whole, a single generating station, with high-tension multiphase transmission to sub-stations located in some of your existing car sheds and stables, will be found the most economical to work, involving less capital outlay, taking less time to install, lending itself to compliance with the Board of Trade requirements and to the safety of your property in gas and water mains, and being of a type least likely to be superseded when further demands are made, either as an increase in the area to be served or increase of traffic over the existing system. In following my recommendations your tramway system will be equipped with an installation of the highest class, and will not be handicapped by an attempt to make use of plant or arrangements that are either obsolete or unsuited for the economical working of your system of electric tramways.

HORACE FIELD PARSHALL.

COMPARISON OF THE COST OF CONSTRUCTION, INCLUDING BUILDINGS AND PLANT, BETWEEN A THREE-PHASE GENERATING STATION, WITH CONVERTING SUB-STATIONS, AND A SYSTEM OF SEVERAL GENERATING STATIONS.

(*a*) Cost of construction of a three-phase generating station containing four 2500 kw. units, including buildings and plant, together with plant for sub-stations located in existing car barns and stables, and including high-tension cables.

Generating station building, including excavation, foundations, steel work and brick work, foundations for engines, chimney stacks, including excavation, foundation, steel construction work, and brick lining..	£45,000	
Generating station equipment, including steam units, boilers, coal conveyors, steam mains, condensers, pumps and electrical plant, including delivery and erection.....	180,000	
Sub-stations—Cost of equipment complete of five rotary converters sub-stations, including supply, delivery and erection of rotary converters, transformers, switchboards and auxiliaries	70,000	
Three-core high-tension cables for transmission, at 6500 volts.....	21,000	
Total		£316,000

(*b*) Cost of construction for five generating stations of approximately 2000 kw. capacity, each consisting of four 500-kw. railway units.

Buildings, including excavation, foundations, steel work, brick work, foundations for engines, chimney stacks, including excavations, foundations, steel construction work, and brick lining—at £30,000 each.....	£150,000	
Generating station equipment, including steam units, boilers and conveyors, steam mains, condensers, pumps, electrical plant and auxiliaries—at £48,000 per station....	240,000	
Total		£390,000

Note.—This comparison is exclusive of the cost of ground and railway connections, which, if included, would bring out a result much more favorable to the single generating station.

COMPARATIVE STATEMENT OF COST, IN PENCE, PER KW.-HOUR, DELIVERED TO CARS ON THE BASIS OF 600 CARS RUNNING FOR SIXTEEN HOURS PER DAY, WITH 200 OF THESE RUNNING BETWEEN FOUR AND FIVE HOURS ADDITIONAL PER DAY, TAKING AN AVERAGE OF 7.2 KW. PER CAR.

(*a*) A three-phase generating station containing four 2500 kw. units, with transmission at 6500 volts, and five sub-stations containing 500-kw. and 800-kw. units, and located in present car depots.

Power Expenses.	Generating Station. D.	Sub-Station. D.	Generating and Sub-Stations. D.
Coal delivery and handling.....	0.1240	—	0.1240
Water, at 4d. per 1000 gals.....	0.0082	—	0.0082
Oil, waste and supplies.....	0.0088	0.0053	0.0141
Labor	0.0500	0.0360	0.0860
Total power expenses.....	0.1910	0.0413	0.2323
Maintenance	0.0257	0.0028	0.0285
Fixed Charges.			
Depreciation, interest, insurance, rates and taxes.....	02081	0.0616	0.2697
Totals	0.4248	0.1057	0.5305

To the above figures must be added the cost of maintenance, depreciation, and interest upon the high-tension cables for connecting the generating station to the sub-stations, amounting to 0.019. This makes the total cost of the three-phase scheme 0.5495.

(*b*) Five generating stations containing 500-volt railway generating plant.

Power Expenses.	D.
Coal, delivery and handling.....	0.1550
Water, at 4d. per 1000 gals.....	0.0103
Oil, waste and supplies.....	0.0110
Labor	0.2000
Total power expenses.....	0.3763

Maintenance	0.0350
Fixed Charges.	
Depreciation, interest, insurance, rates and taxes	0.3254
Total	0.7367

Note.—The above figures do not include interest on the cost of sites and railway connections.

The difference as between .5495d. for the single multiphase station and .7367d. for the five 500-volt stations, based on 600 cars, amounts to £20,280 per annum as the saving in working costs in favor of the single multiphase station.

REPORT OF SUB-COMMITTEE

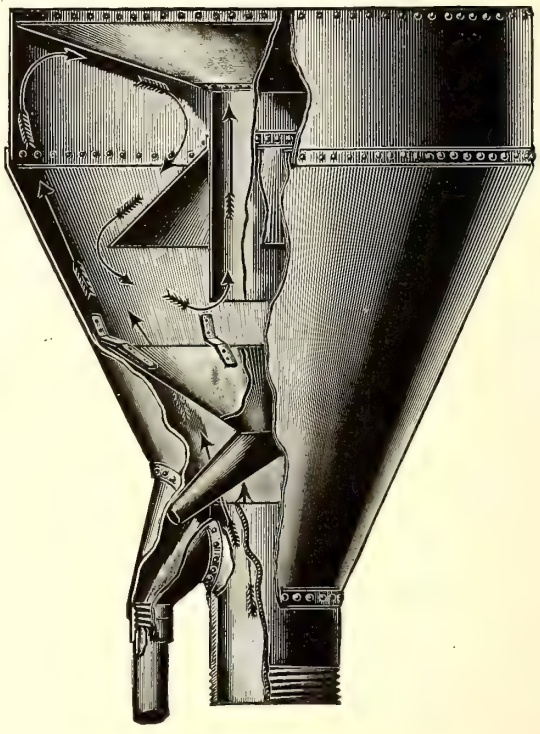
The sub-committee of the tramways committee on the generating and distributing of electric power for tramway traction drew up the following report on Mr. Parshall's recommendation, and the tramways committee, at a meeting held the same afternoon, unanimously approved of it.

The sub-committee's report was as follows: From our study of the report, and of the subject generally, we believe the advice given is sound from the economic as well as from the engineering point of view, and it clearly points to the tramways committee generating, distributing, and controlling their own power, and we think that, in view of the information contained in the report, it is scarcely necessary for us to report at any great length. We are quite convinced that the power will be produced cheaper by having one generating station for the tramways at, say 6500 volts, with district sub-stations in our present tramway depots, as suggested, each of which would form a distributing center, than by having separate installations of plant at several power stations generating current at 500 volts. We think it is also established that, for the tramway system of the near future, which will extend, at numerous points, to a considerable distance beyond the city limits, a high-tension station with sub-stations, as suggested, will be most efficient, and will best fulfill the requirements of the Board of Trade, and avoid electrolysis of the water and gas pipes. We have also before us the important fact that the maximum loads for lighting and traction occur at the same time. From the information now before us, it is evident that for the most economical as well as best mechanical results, entirely separate and different machinery is required for traction and for lighting purposes respectively. It also seems obvious that the undertaking which each of the departments in question has before it at present is sufficiently large of itself to admit of the adoption of the most economical generating units and the production of current at the lowest possible cost. That the electricity committee could supply current for the tramways need not be questioned, but so far as we know they do not claim that they will be able to supply it either better or cheaper than the tramways committee could produce for themselves. They could only produce it as cheaply as the tramways committee by putting down special traction machinery for the purpose, and in that case, in order to arrive at the exact cost, the power for traction would require to be produced and accounted for as a separate undertaking, just as if the tramways committee were producing it for themselves. It is clear that the supplying of power for the tramways by the electricity committee could be of no possible benefit to them unless they were to do so at a profit, which is quite inadmissible. After the fullest consideration of the whole circumstances of the case, our conclusion is that to have the power stations for lighting and traction combined would be of no benefit to either committee, but that, on the other hand, any such arrangement would be a great disadvantage to the tramways department. As pointed out in Mr. Parshall's report, with a continuous traction load for over twenty hours out of the twenty-four, as against only a few hours' continuous lighting load, the tramways committee can take about four times the work out of their plant that can be taken out of the same amount of plant for lighting. In addition to what has already been suggested, this gives the tramways committee another distinct economic advantage in putting down their own plant and producing and distributing their own current on the lines indicated. A still greater advantage is clearly obvious in the matter of administration. The responsibility for the operating of the tramway system should undoubtedly carry with it the control of the power, which is the mainspring of the whole concern. Whoever controls the power controls the tramways. The tramways department, being a commercial undertaking, has always been self-contained, and, in our opinion, should remain so. The tramways committee have supplied the horse power. They have also supplied the electric power for the sectional demonstration. Now they are in a position to begin generating their electric current for the whole system on the best known principle, and with the most up-to-date machinery for this special purpose. Keeping in view the magnitude of the operations confronting both committees, we can see no benefit whatever to be gained, but quite the reverse, by any combined arrangement, which would mean two separate committees being engaged in carrying out the powers of the Tramway acts, one committee supplying the power and another working the tramways. Any such dual control should, in our opinion, be avoided. We have, therefore, pleasure in recommending that the tramways committee, who are responsible to the corporation for the efficient working of the corporation tramways, be still entrusted with the supplying and distributing of their own power for electric traction, and that it be remitted to that committee to proceed to convert the tramways and arrange for the supply and distribution of power on the general lines indicated by Mr. Parshall.

The report was later adopted by the Glasgow Corporation by a vote of 56 to 4.

Exhaust Heads for Power Plants

Marlin & Co. of Pittsburgh are making some of the largest exhaust heads ever installed in this country. All of the heads manufactured by this company are of the best galvanized steel, thoroughly riveted and soldered, and in their operation are as follows: The exhaust steam in rising passes by a conical shaped drip pan,



EXHAUST HEAD

then passes near the outside of the head, and finally into the atmosphere through a central outlet. In its passage a considerable part of it is condensed, the water from condensation being all led off through a drip. The head is built on a piece of welded steam pipe, which extends inside far enough to form a channel that connects with the drip. The diaphragms for presenting a large condensation surface are held in position by heavy wrought-iron braces. The drip is so arranged that it cannot become clogged or frozen. It separates the water and oil from the steam, and exhausts the dry steam, thereby avoiding damage to neighboring walls and roofs. It is claimed that these exhaust heads cause no back pressure on the engine, and are noiseless in their operation.

Interesting Electrical Publication

The March issue of the Electrical Engineer and Telephone Magazine, a paper published in Chicago in the interests of electrical and telephone engineering, contains a number of articles of special interest. Among these are "The Drake Selector System," by Thomas C. Drake; "The Algebra of Electricity," "The Inspector and the Trouble Man," by the Inspector; "A Trip to the Pole Country," and a "Digest of the Telephone and Kindred Patents," by Edward E. Clement.

The Harrisburg Standard Self Oiling Engine

The Harrisburg Foundry & Machine Works, of Harrisburg, Pa., after long experience in steam engineering, have designed a system of engines now known as the "Standard" or "Harrisburg Standard," which they believe will meet all possible requirements for high, medium and slow speed engines up to units of 3000 h.p. The name of the Harrisburg Foundry & Machine Works has long been a familiar one to steam users, through their engines known as the "Ide" and "Ideal." More recently, the "Harrisburg Standard" has been evolved from the experience had with the other engines, embracing the good points of the others.

The "Harrisburg Standard System of Engines" include simple engines, and tandem compounds with single valves; and simple tandem and cross compound engines with four valves, medium and slow speed, the latter of the "Corliss" rocker type. The accompanying engravings illustrate in turn these new machines, commencing with the Harrisburg Standard simple valve engine. A peculiar feature of the new engine is that they are all constructed with side cranks, requiring only two main bearings, whether designed for direct coupled or belted service, and thus many of the disturbing elements, such as excessive friction from bad alignment, that attend the operation of three or four bearing engines, are removed, the friction in these engines being in many cases as low as 2 per cent.

The simple engine is made up to 36 ins. diameter and stroke, and, as will be noted in the accompanying illustration, Fig. 1, is compact and graceful in design and its high efficiency is due to a combination of features, none of which are experimental, however. These salient features include, in addition to the above, an automatic oiling device, by which the crank disc, connecting rod and cross head are enclosed, the latter provided with a hinged hood which may be turned back, and a plate on the side, which may be easily removed for inspection, and adjustment of reciprocating parts, as shown in Fig. 2. This arrangement of hood makes removal unnecessary as all adhering oil drains back into the engine frame. By the revolution of the disc in the oil, the rim of which touches its surface, it is splashed over the wearing parts, including the cross-head, and by means of a lateral trough across the inside of the cover a large portion of the oil is led through a pipe and directed in a stream upon the main bearing adjoining the crank disc. The lubrication of the crank pin is accomplished in a very ingenious manner, by means of an eccentric annular chamber, recessed in the face of the disc around the main shaft next to the main bearing, from which a diagonal hole is drilled through the disc, coming out about the middle of the surface of the crank pin, so that by centrifugal force instead of by the too uncertain force of gravity, a constant volume of oil is provided for its lubrication, completing the circulation from reservoir to crosshead, main bearing, crank pin, and finally draining to reservoir again.

The patented governing mechanism is also a special feature of these engines. It is of the fly-wheel, technically termed, centrally balanced, centrifugal-inertia type, and is claimed to be sensitive to regulate to 0.5 per cent in load variations from zero to 125 per cent. Roller bearings are provided in the governor bearings and the principal mechanism consists of two balance levers, which are connected to an eccentric sleeve which surrounds the shaft, and which is pivoted at one side, so controlling the throw of the eccentric rod to a nicety.

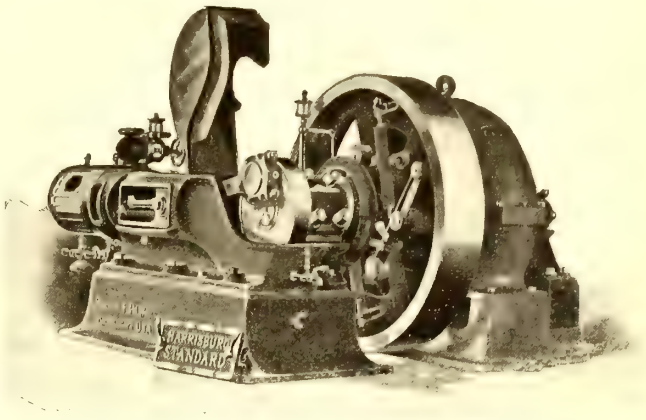


FIG. 2.—VIEW OF ENGINE, SHOWING OILING DEVICE

The pillow blocks for the crank shaft have the cover fitted in a diagonal position, and the shell is provided with an oil chamber with recesses for the oiling chains. The engine frame is extended with stuffing box exposed in such positions as to provide for constant use and easy access, and prevents the water of condensation from getting into the oil supply, should a leak occur. The oil is prevented by a guard from getting on the piston rod. In the process of manufacture, the pistons, piston-valves, pins and other parts are all ground to an accurate fit, and micrometer records made of each piece, so that any part of an engine can be duplicated

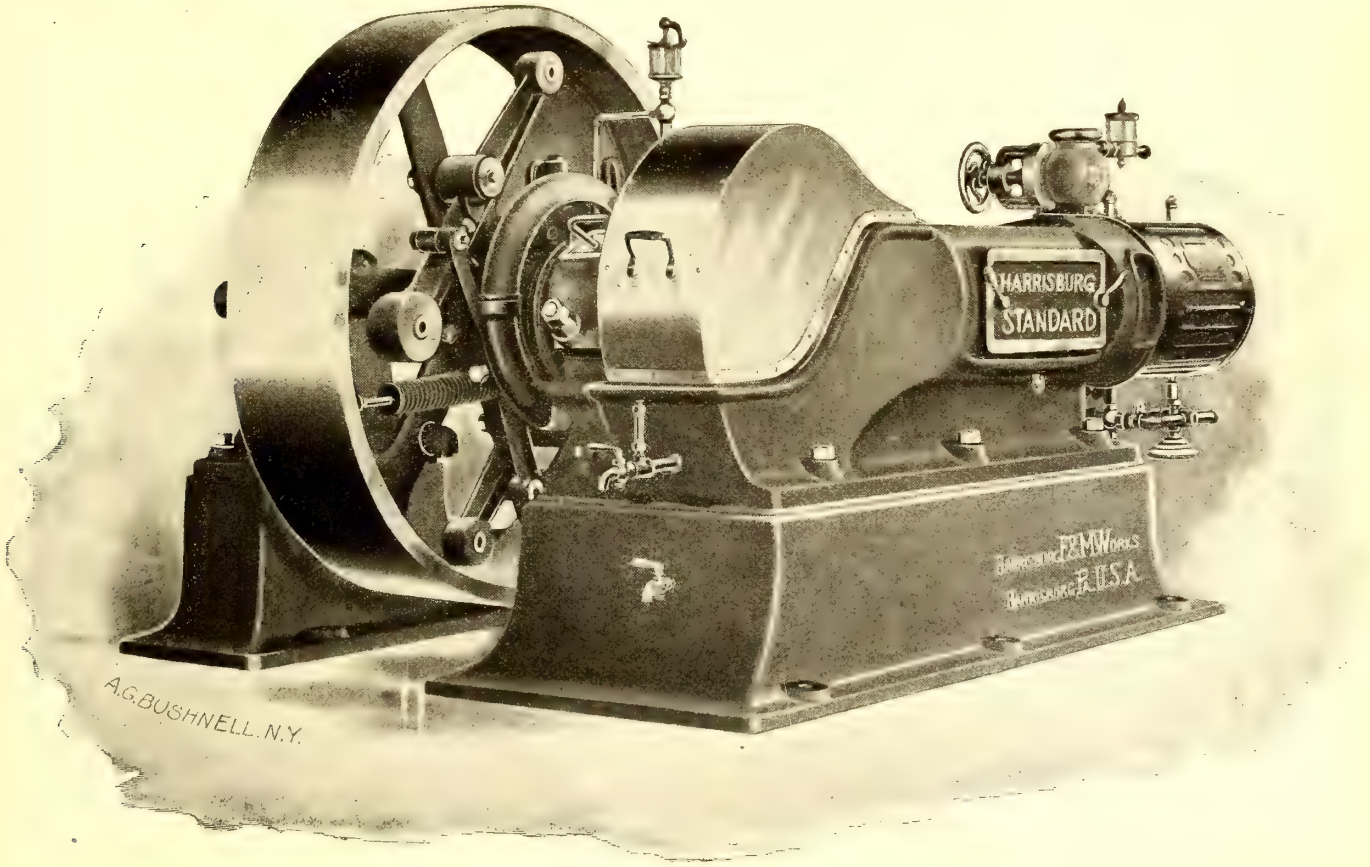


FIG. 1.—VIEW OF SIMPLE STANDARD ENGINE

at any time after it leaves the works. The crank disc, including the pin, is cast in one solid piece of steel, the mould being placed in a horizontal position, with the pin down, producing a dense metal in the pin. This is afterward turned and properly fitted, when the disc is shrunk on the shaft and keyed in position.

Every engine is thoroughly tested before it is shipped, and for this purpose metal bed plates on heavy masonry are provided with suitable channels for clamping them in place. When in position for testing, the engine bed is supported on metallic points, and the machine is first run for adjusting the governing and valve mechanism. Next, the fly-wheel is accurately corrected to a running balance, and finally each engine is so perfected that it is run upon the metallic points without fastening. Very accurate and elaborate tests are made to perfect the governing mechanism of each engine, and when the machines leave the shop, a guarantee can be given as to their exact performance.

It is a principle in these works never to turn out a second grade article, and the general workmanship, material and construction of the new engines are all up to the highest standard.

Although the "Harrisburg Standard Engine" was designed but a year ago, there are already in operation nearly a hundred of these machines, with orders for thirty more in the shop.

The Harrisburg Foundry & Machine Works also manufacture road-rollers to a considerable extent, and also tubular boilers, and in order to meet the growing demands of their trade, are erecting extensive shops at West Harrisburg, for which the walls and stack are nearly up. The ground dimensions of the main building are 300 ft. x 140 ft., and it is intended that all departments, including the foundry, shall be under one roof. The designs show that this is to be an up-to-date establishment in every particular, and the equipment will embrace the latest improved machinery, suited to this class of work.

The affairs of the company are under the management of W. R. Fleming, who was induced to give up his engineering business in New York for this purpose and who has had much to do with the designing of the "Standard" engine. Mr. Fleming took charge of the company's affairs Jan. 1, 1898, since which time the output of the establishment has shown an increase of 45 per cent over the previous year.

Handsome Interurban Cars

The accompanying photographs show both interior and exterior views of interurban cars recently manufactured by the St. Louis Car Company for the St. Louis & Belleville Electric Railway Company, which operates between St. Louis and Belleville, Ill. The cars are 46 ft. over all, with steam coach roof and closed vestibules at each end, and are mounted on the St. Louis Car Company's No. 18, high-speed, double-motor trucks. The cars are also equipped with Christensen air brakes, and four G. E. 57 motors to each car, and weigh complete about 48,000 lbs. each. The cars have a partition at one end, measuring about 9 ft., with a seating capacity of twelve passengers, which will be reserved as a smoking compartment. The seats are St. Louis Car Company's patent, leather covered, "walk-over" type, twelve on each side of aisle, with a seating capacity of forty-eight passengers to the car.

The cars have nine double sash on each side, with six closed panels from outside, as shown in the illustration. The panels on the inside of the car are fitted with large French beveled mirrors, and all sash is fitted with French plate glass. The vestibules have five drop sash, and are provided with a folding door on one side.

The interior finish of the cars is of solid mahogany, finished in natural color, and all mouldings, head pieces, etc., are handsomely hand carved, and all inside trimmings, which are solid bronze,



FIG. 1.—INTERIOR VIEW OF CAR—BELLEVILLE, ILL.

stand out in bold relief, and present an extremely tasteful appearance. The curtains are of red silk faced pantasote, mounted on spring rollers, and provided with St. Louis Car Company's wire cable fixtures. There are also twenty-four electric heaters in each car, one placed under each seat, thus insuring plenty of warmth for passengers.

The ceilings are of a very delicate blue, ornamented in gold, and the electroliers, of fancy design, are in five-light clusters, with opalescent globes in center. Cars are also furnished with electric signal bells, push buttons being placed at every seat.

The outside construction of the car, as can be seen, is of steam railroad type, with straight sides, heavy truss rods, etc. The cars are also equipped with two Wagenhals electric arc headlights, one at each end, of 5000 candle power each, which enables the motorman to see an obstruction on the track as well at night as day.

In addition to the air brakes, the cars are also equipped with St. Louis Car Company's solid bronze ratchet hand brake, and are also supplied with an air whistle, instead of a gong, as is ordinarily used on street cars. The cars are painted Aurora red and light

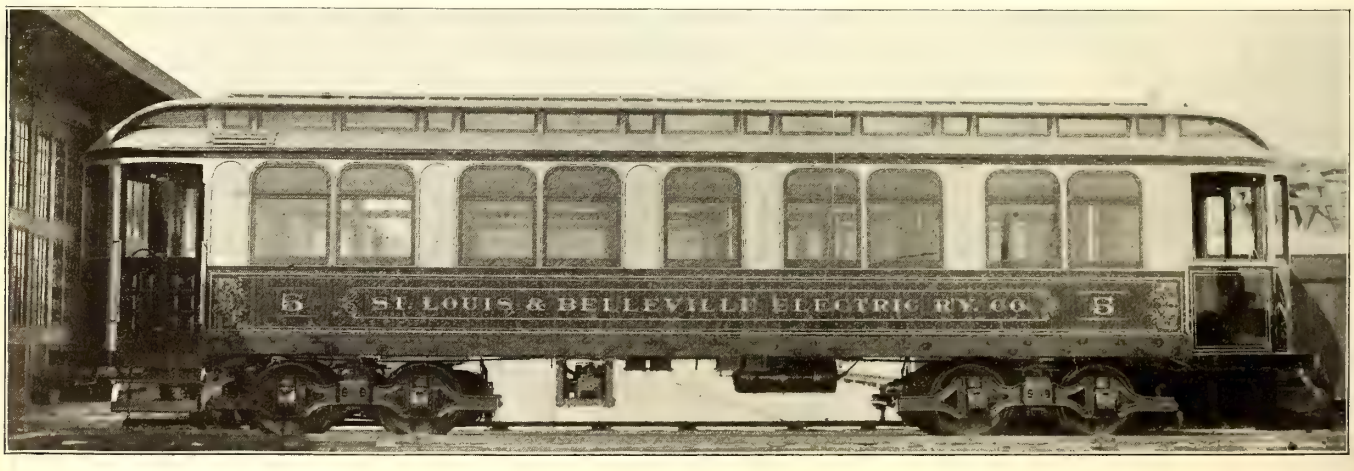


FIG. 2.—EXTERIOR VIEW OF NEW INTERURBAN CAR—BELLEVILLE, ILL.

lemon yellow, a very pretty combination, with neat lettering and ornamenting on the sides.

Fig. 3 shows an electric locomotive which was built by the St. Louis Car Company for the San Antonio Brewing Company, San Antonio, Tex., and which is equipped with automatic freight car couplers, and four G. E. 57 motors, mounted on St. Louis Car Company's No. 15 double trucks. This locomotive is capable of handling from ten to twelve car loads of freight, with the utmost ease.

The St. Louis Car Company also employs an electric motor of this type, for switching purposes at its works, and finds it not only a great convenience, but a labor saver as well.

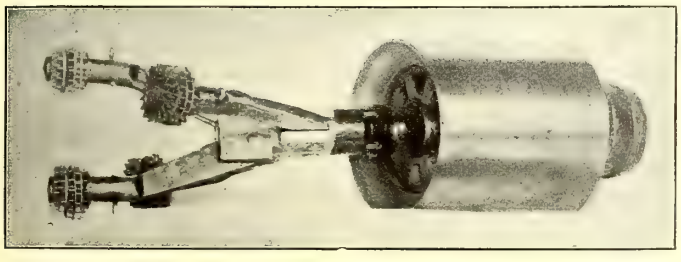


FIG. 3.—ELECTRIC FREIGHT LOCOMOTIVE—SAN ANTONIO, TEX.

Cleaning Water Tube Boilers

Almost every quality of feed water has been found to contain more or less scale-forming ingredients, and where boilers have been allowed to run a year or more without careful cleaning, scale has in many cases accumulated to the thickness of ½ in. or more. Any considerable thickness of scale not only adds very largely to the fuel bill, but it greatly impairs the efficiency of the boiler, reduces its capacity, increases cost of repairs and shortens its life.

The manufacturers of water-tube boilers and others interested in the subject have made numerous experiments with the idea in view of adding to the life of the boilers by removing this scale by mechanical means. One of the latest machines for this work consists of a specially designed turbine attached to the end of a wire-wound hose, and driven by a water pressure of from 90 lbs. to 125 lbs. This pressure causes the turbine to revolve with great force and power, throwing the four heavy cutting arms outward by centrifugal force against the scale with sufficient power to cut and pulverize it into powder, which the flow of water washes away. A series of solid cutting heads and drills is furnished with this cleaner, which is designed to penetrate solid scale, and, at the same time, to save the more delicate parts of the flexible head.



HEAD OF BOILER CLEANING DEVICE

In designing a cleaner which would enter 3-in. tubes and pass around the bends which some of them contain, it was found necessary to condense a large amount of power into a very small compass. It was thought an impulse cleaner does not contain sufficient power to remove heavy scale, and the turbine type of waterwheel was used.

It is this feature which, the manufacturers claim, gives about five times as much power to the turbine as to the impulse cleaner. It is amazing to know the quantity of scale which many of these machines have removed, at a cost of from ten to forty cents per tube. The cleaning of water tubes by this process not only removes the obnoxious and expensive scale, but polishes out the tubes, and, in fact, leaves them in better condition than when new. The cleaner is adapted to any type of boiler, horizontal or upright, with straight or bent tubes, and can be carried by the operator to the top of a boiler, around any obstruction, into the manhole of a steam drum, or wherever he can go. The machine is manufactured and sold by the Chicago Boiler Cleaner Company, Chicago, Ill.

Lubricating Greases

The announcement is made that Dreher journal grease has again been placed upon the market in a somewhat improved form for the use of street railway companies. This grease has been widely used by steam railroads, and is well known to most steam railroad managers. It has been used by the Pennsylvania Railroad Company with excellent results for a number of years. The grease is so compounded as to lubricate only when the car is in motion; as soon as the car stops the grease hardens or "checks," thus avoiding all drip or wasting. The grease in addition to its lubricating qualities is extremely cooling and cleansing, preserving a smooth, clean surface for the journals at all times. It is stated that one application of this compound will suffice to run a car 12,000 miles.

The manufacturers of the Dreher journal grease are also introducing a motor grease which, it is stated, will greatly prolong the life of street railway motor armatures. It is claimed 1 lb. of this grease will carry a car 500 miles, thus making it more economical than lubricating oils, and at the same time giving better results. Particular attention is paid in the manufacture of both these compounds to giving them the necessary body.

The Dreher Grease & Oil Company, of New York, which is now manufacturing these products, is receiving numerous testimonial letters stating that these lubricants are giving excellent satisfaction. One of these recently received from the foreman of the Fifth Avenue depot of the Nassau Electric Railway Company, of Brooklyn, reads as follows:

"I made a test of the grease you sent me as a sample, and can state that the test was very satisfactory in every way. I can recommend it to any one in need of an A1 grease, both for motor and journal bearings.

"The 10-lb. sample of motor grease was used on one of our Westinghouse equipments for forty-two consecutive days with an average of 125 miles a day, making a total mileage of 5,250 miles. No oil was used during this time. The 15-lb. sample of journal grease was used on the same car and ran 11,250 miles with a packing of wool waste. No oil was used at all."

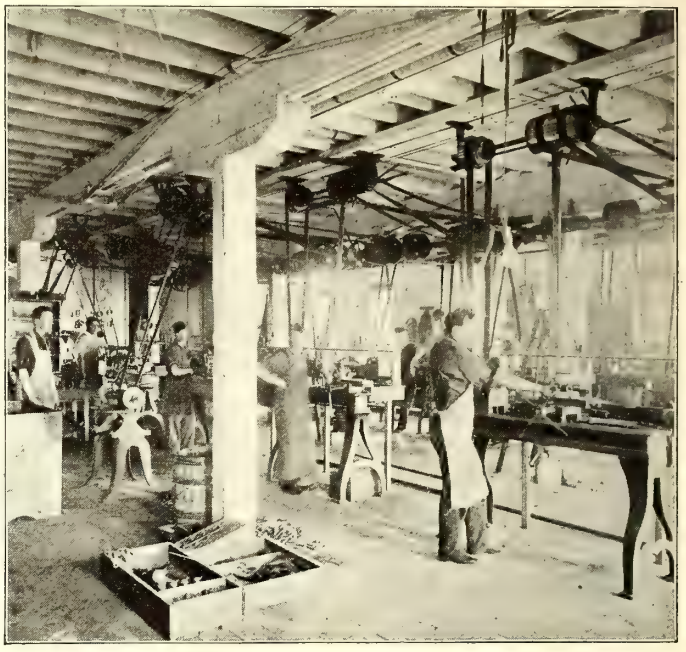
The Manufacture of Electric Railway Supplies

It is always interesting to know where and how particular things are made, and this is especially true of such electrical and mechanical appliances as enter into the overhead construction of city and suburban electric railways. To this end a visit was recently made to the works of the Ohio Brass Company, Mansfield, Ohio, which is one of the largest manufacturers of this class of goods in any country. It will be impossible, however, to name in detail all the various appliances made here, for the illustrated catalogue of the company gives a list of over 400 articles manufactured for the above purposes, and these include not only specialties in overhead material, but also car and motor parts.

The works are located on the outskirts of the city, near the Union depot, and at this season, while running double shift, they employ about 200 hands. The main building is a three-story brick structure 300 ft. x 75 ft., having a wing of the same material 150 ft. x 100 ft. Back of the main building is the brass foundry, a one-story structure 200 ft. x 100 ft., and a japanning building 50 ft. x 60 ft. The business was established in 1888, originally as a jobbing shop, but in 1890 began to manufacture street railway supplies, and the business has steadily increased from year to year, and during the last year turned out 120 per cent more material than the year before, and now shipments are made to all quarters of the globe. The products, however, are not confined entirely to brass, as the name of the company might imply, but embrace products in malleable iron amounting to many hundred tons per year. Much of the malleable iron material is galvanized on the premises by an electrolytic galvanizing process, giving a much more thorough finish than where galvanizing is done by the dipping process. The company also does its own nickel plating and japanning. The departments embrace a brass working shop, in which there is a fine complement of metal working tools, together with testing appliances and trucks and crates for the shifting of the material about the works. The iron working department is similarly equipped, and in both cases the shafting is driven by an electric motor of the Card type. Testing machines are employed for determining the tension strength of materials up to 10,000 lbs. capacity, and there are transformers which give a 10,000-volt current for electrical testing. A large product of the establishment consists of insulating material which the company has named "Dirigo," and which is giving excellent service. In the manufacture of this material a special department is employed in which there are a great number of hydraulic presses and other machines. The company employs a corps of competent engineers and draughtsmen for originating special designs in every department of the work, and also for such new devices as are suggested by particular customers.

The brass foundry is of ample proportions and has twelve smelting pits, together with the ordinary foundry equipment which includes twelve tumblers for smoothing up the small castings. In connection with the plating department is a large number of emery grinders and buffing machines, all of which are provided with exhaust pipes for removing the dust. The japanning department is equipped with two large baking ovens with suitable racks for drying the material, and joining it is the tinning department, in which are the usual tanks for acid baths and melting kettles. The stock and tool room is especially well designed, there being a large number of shelves, cases and racks for storing in separate receptacles the great variety of products. The shipping room is of ample proportion, and right alongside are tracks from a neighboring steam railway, so that material for shipment is loaded directly into the cars without any trucking. There is also a wood working department, in which the patterns and templates and shipping crates are manufactured, from which it will be seen the works include almost every branch of the mechanical trade. Power is supplied from a 75-h.p. engine, while there are generators for lighting and power. The boiler equipment consists of two 50-h.p. and one 100-h.p. boilers.

The offices of the company are located on the third floor of the main building and occupy rooms with glass partitions on two sides of a reception room of ample dimensions, all being finished in Georgia pine. Adjoining on one side is a sample show-room, in which samples of almost all materials manufactured are placed on shelves and in cases, making a very attractive museum.



VIEW OF MACHINE SHOP

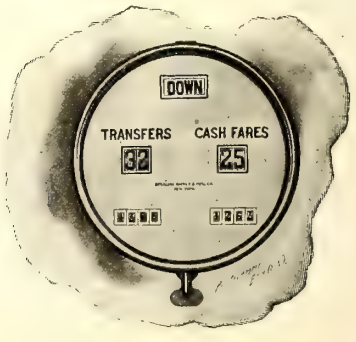
The affairs of the company are operated under the direction of E. T. Cooke, president; B. F. Blymyer, vice-president, and C. K. King, secretary and manager of the railway department; F. P. Black, treasurer, and William Bunting, superintendent. The New York office of the concern is located in the Commercial Cable Building and is under the management of R. A. Byrnes.



VIEW OF BRASS FOUNDRY

Double Registers

The practice on street railways, where one register only is used on each car, differs as to whether it is better to record transfers or not. Arguments can be cited in favor of both plans, but the fact that such a diversity of opinion exists would seem to show that the double fare register, in which a record can be kept of both cash fares and transfers, would satisfy both sides and consequently have wide application. The prevailing tendency of railways is undoubtedly toward the extension of transfer systems, especially in the case of consolidated roads, so that every new device of this kind possesses much interest. A double register can also be used for recording two rates of fares upon long interurban roads.



NEW DOUBLE REGISTER

The accompanying engraving shows a double register recently brought out by the Sterling Supply & Manufacturing Company, and which consists really of two distinct registering mechanisms inclosed in one case. The appearance of the register is very similar to that of the well-known Sterling numeral register, except that there are two sets of dials instead of one, each set being operated by a separate cord or rod. The mechanism is operated through a train of gears and not entirely by springs, and the gear connection between the trip and the totalizing wheels is positive, no cams or dogs being used. The construction is similar to the well-known Sterling standard and every working part of the register is a carefully tested steel casting and all parts are interchangeable. The interior mechanism is compact and simple and the finish of the case is durable and handsome.

Open Cars for a French Railway

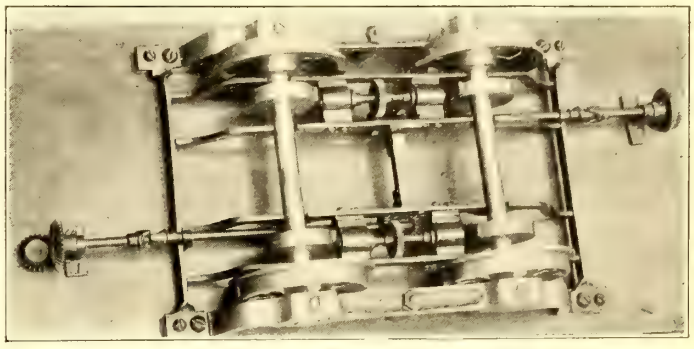
The car shown in the accompanying illustration is of considerable interest, since it seems to be the first open car of purely American type ever sent to Europe. It is from the shops of the Brill Company, and is of the standard twelve-bench type, and is mounted on Eureka maximum traction trucks. The length of the body is 34 ft. It is 43 ft. 8 ins. over the buffers. The limitations of French streets, however, come in, and a breadth of only 5 ft. 10½ ins. is permitted at the sills. This is increased to 6 ft. 5 ins. at the posts, but the extreme width at any part had to be kept down to 7 ft. 8¾ ins. For this reason, although the car has twelve benches, its seating capacity will not exceed forty-eight persons, allowing the American standard of 17 ins. each. The platforms are 4 ft. long, and are separated from the body of the car by bulkheads in the usual manner. On account of the narrowness of the bodies only two sash are placed in these bulkheads. The peculiar form of the grab handles seen on the post is also made necessary by the narrowness of the body and the limiting width over all. The openings between the seats are closed by leather-covered hook chains. The interior finish is of bird's-eye maple for the head lining and ash for the trimming over the openings.

The trucks have 30-in. and 20-in. wheels, with a 4-ft. wheel base, and are furnished with G. E. 1000 motors. The gage is 4 ft. 8½ ins. These cars without motors weigh 15,275 lbs. The weight of one of the trucks was 3000 lbs. The steps are 18 ins. from the ground, with a 15-in. riser. The openings are closed by curtains which come to the floor, the round-corner seat-end panels enabling this to be done easily.

Shipment was effected after the car was entirely completed by taking it apart in sections and packing it closely in boxes. The great length of the car is particularly noticeable, showing that the French street railway people at least are waking up to the advantages of as large a car as can be used on their streets.

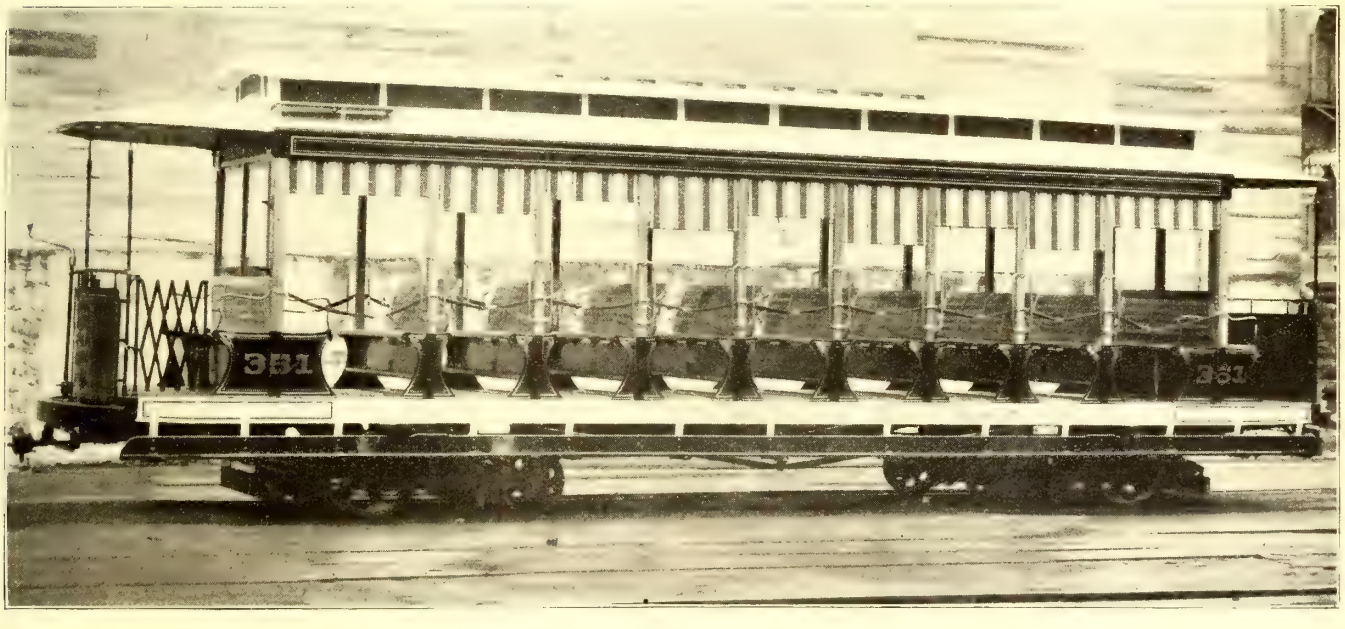
Novel Design of Brake for Street Cars

The accompanying illustration shows a device of the inside brake type. It is quick acting in operation, and, as will be noted from the illustration, the shoes act on chilled drums, attached to the axles, the shoes working between the drums. The shoes are forced against the wheels by means of a shaft, which terminates in right and left screws, that force the shoe heads in opposite direction. This shaft is operated through the medium of spur gears, which, in turn, mesh into the corresponding gears on a shaft that extends under the floor of the car, and which is provided with a universal joint and terminates in a beveled gear, which meshes



NEW BRAKE

into a corresponding gear on the lower end of the brake spindle. An auxiliary shaft, provided with beveled gears, couples the two shoe shafts together, as shown, by which means the brakes of all the wheels may be operated from either end of the car. As the shoes operate on the rim of the inside drum, a very close adjustment can be maintained at all times, so that very little exertion is required on the part of the motorman to bring the shoes into action, while the threading of the shaft provides for the automatic adjustment as fast as the shoes wear. The drums are of the split type, and are keyed and fastened to the axle in the usual manner. This brake was designed by John T. Duff, of Allegheny, Pa., and he claims that it can be adjusted to any type of truck, and so arranged as not to interfere with the mounting or dismounting of the motors. The brake has been worked experimentally and seems to sustain the claims that are made for it.



OPEN CAR FOR A FRENCH RAILWAY

The plant of the Rhode Island Locomotive Works, at Providence, R. I., was formally transferred to the International Air Power Company on Mar. 14. It is reported that the price paid was about $3,600,000. It is also stated that the bond holders of the locomotive works received a mortgage of $225,000 on the property.

Lightning Arresters for Street Railway Circuits

Overhead circuits during storms become highly charged with an induced static electricity—the difference of potential existing in some instances between the line and the earth; in others, between the different sides of the circuit.

Owing to its high oscillatory character, this electricity will not discharge through a coil, but will, in preference, select some path of low inductance, even though of higher resistance. It is due to this fact that when the discharge seeks a path to earth through the coils of a dynamo, motor, or other apparatus, it punctures the electrical insulation of the machine and takes a path to earth generally through the layers of the armature to the core, or over the air space to the pole pieces. The normal current of the line following the lower resistance thus established causes a "ground," or short circuit, and a consequent burn-out. It is the function of a lightning arrester to offer the discharge a better path to the earth. Experience shows that the static discharges will go over the infinitely high ohmic resistance of an air-gap rather than through a few turns of a coil of but a few feet in length.

The Garton-Daniels Electric Company, of Keokuk, Ia., after an experience in manufacturing lightning arresters of six years, has designed an arrester that takes advantage of this peculiar action of static electricity in protecting electric plants and circuits from damage due to lightning discharges. A cross section of the Garton arrester is shown in Fig. 1.

Referring to this illustration, the course of a discharge is as follows: It enters the arrester by the binding post *A*, thence across non-inductive resistance *B*, which is in multiple with the coil *F*, through conductors imbedded in the base of the arrester, to flexible cord *C*, to guide rod *D* and armature *E*, which is normally in contact with and resting upon carbon *H*, thence across the air-gap to the lower carbon *J*, which is held in position by bracket *K*. This bracket also forms the ground connection through which the discharge reaches the earth. It will be noted that the discharge takes its path through the non-inductive resistance in multiple with the coil. The path is, however, of high ohmic resistance, and the normal current is shunted through the coil *F*, which is thereby energized, drawing the iron armature *E* upward instantly. This forms an arc between the lower end of the armature and the carbon *H*.

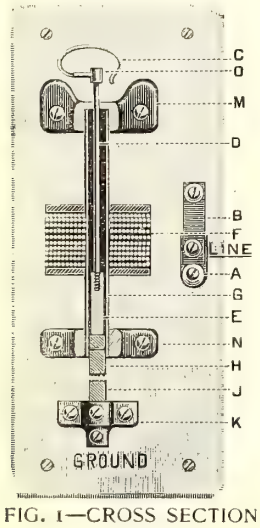


FIG. 1—CROSS SECTION OF ARRESTER

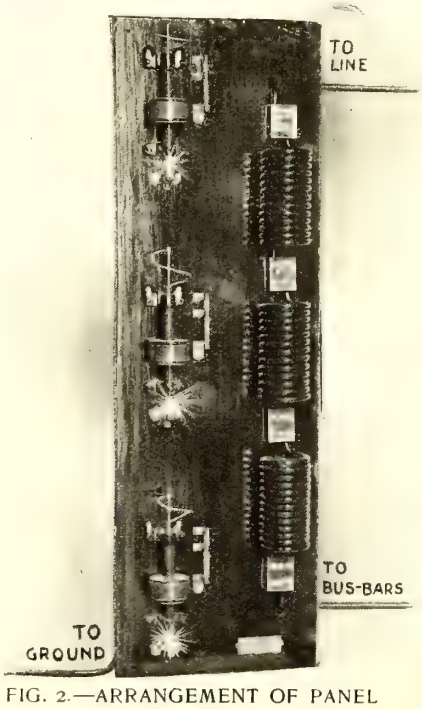


FIG. 2.—ARRANGEMENT OF PANEL FOR RAILWAY CIRCUITS

As this arc is formed inside the tube *G*, which is practically air-tight, the oxygen is consumed, the current ceases, and the coil loses its power, allowing the armature to drop of its own weight to its normal position on the upper carbon. The arrester is again ready for another discharge.

In the railway types a portion of the resistance rod is connected in series with the coil, thereby limiting the flow of current following the discharge. This is necessary, as the normal as well as the static difference of potential is between the line and the ground. This non-inductive resistance is so low that, while limiting the flow of normal current, it does not limit the flow of static electricity, as the potential of the latter is so vastly higher than the normal voltage of a railway circuit.

Arguments have been made against lightning arresters with moving parts, but practice has shown many of these fallacious. The Garton arrester comprises moving parts, but it is so simple and the parts so arranged that all the difficulties anticipated in a device of this character are entirely obviated. The most convincing proof that moving parts are not always objectionable is in the success of the Garton arrester under the most trying conditions.

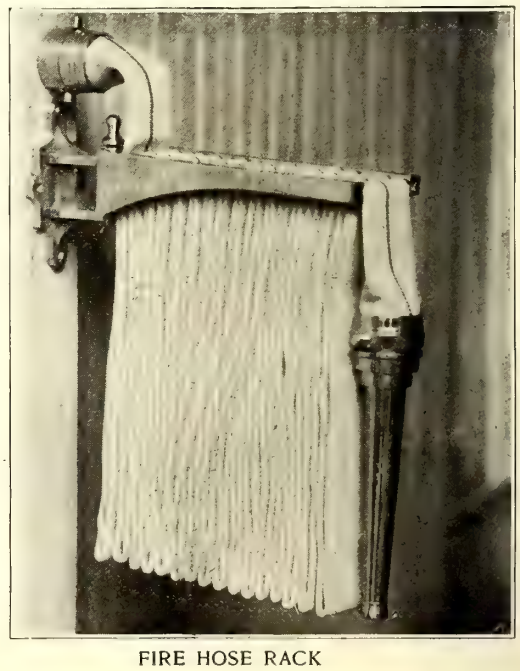
Every operation of this arrester cleans the contacts and discharge points, thereby keeping the conductivity at a maximum and the resistance at a minimum. The arrester is so quick in its action that discharges in rapid succession are taken care of with the greatest ease. After a discharge the Garton arrester increases the resistance in the circuit and chokes and disrupts the current flow. This action is made so quickly that a sensitive plate is incapable of detecting any motion.

The usual arrangement of arresters for the protection of a street railway power station is shown in Fig. 2. Here, it will be noticed, the arresters are used in connection with kicking coils, which consist of a coil of wire so designed as to offer the least ohmic resistance and the highest inductive resistance. One is placed in each circuit, between the apparatus to be protected and the lightning arresters. Acting in the same way as the coils of an armature, which drive the discharge through the insulation to the core, the kicking coil drives the discharge through the lightning arrester before it reaches the machine.

It will be noted that by placing coils and arresters as shown, the discharge passes through the upper arrester; any excess discharge will be taken care of by the second and third, and the three kicking coils offer an inductive resistance that effectively protects the generator. The Garton-Daniels Electric Company is now mailing its 1899 catalogue, which contains a complete description of its line of aresters for this year.

Fire Hose Racks and Reels

The hose rack and reel illustrated herewith, and which are manufactured by H. J. M. Howard, of Washington, D. C., ought to appeal to station and car house foremen, who desire to have their fire protective apparatus ready at hand and yet out of the way when not in use.



FIRE HOSE RACK

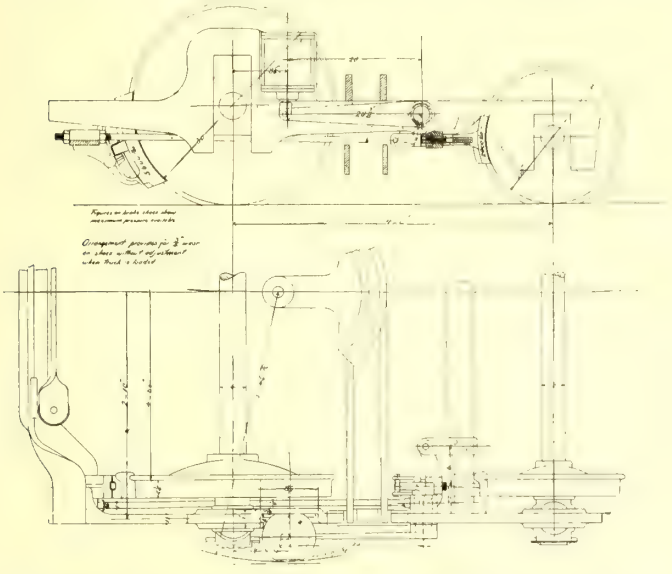
The method of hanging hose on wooden pins, illustrated, avoids all possibility of hose rusting and prevents the sharp bends so objectionable in other styles of racks. The hose being supported in this manner allows the air free circulation through the folds of the hose, keeping it dry at all times. At the same time it is quickly available, as the side arms can be swung out, dropping the hose.

Mr. Howard also manufactures a hose reel mounted on a vertical axis, which, revolving as it does, fills all the offices of a swinging hose reel to those who prefer that type. The automatic draining feature will recommend it to those having hose in places exposed to low temperature.

Although these racks and reels have been on the market but a short time, Mr. Howard states that business is good, that many of the largest street railway plants are being equipped with these devices.

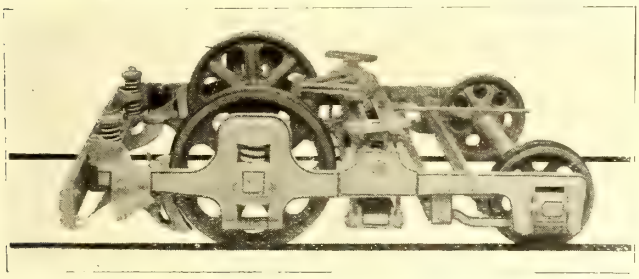
Air Brake with Motor Compressor for New York

During the last month the Third Avenue Railroad Company, of New York, as mentioned elsewhere, awarded contracts to equip the 160 new electric cars, which it will soon put upon its line, with air-brake apparatus of the Standard Air Brake Company. This



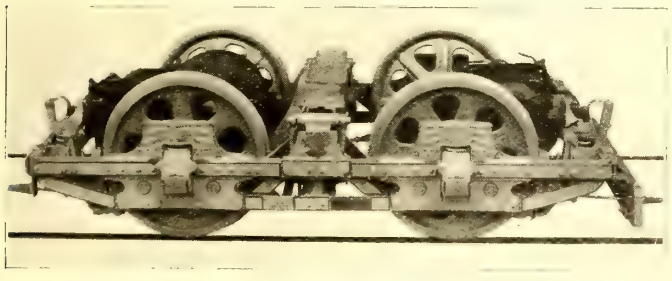
AIR BRAKE CONNECTIONS FOR MAXIMUM TRACTION TRUCKS

constitutes probably the largest order ever given in this country for street railway air brakes and is a striking commentary on the importance which the air brake is being accorded by electric railway managers. The type of air brake adopted is the independent driven compound compressor with automatic current controller and rheostat. The type adopted has only recently been put upon the market by the Standard Air Brake Company and is illustrated in the accompanying engravings.



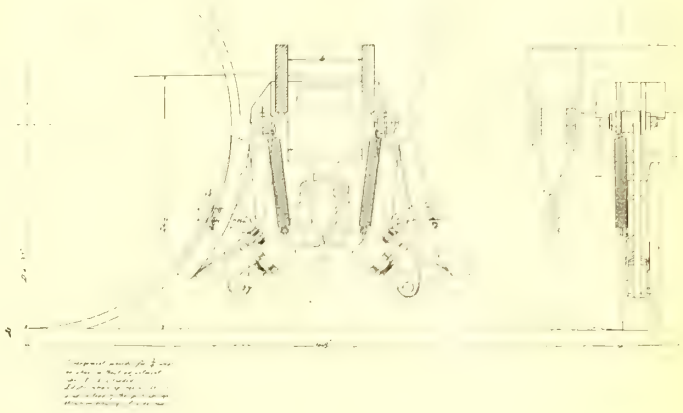
MAXIMUM TRACTION TRUCK FOR THIRD AVENUE RAILROAD

As will be seen, it differs materially from previous equipments of this kind. The motor is of a special construction and designed solely to answer the severe conditions of street railroad air braking. It is series-wound, multipolar, entirely enclosed and securely protected against dust and moisture. At full load the speed is



SHORT WHEEL BASE DOUBLE TRUCK FOR THIRD AVENUE RAILROAD

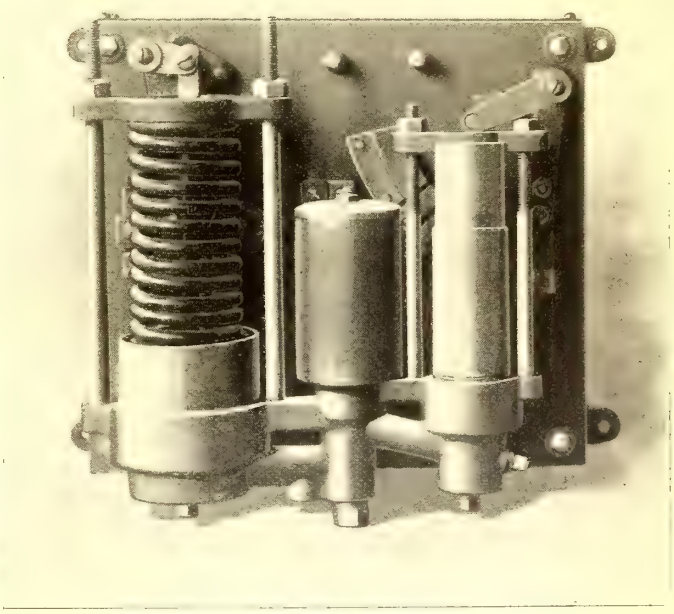
750 r.p.m. The bearings are of ample size and length, self-oiling and self-aligning. The armature is of the type known as iron clad, built up of discs of sheet iron perfectly laminated one from the other, and with grooves punched to receive the windings. The armature core is mounted on a bushing independent of the shaft and keyed to it. This construction allows of expansion and contraction of the armature core without affecting the shaft. The armature coils are of the best cotton covered, soft drawn copper wire, wound on forms, then taped with a special linen tape and laid in mica troughs of the best India mica, in the grooves of armature. The character of the insulation, and the extreme care with which this part of the work is carried out, are sure guards against possible grounding or breaking down of insulation. The pinion, armature and commutator bushing are held in place by keys of the latest design, being a milled half-round key, giving



AIR BRAKE CONNECTIONS FOR DOUBLE TRUCK

the most durability and admitting of the greatest strength of shaft. The brush holders are of good red brass, milled to standard size to receive the brushes. The latter are held in place with adjustable phosphor bronze springs, which are very elastic and can be thrown back to a position where the brush can be removed with perfect ease. The commutator casing is covered with a steel band secured with a self-locking device, and the band is easily removed, giving quick access to brushes, and ample room is provided and unusually large clearances are allowed around the brush holders.

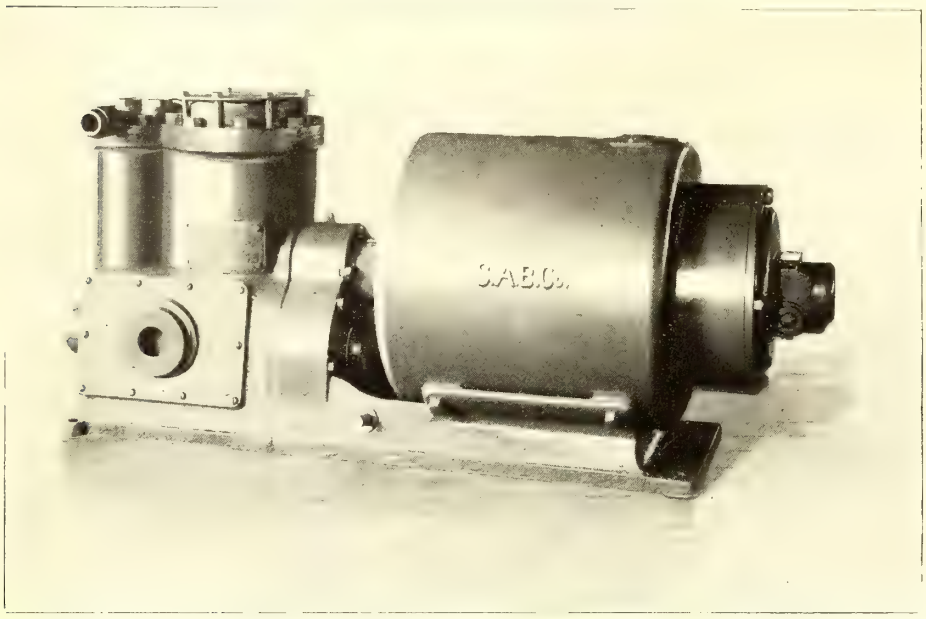
The compressor is of the compound type, and the efficiency shown, working against a pressure of 60 lbs. per sq. in., exceeded



AUTOMATIC CONTROLLER AND RHEOSTAT

85 per cent. It is bolted to the end of the motor, the crank shaft extending at this end to receive a gear wheel, meshing with a pinion on the armature shaft directly above. The cylinders and upper half of housing and gear case are cast in one piece, carrying one-half of the bearings for crank shaft. The lower half of the housing and gear case, together with the base for motor and

the other half of the bearings for crank shaft are also cast in one piece. The crank shafts and connecting rods are of cast steel. The valve seats and valve bonnets are of brass, the intake valve being in the head of low pressure cylinder, while the intermediate and discharge valves are in the head of the high pressure cylinder.



STANDARD MOTOR COMPRESSOR

The gear and pinion are entirely enclosed in a gear casing, forming an oil chamber, and, when steel pinions are used, can be run in a flood of oil. The housing of the crank shafts is so arranged that it forms a chamber, and all cranks and pistons, together with the bearings, operate in oil. The muffler over the top of the intake valve is cast in one piece and enclosed with a wire screen filled with special woven asbestos cloth and iron wire threads, making a perfect guard against dirt and completely muffling the noise of valves.

The new automatic current controller and rheostat is worthy of special mention. The construction is very durable and simple, and its few parts serve as the best guarantee of its effectiveness. All electrical parts, together with the working devices, are mounted on a slate slab to insure perfect insulation. The apparatus automatically maintains a practically uniform pressure in the air storage reservoirs, and the rheostat forming a part of the machine prevents the sudden starting of the motor against full load. By its use, when the air supplied to reservoirs reaches a predetermined limit, the motor compressor is entirely stopped. As long as air pressure in the reservoirs remains within 8 lbs. or 10 lbs. of the required maximum, the motor compressor remains inoperative. Should the pressure, however, be reduced below the limit, the motor compressor is immediately started (slowly at first and gradually increasing as the resistance is automatically removed from circuit) and continues operating until the maximum limit is reached, when it again immediately stops as before. The motor is series-wound, and when starting with empty reservoirs would naturally "run away;" but, under such conditions, the resistance remains in circuit and is only cut out as the pressure increases. The speed of the motor compressor is at all times automatically controlled by the amount of work required. While the motor compressor is in operation, if for any reason the line circuit is interrupted, the resistance is thrown in circuit with the motor compressor simultaneously with the stopping of latter. When the circuit is again restored, the motor compressor resumes operation, gradually increasing in speed in the way above indicated. The resistance wire in the controller is wound on porcelain tubes secured in the base of the controller, under the slate, giving perfect insulation. The back of the controller is lined with asbestos and covered by a sheet of metal. The whole is then entirely enclosed in an iron casing, fitted with a cover and secured by a lock. The resistance is divided into six steps and seven contact points.

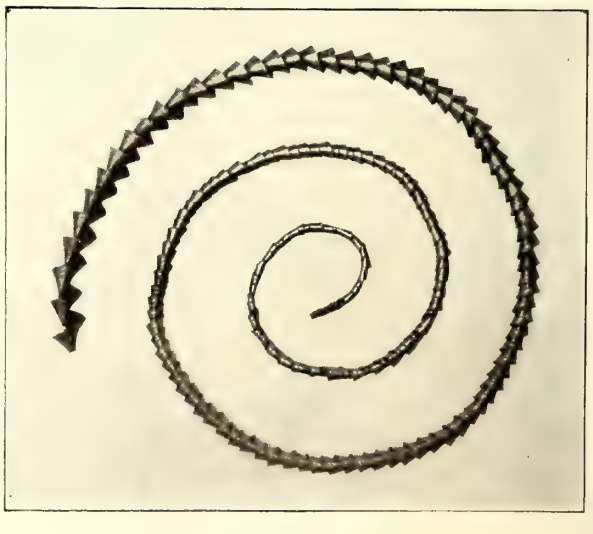
The company will adopt a special method of attaching the brakes to the trucks. Two types of trucks have been adopted for the new equipment, the Peckham 14-B short wheel base truck and the Peckham 14-D maximum traction truck. Of these, 200 of the former and 120 of the latter have been ordered during the past month. The method of connecting the brake to these trucks is quite novel, as will be seen by an examination of the accompanying diagrams. In the case of the short wheel base truck there are two jam cylinders on each truck, and these are connected to a form of toggle joint which brings the shoes in contact with the wheels by an outward pressure. In the case of the maximum traction truck, one jam cylinder is mounted on each truck and connected by a system of levers with the brake shoes. Views of both of these trucks are given herewith. Detail descriptions of them have been published in previous issues.

The independent motor driven compound compressors of the Standard Air Brake Company are built in sizes of 1½ h.p., 2 h.p., 3 h.p., 5 h.p. and 10 h.p. The company also manufactures what is known as its double cylinder, single acting, direct connected, motor driven compressors, and has also four types of axle driven machines. The company's 7½-in. duplex, geared,, axle driven compressor was fully described in the STREET RAILWAY JOURNAL for June, 1898. Since that time a number of improvements have been added and a large number of machines have been placed upon the market.

A test was made of this equipment recently at the factory of the Standard Air Brake Company, at Jersey City, in the presence of a number of railway managers, and the results were pronounced most satisfactory. Besides its factory at Jersey City, the company has a second factory at Trenton, N. J. Both are running full time, twenty-four hours a day, to supply the large demand for air brakes. Orders for these appliances have come from all civilized parts of the globe.

A Long Metal Shaving

The accompanying engraving made from a photograph illustrates a metal shaving recently drilled from a steel rail on the Illinois Central Railroad. With the old-fashioned ratchet drill such a boring would be practically an impossibility. The one shown is from a 13-16 in. hole; it was made without a break, in one



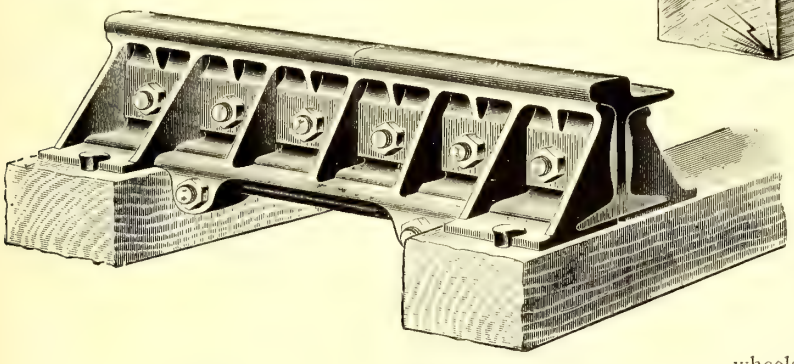
LONG METAL SHAVING

minute and forty-six seconds, and contains all the metal taken from the rail in drilling the hole. It gives proof that the drill which did the work was driven by a continuous feed. The boring was some 40 ins. long and was cut by a Paulus drill manufactured by the Buda Foundry & Manufacturing Company, of Harvey, Ill.

The Argentine-American Commercial Company, of Philadelphia, proposes to establish a warehouse in Buenos Ayres for the exhibition of American goods of all kinds, with a view to increasing the trade relations between the Argentine Republic and the United States. This company will also employ a number of competent salesmen to introduce the American goods.

A New Rail Joint

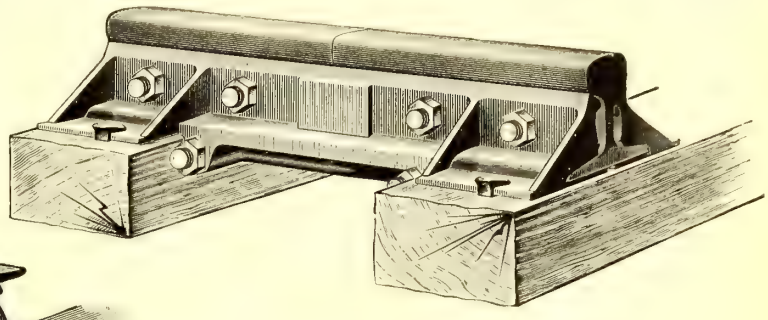
In the accompanying illustrations is shown the Atlas rail joint, which is manufactured by the Atlas Railway Supply Company, of Chicago. The Atlas joint consists of one or two girders whose depth and design make the connection between the rail ends stronger than a section at any other point. When two girders are used, they slip over the rail from either side in such a way that the lower flange is practically enclosed, and presents a broad bearing surface to the under side of the head. In addition to the usual bolts through the web, there are others through lugs on the under side of the joint and passing under the flange. If the single bar style is used the lower flange of the joint is made wide enough to extend under the entire width of the rail. Over the ties the flanges



RAIL JOINT FOR GIRDER RAILS

of the joint are extended so that they serve as rail braces, and the lower flanges of the joint act as tie plates.

A special joint is made for track that is laid with chairs, the joint being deep enough to do away with a chair at that point.

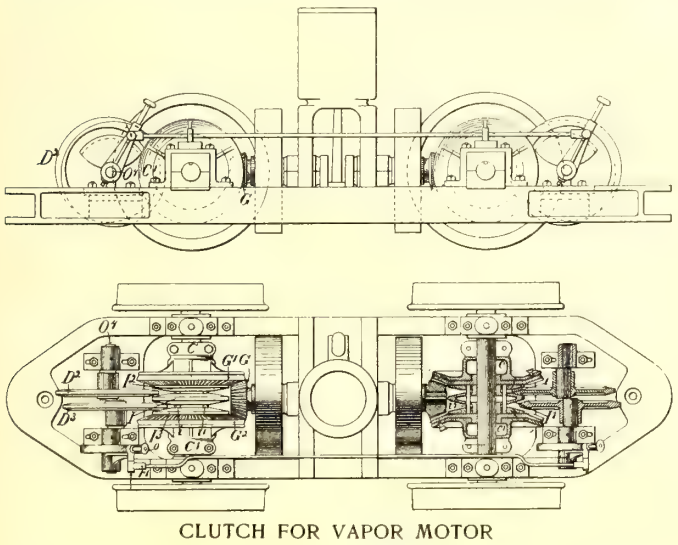


RAIL JOINT FOR T RAILS

New Clutch for Use with Vapor Motors

Since the invention of vapor engines many attempts have been made to apply them to self-propelled vehicles for street railway traction. In systems employing a gasoline or other vapor engine, mounted on the truck or car body and operating continuously at a uniform speed, the main obstacle has, of course, been the difficulty of securing a flexible connection between the engine and the axle for bringing the car to speed from a state of rest, and also for graduating the rate of speed. In 1896 a mechanism was invented by E. Prouty, of Chicago, Ill., that, it is claimed, successfully supplies this demand for a flexible connection.

By the use of a single lever the car is started from rest without jerk or jar, and given any desired speed up to the maximum, and



CLUTCH FOR VAPOR MOTOR

by simply pulling the lever over to the opposite position the car is as smoothly reversed and moved in the opposite direction. By placing the lever in a vertical position the car is stopped, while the engine continues to run as before. At the same time the application of the power to the vehicle is graduated in correspondence with the speed.

The accompanying illustration shows the clutch applied to a truck. F is the beveled pinion on one end of the engine crank-shaft and G^1 and G^2 are beveled gear running idly in opposite directions when the load is off. I is the middle block, fastened rigidly to the axle, and which is beveled ordinarily 3/16 in. to the inch. I^2 and I^3 are beveled discs on one side and smooth, flat surfaces on the other, and while they admit of a lateral movement on the axle they are held by keys or pins, i and i^1, forcing them to revolve with the axle. C and C^1 are the outside discs, that are rigid on the axle, with a flat face lying against the corresponding flat face on the beveled gear. $D2$ and $D3$ are impinging wheels on the eccentric rocking shaft $O4$, $D3$ being shown in effect, G^2 now carrying the load, while G^1 is playing as an idler. By reversing the lever G^2 is freed and G^1 is put into effect, and by placing the lever in a vertical position both gears are freed and play as idlers. The impinging wheels never slip, but revolve by contact with the discs.

It will be noted that the friction of the discs on both sides of the gear is in the same direction, eliminating all counter friction when applied. Hence, if the clutch is thrown in lightly, it is operative without loss of power to that extent, and will start or move the load gradually. It is stated that in practice the clutch does not heat when run at any degree of slipping pressure. As there is no counter friction there can be no loss by slipping friction, and, it is claimed, as the faces of the clutch do not disintegrate, but wear as an ordinary journal, the force of the power or engine is conveyed to the load without any more waste than would be on the wrist pins and cross head of an ordinary locomotive.

Signal System for Single Track Roads

Williamson & Company, of Allegheny, Pa., manufacturers of the Ramsey signal system, report that this device is giving entire satisfaction wherever it is used, and that it has proven itself entirely efficient in actual operation, covering a period of several years. The large number of high speed single track surburban roads now being built has largely increased the demand for an adequate signal system to prevent collisions and to enable the conductors of cars on different parts of the system to communicate with each other and with the central office. The Ramsey signal system appears to fulfill all these conditions. The latest modification of this device was fully described in the Street Railway Journal for September, 1898.

Massachusetts Institute of Technology

The Massachusetts Institute of Technology has recently made a number of important additions to its laboratories, thus greatly enlarging the facilities for making tests of various kinds. One of the principle improvements is the erection of a new building and the addition of a new tandem compound engine in the engineering department, by which twice the amount of work can be done. Where thirty men formerly worked on one engine and its pumps, fifteen men now work on each engine, giving the men a great deal more experimental work. Various tests are now being carried out on the effect of moisture on timber, elasticity of wood, etc.

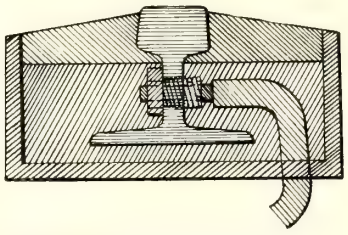
American Institute of Electrical Engineers

The 133d meeting of the institute was held at the Institute Building in New York on the evening of March 22, 1899, President Kennedy in the chair. A paper was presented by M. L. Pupin, of Columbia University, on the propagation of long electrical waves. An interesting discussion followed the reading of this paper. The council decided to hold the next general meeting at Boston during the last half of June, the exact date to be fixed by the executive committee.

Safety Third Rail Railway at Coney Island

During the last month a third-rail electric railway, installed by the Safety Third-Rail Company, of New York, to demonstrate the advantages of its system, was put in operation at Manhattan Beach, Coney Island. The road equipped is the Marine Railway, connecting Brighton Beach and Manhattan Beach, and it is 1951 ft. in length. The track is of standard railroad construction, with 56-lb., 4⅛-in. T rails and stone ballast, and differs from a trolley track only in the absence of the overhead system and in the use of a third rail which is laid on the ties in the center of the track. A standard 500-volt current, taken from a special dynamo located in the lighting station of the Manhattan Beach Hotel, is used.

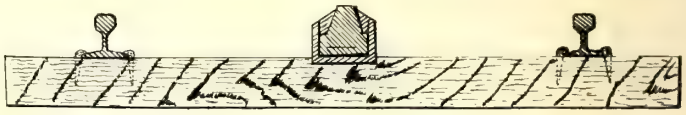
The third rail, which is of standard T section, is of steel, and is laid in alternate live and dead sections insulated from each other. The live sections are 15 ft. in length and are supported at either end by granitoid bases, as shown in the section and side elevation of the third rail construction herewith. The entire rail circuit, including the granitoid pieces, is then enclosed in a creosoted wooden trough, which is then filled with a special form of insulation which is poured in hot. The granitoid insulating blocks also act as section insulators between the live and dead sections, presenting a surface of 1 ft. between the two. The line has seventy-two live sections and seventy-three dead sections, the latter are 10 ft. in length. The height of the top of the third rail above the ties is 5 in. The track rails are bonded in the usual way for return.



SECTION OF THIRD RAIL, SHOWING METHOD OF INSULATION AND CONNECTION TO FEEDER.

The system of connections used is shown diagramatically on page 261. Each live sectional rail is connected to a solenoidal switch which has two windings, one of low resistance wound with coarse wire and another of high resistance wound with fine wire. The former is normally open and the latter is normally closed, connecting its circuit between the sectional third rail and the ground. The car carries a small motor-dynamo of 20-500 volts and a storage battery of ten cells connected as shown in the diagram. When ready to start, the motor-dynamo is driven by the 20-volt battery current, generating at its other end, an e.m.f. of 500 volts. The method of operation is then as follows:

Suppose the car to be over a rail and ready to start. The switch being open there is no connection between the feeder and the car, which therefore can receive no current. The motorman operates the controller and thereby connects the motor-dynamo to the third rail and to the ground and current passes through the fine wire of the switch and causes it to operate. In response to this current



CROSS SECTION OF TRACK THROUGH INSULATING BLOCK

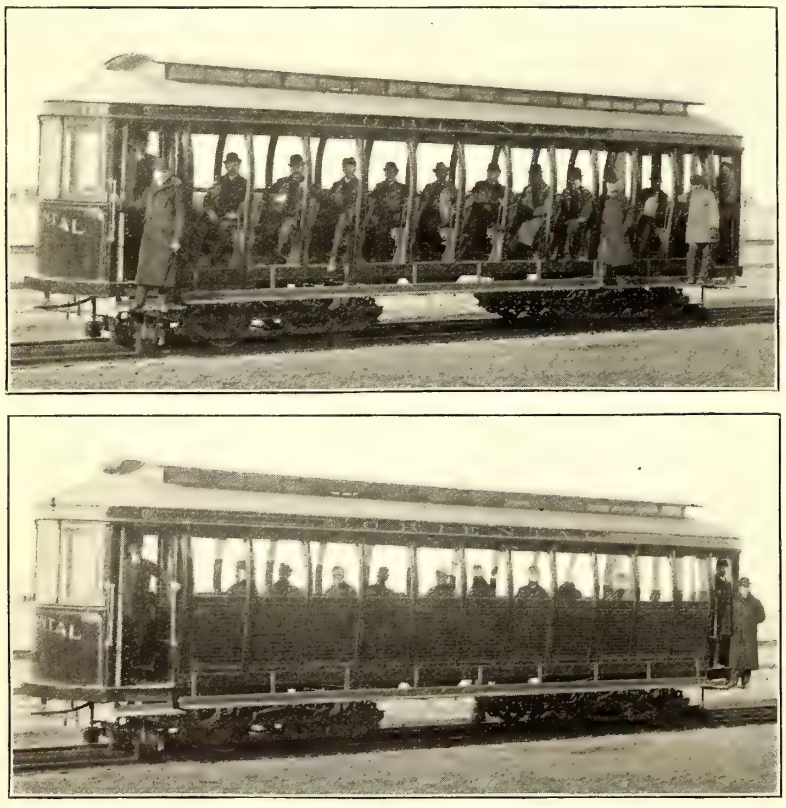


CROSS SECTION OF TRACK THROUGH LIVE OR DEAD SECTION



SIDE ELEVATION OF INSULATING BLOCK

the plunger rises and first makes contact between the main feeder and the rail and then breaks the current of the fine wire winding. The controller is now open and current comes from the feeder through the coarse wire winding of the switch to the third rail and from thence through the car motor to ground, causing the motor to revolve and the car to move. The switch is held shut because of this current in the coarse wire winding. In this closed condition the switch will remain as long as the car is taking current from the section to which the switch is connected. When the car leaves the section, there is no longer any current passing through the switch feeding it and it falls open, first breaking the circuit between the feeder and the sectional rail and second, restoring the circuit from the sectional rail through the fine wire to earth. The switch is then ready for the next car. The car being thus started, the motor-dynamo is no longer needed to operate the switches because the car is provided with two sets of shoes which are con-



DUPLEX CAR, OPEN AND CLOSED



VIEW OF TRACK

nected together and placed sufficiently far apart to span the distance from section to section. The forward shoe as it impinges on a section, subjects it to the full line potential, drawing its source of current from the rail preceding, for the main feeder has already been connected thereto in the manner just described. Once started, therefore, the car becomes independent of the motor-dynamo, for it uses the power house current to operate the switches.

It will be noted that the switch remains closed until the car ceases to take current from the section it controls. It will then fall open from lack of current to hold it up and there is then no

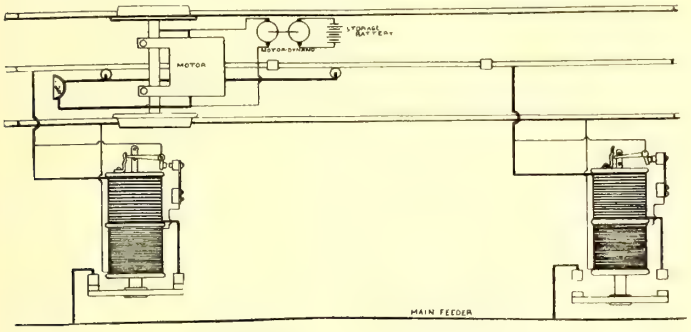


DIAGRAM OF CONNECTIONS

current to break, and hence no arc at the switch jaws, and it is therefore a non-arcing switch.

One side of the motor-dynamo is connected across the motor terminals and ordinarily receives current therefrom, acting as a motor and driving the low potential side as a dynamo charging the ten small storage cells. If, however, the line current should fail, the sides of the motor-dynamo will exchange functions and the high potential side, now a dynamo, will supply current to operate



END VIEW OF CAR AND SWITCH

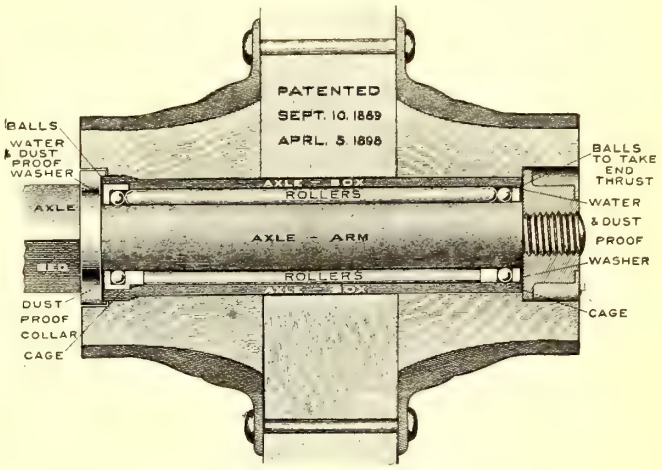
the switches and light the car. This is the operation also at starting.

The car is of the Duplex type, manufactured by the Duplex Car Company, of New York, and has attracted much favorable comment by its tasteful appearance when open and closed. The engravings on page 260 show it in both conditions. The car is mounted on two Peckham 14-A trucks, equipped with G. E. 1000 motors with standard controller, with the exception that one contact is changed. The car carries ten cells of storage batteries and the rotary transformer required by this system. Both of these are located underneath the car so as to take up no space available for passengers.

To demonstrate the reliability of the system under adverse conditions, the road has been subjected to very severe tests. One of these tests was that of covering the road for a distance of 25 ft. with closely packed and wet snow heaped to a height of several inches above the track, entirely hiding the three rails from view. This condition did not interfere with the operation of the system in the slightest degree and the car glided through the snow without difficulty and was started on the section covered with snow without trouble. Another test consisted of covering the track with dirt, entirely hiding the three rails, after which buckets of water were poured on the track, making a combination of mud and water. This did not in the slightest degree interfere with the operation of the car. The test was carried on under the supervision of Capt. J. McL. Murphy, the inventor of the system, and was witnessed by a number of well-known railway men who spoke in the highest terms of the results secured.

Roller Bearings

A new form of roller bearings for street railway service, heavy road wagons, etc., is shown in the accompanying cut. The device consists of a series of from nine to fifteen rollers, the number varying according to the size of the axle, about ⅜ ins. in diameter.



SECTION OF ROLLER BEARING

These rollers are readily interposed between the axle and the axle box, coming into immediate contact with both. In addition to this, there are balls at the end of each of the rollers, thus reducing the friction to a minimum. It will be observed that the weight is not on these balls, and there is, therefore, no danger of their being crushed. The weight comes directly on the rollers and is evenly distributed throughout their length. The device is manufactured by the Standard Roller Bearing Company, of Philadelphia, and the principal claims made for it are simplicity and strength, cheapness, and a great saving in power.

Exhibits at the Convention

Mr. T. C. Penington, secretary of the American Street Railway Association, has issued the following letter to electric railway supply men, in reference to the exhibits at the next convention:

The exhibits and displays of the supply men are so important a part of our conventions, that the executive committee, in making arrangements for the meeting, have been as mindful of our wide-awake allies and as zealous in providing for their convenience and accommodation as for any other feature of the gathering. The Exposition will be held in Tattersalls, the largest exposition hall in the city. We will have an abundance of floor space with all the light, heat and power required. Every applicant is assured that he will get all the space desired, as our resources in this direction are unlimited. The convention will be held on the second floor of the exhibit hall, all stairways leading up from the inside, thus insuring the attention of all delegates and visitors to the exhibits.

The income from the sale of space will go to the American Street Railway Association. The executive committee of the association has fixed the price at ten cents per square foot, and ruled that no space less than one hundred square feet will be assigned, but applicants may have as many multiples of this quantity as they wish, all in one body. Payment for space should be made to Mr. T. C. Penington, secretary and treasurer of the American Street

Railway Association, 2020 State Street, Chicago, Ill. Application for space should be made to Jas. R. Chapman, 444 North Clark Street, Chicago, chairman committee on exhibits. Please state in your application for space the shape desired, number of feet wide and long, and the committee on exhibits will comply with your request if possible. Cars, sweepers and plows will be placed outside of the building on the street.

It is earnestly requested that all exhibits shall be in place and all work finished by Monday evening, Oct. 16, which is the evening prior to the opening of the convention. The local committee has rented the building from Oct. 10 to Oct. 24, so you can ship your goods early and will have ample time to remove them. Watchmen will be in charge of the building so that exhibits will be safe. All goods should be marked to yourselves, Tattersalls, Chicago, care of H. W. Smith, successor to Anderson Transfer Company, 1618 State Street, sending him bill of lading or advice that you have shipped goods in his care, giving particulars in regard to shipment, and it will be delivered to your space in the exhibition hall. Ship all goods early to insure delivery in time and prepay charges. We hope to have you with us with an extensive display. All articles intended for the exhibition shall be delivered at the building by the agent or owner, and at his expense, but the local committee have made arrangements with H. W. Smith (successor to Anderson Transfer Company) to haul and deliver all shipments to and from the building at low rates if directed in his care. Articles will be placed on your space in the hall if you mark the number of space on your boxes. The number of your space will be mailed you in ample time for shipment. All electrical connections for power and extra lights must be made at the expense of the exhibitor.

We expect a large exhibit, and perhaps it would be in the interest of the exhibitors to make arrangements to have the building open in the evening, as it is well lighted, and the electrical companies expect to make a large display. Space must be applied for by Sept. 1. Assignments will be made as promptly as possible after that date and exhibitors notified of their location. Exhibits of like character will be grouped together and space will be assigned in the order of application. The committee on exhibits will make contracts with carpenters, electrical workers and laborers at regular prices, so the exhibitors will not be overcharged for lumber, labor, etc.

Friday, the 20th, has been set apart by the executive committee for the examination of exhibits. No session of the association will be held on that day and no entertainments of any kind will be given by the local committee, so all delegates will have ample time to call upon you and see what you have to show them.

The headquarters of the association will be at the Auditorium Annex. All our hotels are within a radius of one-half mile and within ten minutes' ride of the hall. They include Auditorium, Victoria, Leland, Great Northern, Wellington, Grand Pacific, Tremont and Sherman. The executive committee advises all who desire room to apply at once, as they will be assigned in the order in which applications are received. The executive committee found our Chicago friends so enthusiastic as to the coming meeting, and so hospitable in their greeting, that success is assured, the location being central and accessible; and the inquiries and information already received being so encouraging an unusually large attendance seems guaranteed. The annual dinner will be held at the Auditorium, Friday, Oct. 20, at seven o'clock, P. M. Tickets will be sold at the actual cost to the association.

The railroads will sell tickets on the certificate plan. Be sure and leave your certificate with the clerk the first day of the convention, when you register; it will be signed, vised and ready for you on Thursday, Oct. 19, 1899.

Please make your arrangements and applications as above noted as promptly as possible.

(Signed) T. C. PENINGTON,
Secretary and Treasurer.

Large Orders for Well Known Engines

The Willans engine, as manufactured by Willans & Robinson, of Rugby, Eng., are being introduced very extensively into tramway power plants. Among the larger orders for engines for this class of service received during the past year may be mentioned the following: Eight engines of 1200 h.p., besides several smaller engines, for the Liverpool Corporation; four of 700 h.p. for Bradford, Eng.; two of 500 h.p. and 250 h.p., respectively, for the City & South London Railway; two of 800 h.p. each for the Brighton Corporation, England, and two of 1200 h.p. each for the Glasgow Corporation.

The manufacturers of this engine report that the orders received during 1898 exceed those of any previous year, and the sales thus far in 1899 continue to show an increasing demand. This concern is now building larger engines than ever before, the standard size for central station work having until recently been about 280 h.p., but within the last few months the size has been increased considerably, until now, 700, 800, and even 1000 and 1200 h.p. engines are not uncommon. To meet the demands of the business, the manufacturers are arranging to greatly enlarge the capacity of their works.

Personal

MR. E. L. SIMONTON, formerly electrician of the Lincoln Electric Street Railway, has resigned.

MR. H. R. McLEOD has left the Portland & Cape Elizabeth Railway Company, of Portland, Maine.

COL. G. W. PARKER has been elected president of the Springfield Traction Company, of Springfield, Mo.

MR. WILLIAM P. GANNON has been elected president of the Syracuse Rapid Transit Railway Company, of Syracuse, N. Y.

MR. JOHN M. BLATT has resigned from the superintendency of the Milwaukee, Racine & Kenosha Electric Railway Company.

MR. EDWIN WARNER has been appointed secretary and treasurer of the Birmingham Electric Railway Company, of Birmingham, Ala.

MR. FREDERICK SARGENT, of Sargent & Lundy, Chicago, has been appointed consulting steam engineer for the Boston Elevated Railway.

MR. EDWARD W. DECKER has left the Portland & Yarmouth Electric Railway Company, of Portland, Maine, of which he was formerly superintendent.

MR. L. C. WEIR has been elected president and general manager of the Weir Frog Company, of Cincinnati, Ohio, in place of F. C. Weir, who died on March 1, 1899.

MR. JOHN CLIFFORD has been appointed superintendent of the Wilkesbarre & Wyoming Valley Traction Company, of Wilkesbarre, Pa., in place of John Meixwell, resigned.

MR. CHARLES F. FRANKLIN, superintendent of the Newburgh Electric Railway Company, has resigned his position to accept a situation as superintendent of the Ohio Southern Railroad.

PROF. A. B. W. KENNEDY, of London, is visiting America with a view to examining American electric railway practice and to render a report to the London County Council upon the results of his investigations.

MR. MAURICE HOOPES, electrical engineer of the Lynn & Boston Railway Company, has resigned that position to take charge of the building of a new railway between Albany and Hudson, N. Y. His place at Lynn will be taken by Mr. William Pestell.

MR. S. W. JAMISON, general manager of the Roanoke Street Railway Company, of Roanoke, Va., has resigned that position, and will be succeeded by George C. McCahan, who has been made superintendent of both the street railway and electric light companies.

MR. F. E. DRAKE, director of machinery and electricity of the American commission to the Paris Exposition of 1900, sailed for Europe on the "Lucania," on March 11. He will spend most of his time in Paris negotiating for several engineering concerns, and in going over the field of the exposition work preliminary to taking up the detail of the final allotment of space.

MR. E. K. STONE, JR., of Quincy, Ill., writes that through the similarity of names, his father's death, which occurred Nov. 28, 1898, has been quite generally misunderstood to be his own. Mr. Stone states that he has sold out his interests in the local road at Quincy, but expects to continue in the same line of business.

AMONG THE MANUFACTURERS

THE E. W. BLISS COMPANY, of Brooklyn, N. Y., is sending out a folder describing the new pattern Bliss inclinable power presses for the manufacture of sheet metal goods.

BRYAN & HUMPHREY, consulting mechanical and electrical engineers, of St. Louis, announce their removal from their old offices to rooms 706-708 Lincoln Trust Building.

FREDERICK J. GRAF, of New York city, states that he has received the highest award for fenders at the American Institute exhibition, held at Madison Square Garden, New York.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, of Philadelphia, has placed its New England office, which is located at 170 Summer Street, Boston, in charge of F. B. Smith.

THE JOSEPH DIXON CRUCIBLE COMPANY, of Jersey City, N. J., is sending out another one of its extremely unique and ingeniously gotten up brochures describing Dixon's pencils for all kinds of use.

THE FALK COMPANY, of Milwaukee, Wis., has secured the plant and business of the Western Gear Company, of Milwaukee, and will continue the manufacture of the gears and pinions formerly made by that company.

THE ELECTRICAL INSTALLATION COMPANY, of Chicago, has secured a contract for all the overhead work for the northeast division of the Brooklyn Avenue Railway, at Kansas City, Mo., which includes 4 miles of double track. The work will be of span wire construction with iron poles.

COMPAGNIE HEILMANN, of Paris, France, manufacturer of electrical locomotives, announces that it has been decided to change the title of the company to the Société Anonyme de Locomotion Electrique. No other change will be made in the status of the company. The Paris office is at 2 Rue Pasquier.

CHARLES A. BROWN and GEORGE L. CRAGG, of Chicago, have recently formed a partnership under the firm name of Charles A. Brown & Cragg for the practice of law, giving special attention to patent, trade-mark and copyright litigation and to the soliciting of United States and foreign patents. With the firm will be connected A. L. Lawrence.

THE DUPLEX CAR COMPANY, of New York, has in operation one of its new cars on the experimental line of the Safety Third Rail Company at Manhattan Beach. The Duplex Car Company, whose offices are in the Postal Telegraph Building, is daily receiving inquiries from street railway companies regarding its new form of car and is also receiving flattering testimonials.

PRESTON, COHEN & CO., of Philadelphia, Pa., have made arrangements for handling the goods of some of the leading manufacturers of electrical and street railway supplies at their Philadelphia office, 1004 Real Estate Trust Building. The members of the new firm have had considerable experience in this line of work, and with their present facilities will undoubtedly make a complete success of their new venture.

THE LOMBARD WATER-WHEEL GOVERNOR COMPANY, of Boston, has received an order for three additional type "B" governors for the plant of St. Anthony Falls Water Power Company, of Minneapolis. These governors are for the three additional units of the four Victor turbines each, which are to be installed. This will make in all ten Lombard governors in the above named plant, regulating forty water wheels.

IT IS ANNOUNCED that the partnership heretofore existing between J. R. McCardell, C. H. West and M. J. McDonald, under the firm name of McCardell, West & Co., was dissolved by mutual consent on March 20, 1899, Mr. West withdrawing from the firm. J. R. McCardell and M. J. McDonald have purchased the entire interest in the business, patents, etc., and will continue the business under the firm name of McCardell & Co., at Trenton, N. J.

FRANK H. MONKS, who is well known as the former master mechanic of the West End Railway Company, of Boston, now the Boston Elevated Railway Company, is doing a large business as expert on street railway properties in all parts of the country. Mr. Monks, by experience, is well fitted for determining the value of street railway properties and making suggestions for their improvement, and numbers among his clients the properties of many prominent lines, as well as general investors.

EUGENE MUNSELL & CO., of Chicago, will open a large mica factory at Ottawa, Can. Extensive buildings on Wellington Street have been leased and it is the intention to forward the mica direct from the mines to the factory, where it will be carefully examined and prepared for shipment to New York. Eugene Munsell & Co. now have establishments in New York, Chicago, St. Louis, Cincinnati, San Francisco, and London, Eng., and the opening of these new works is a good indication of the company's prosperity.

THE GARTON-DANIELS ELECTRIC COMPANY, of Keokuk, Ia., reports that orders for its lightning arresters are coming in almost faster than they can be cared for. During the winter this company had prepared twice as large a stock of arresters as last year, but the spring demand has required it to double its force to keep up with orders. Additional help will be secured, however, and all orders will be shipped with promptness. This company's new catalogue, No. 22, is having a large demand and it may be necessary to issue a second edition.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., is sending out its catalogue No. 96, for 1899, and also a little eight-page leaflet devoted to the subject of mechanical draft. Catalogue No. 96 describes and illustrates the Sturtevant steel plate fans for all kinds of service, and will be of great value to any one needing appliances of this kind. The leaflet on mechanical draft contains among other views, an illustration showing the relative size of a fan and chimney required for the same boiler capacity with mechanical draft and natural draft respectively.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, of Newark, N. J., is sending out its complete catalogue for 1899, of the Weston standard electrical instruments. These instruments are built in an almost unlimited number of sizes, styles and shapes, and for every class of service required. They are made under the most careful supervision and all parts are turned out and fitted by experts in this line. In addition to this, each instrument is thoroughly tested and checked before it leaves the factory, so that the name of "Weston" on an electrical instrument is a guarantee of no mean value.

THE ARCHITECTS AND ENGINEERS Electrical Bulletin for February, which is published by the Sprague Electric Company, is just out in a new cover. This bulletin has been published for some time and contains facts and figures of interest to architects and engineers that cannot be secured in any other publication. The issue for February includes, among other articles, the following: "Automobiles," "Electric Heating, and Surface Contact Electric Railways," by E. H. Johnson; a description of the Sprague multiple system, by C. R. McKay; "Electric Wiring Practice," by Fred. Bathurst.

EDWARD ROBINSON, proprietor of the Wells light, will be one of the passengers on the "Lucania," April 8. Mr. Robinson goes to England and the continent on a combined business and pleasure trip and expects to be absent about six weeks. The Wells light is regarded as the most simple and practical lighting device for use in night construction, for shop work, heating heavy metal, etc., and, owing to the unusual activity in the electric and steam railway fields, the company's business for the season has been the largest in its history. The Klondike has opened up a new field for this device, the company having already shipped twenty outfits there for melting the ground.

THE GENERAL ELECTRIC COMPANY, of Schenectady, N. Y., has published a new catalogue on transformer design and operation which is very complete. Among the recent pamphlets and printed matter issued from the printing department of this company are the following: Bulletin No. 4164, devoted to series enclosed arc lighting with alternating current; bulletin 4163, on alternating current induction motors, type I. S., for single phase, 60 cycle, 115-volt circuits, and bulletin 4165, on small direct coupled generating sets. In addition to the above, folders have been issued describing porcelain clamp insulators, T. H. lamp sockets and receptacles, single pole primary switch and fuse boxes.

ELMER P. MORRIS, 15 Cortlandt Street, New York, has secured the contract for 45,000 ties, 140,000 lbs. copper, 17 miles of this being an improved figure-8 design of wire, 650 flexible brackets, all of the overhead material, 2000 tons girder and T rails, 900 wooden poles, and all of the bonds for the Elmira and Seneca Lake Electric Railway, Elmira, N. Y. Mr. Morris has also closed large orders for iron poles from the Brooklyn Heights Railroad Company, Brooklyn; Union Railway Company, New York; the Columbia Railway and the City & Suburban Railway Company, Washington, D. C.; the New Jersey Electric Railway, Newark; 1100 poles for Plainfield, N. J., and iron poles and copper wire for Phœnixville, Pa.

THE TAYLOR ELECTRIC TRUCK COMPANY, of Troy, N. Y., manufacturer of high grade trucks for electric service, has published a new catalogue describing the various types of trucks which it makes. This company claims to fully supply the demand for trucks that are simple in construction, economical in management and easy riding in service. The wheels, axles and all wearing parts are made interchangeable in both the single and double types and contain only the best materials and workmanship. The catalogue contains an interesting illustration of one method of testing the side frames used in the construction of these trucks. In this test the journal boxes are supported solidly and a pressure of 2160 lbs. was placed on each end of the frame, which endured the weight without the least deflection.

THE VOSE SPRING COMPANY, of New York, reports an increasing demand for its various products. Among the specialties that this company is now producing are rubber center yoke springs for journal boxes of electric cars, the Vose patent rubber and iron core springs, coil and elliptical springs for all standard types of electric trucks, trolley springs and brush holder springs, rubber springs, washers and cushions, rubber blocks for elliptical springs, etc. Gustave Suckow, the genial general manager of the company, is probably one of the best known men in the street railway supply trade. He commenced work with this company when but thirteen years old, and has been with it for over twenty-two years and is largely responsible for the satisfactory business it is now enjoying.

THE SIEGRIST LUBRICATOR COMPANY, of St. Louis, Mo., is receiving numerous orders for its well known automatic oiling system. The Southern Electric Railroad Company, of St. Louis, has installed this system on all the engines in its large power station, and the Metropolitan Elevated Railway Company, of Chicago, has also ordered this device for use on two new Allis engines now being installed. The Metropolitan Elevated Railway Company has used the Siegrist system for both cylinder and engine oil for over four years. The Siegrist automatic oiling system has also been specified by Armour & Company for use on a new ice machine and two new Corliss engines now being installed at South Omaha, Neb. This order is given after eight months' use of the system on the other machinery in the Armour plants.

HEDDEN & WHEELER, of Newark, N. J., manufacturers of varnishes, iron paints, etc., report that the growth of their business in iron paint during the past year has been very satisfactory. This paint meets the approval of everyone using it, and letters of commendation are being constantly received. The paint is well adapted to use on all exposed metal work such as electric railway poles, bridges, etc., and a number of street railway companies are using it in large quantities. Among the latter are the Consolidated Traction Company, of Jersey City, N. J.; Buffalo Railway Company, of Buffalo, N. Y.; Camden & Suburban Railway Company, Camden, N. J.; Portland Railroad Company, Portland, Maine; Middletown-Goshen Traction Company, Middletown, N. Y.; Plainfield Street Railway Company, Plainfield, N. J., and many others.

ARTHUR W. FIELD, of Boston, sole New England agent of the Peckham Truck Company and the American Car Company, has just sold the Boston Elevated Railway Company seventy Peckham Excelsior trucks to be used under the nine bench cars of the American Car Company's make, which he sold last January to the same company, and thirty pairs of Peckham maximum traction trucks to be used under the twelve-bench open cars of the American Car Company's make, which he sold to the Boston Elevated Railway Company in connection with the above. He also reports the sale of eight cars to the Western Construction Company, of New Haven, Conn., to be used on the line of the Ohio Central Traction Company, which owns a 12-mile road extending from Galion to Bucyrus, Ohio. Four of these cars are 26-ft. double truck closed cars, two of which have baggage compartments. The other four are ten-bench open cars. Mr. Field reports over $125,000 worth of business since Jan. 1.

L. E. MYERS, Monadnock Building, Chicago, has just secured the contract for building an 8-mile extension of the lines of the Chicago Electric Traction Company, from Blue Island to Harvey, Ill. Under the successful management of E. R. Gilbert, this road is giving excellent promises. Mr. Myers has also secured the contract for building and equipping the Peoria & Pekin Terminal Railway, 12 miles long at Peoria, Ill. The contract includes a power house with steam and electric equipment of 1000 h.p., car barns, round house, machine shops, office buildings and three passenger stations. A 1200-ft. steel bridge with a 380-ft. draw span will be built across the Illinois River. The contract for this has already been let to the Schultz Bridge & Iron Works. Another steel bridge 150 ft. long will be built across the Kickapoo River. The line will be equipped with both steam and electricity, the steam equipment being used for handling freight, and including fifty coal cars and three 70-ton locomotives. Seventy-pound, 60-ft. T rail and 000 figure-8 trolley wire will be employed.

W. R. GARTON COMPANY, of Chicago, has just been appointed exclusive representative of the Electrical Railway Equipment Company, of Cincinnati, Ohio, for its entire line of specialties in the Middle Western States, Chicago being the headquarters for this territory. The Garton Company will carry a very complete stock of everything necessary for the equipment of electric railways, including motor supply and repair parts. Among other concerns which this company represents are the following: Massachusetts Chemical Company and C. S. Knowles, of Boston, Keystone Electrical Instrument Company, of Philadelphia; Pittsburgh Steel Hollow Ware Company, of Allegheny, Pa.; Empire Lamp Works, Graphite Lubricating Company, of Bound Brook, N. J.; Garton-Daniels Electric Company, of Keokuk, Ia.; Partridge Carbon Company, of Sandusky, Ohio; Billings & Spencer Company, of Hartford, Conn., and it is prepared to make prompt shipments of all the products manufactured by these establishments. The Garton Company is also exclusive agent for the celebrated American incandescent lamp, which is made for all voltages and in all types. The company reports that its volume of business is extremely gratifying and it looks for a still greater increase during the coming season.

THE HARRISON SAFETY BOILER WORKS, of Philadelphia, Pa., reports the following recent sales of Cochrane heaters: Minnesota Iron & Steel Company, 350 h.p.; Dayton & Western Traction Company, West Alexandria, Ohio, 300 h.p; Chase & Company, Boston, 150 h.p.; Sears, Roebuck & Company, Chicago, 100 h.p., special; Douglas & Company, Minneapolis, Minn., 200 h.p.; McGinn & Lewis, Pittsburgh, 350 h.p., special; Avondale Mine, Plymouth, Pa., 850 h.p.; Parke & Lacy Company, San Francisco, Cal., 50 h.p.; Imperial Ice Company, Philadelphia, 100 h.p.; Bland, Bullen & Gund Company, Chicago, 350 h.p.; Liberty Mills, San Antonio, Tex., 200 h.p.; Republic Marble Company, Luttrell, Tenn., 150 h.p.; Pana (Ill.) Modern Electric Light, Power & Street Railway Company, 500 h.p.; Alabama Ship Building & Dry Dock Company, Birmingham, Ala., 3000 h.p.; Pabst Brewing Company, Milwaukee, Wis., 500 h.p., and many others. The company also reports the following sales of Cochrane separators: Pejepscot Paper Company, Pejepscot Mills, Maine, 10-in. horz.; J. D. McRae & Bro., Chicago, 4-in. horz.; Empire State Dairy Company, Brooklyn, N. Y., 4-in. horz.; Nutter & Seabury, Boston, 8-in. horz.; Estey Organ Company, Brattleboro, Vt., 8-in. horz.; Warner Bros., Chicago, 4-in. horz.; La Compagnie Generale Glace Hygienique, Paris, France, 6-in. horz.; Atlas Cement Company, Northampton, Pa., 4-in. horz.; United Shirt & Collar Company, Troy, N. Y., 6-in. horz.; Monessen (Pa.) Steel Company, two 5-in. vert., one 6-in. vert., and one 8-in. vert., also 6-in. horz.; Dover Iron Company, of New Jersey, 8-in. horz.; Dill & Collins, Philadelphia, 6-in. horz.; Fergus Falls (Minn.) State Hospital, 4-in. vert.; P. Cogan & Son, Stoneham, Mass., 4-in. horz.; Walworth Construction & Supply Company, Boston, 5-in. horz., and many others.

New Publications

Fourteenth Annual Report of the Board of Gas and Electric Light Commissioners of the Commonwealth of Massachusetts. Paper. 210 pages, with appendix of 158 pages. Published by Wright & Potter Printing Company, State Printers, Boston, Mass.

This very complete report contains full financial and other information pertaining to the 158 companies, and the gas and electric light plants in fourteen towns and two cities which are under the supervision of the Board of Gas and Electric Light Commissioners.

Trade Catalogues

Various Catalogues. Published by the General Electric Company, of Schenectady, N. Y.

Trucks. Published by the Taylor Electric Truck Company, of Troy, N. Y. 39 pages. Illustrated.

Steel Plate Fans. Published by the B. F. Sturtevant Company, of Boston, Mass. 131 pages. Illustrated.

Attractions for Pleasure Resorts. Published by J. W. Gorman, Boston, Mass. 32 pages. Illustrated.

Mechanical Draft. Published by the B. F. Sturtevant Company, of Boston, Mass. 8 pages. Illustrated.

Biddle's Bulletin for February, 1899; Volume 1, No. 9. Edited by James G. Biddle, of Philadelphia. 8 pages.

Electrical Instruments. Published by the Weston Electrical Instrument Company, of Newark, N. J. 60 pages. Illustrated.

Architects and Engineers Electrical Bulletin for February, 1899. Published by the Sprague Electric Company, of New York. 50 pages. Illustrated.

...SUPPLEMENT...

TO THE

Street Railway Journal

Expert Opinion of the New Rapid Transit Proposition in New York

[The following letter, written by President Stuyvesant Fish, of the Illinois Central Railroad Company, to Chairman Orr, of the New York Rapid Transit Commission, has just come into our possession, and is so full of valuable suggestions, based on the writer's experience with the extremely interesting transportation problems in Chicago, that we have decided not to postpone its publication until next month, but to give it at once to our readers.—Editors Street Railway Journal.]

ILLINOIS CENTRAL RAILROAD COMPANY, 214 Broadway.
NEW YORK, March 29, 1899.

MY DEAR SIR:

Permit me to add my congratulations to the hundreds which you must be receiving over the success of the Rapid Transit Commission in securing so fair a proposition as appears to have been made on behalf of those controlling the Metropolitan Traction Company, and to submit some considerations, based on a long experience, in respect to rapid transit in Chicago.

Bear in mind that I am in no way interested in any present or prospective line of communication on Manhattan Island, nor have I ever been so interested in any, and that the Illinois Central Railroad Company has now been running suburban trains in Chicago for over forty years.

I.

A hurried reading of the proposition before you, as given in the newspapers, has not enabled me to see that the vital point of speed of ordinary trains is guaranteed.

The title and the reason for the being of your commission require you to exact rapid transit and that of the rapidest kind consistent with safety and comfort. The utter inefficiency of existing means and the failure, in the past, of such means to even keep abreast of the times, much less to meet a growing demand, require that such guarantees of speed should be most strict, and broad enough to cover the needs of the future.

As no such guarantees can be fulfilled if the carrier is hereafter to be burdened with the payment of an excessive per cent of its profits as taxes, or restricted too much in respect to maximum charges, a liberal, broad-minded, live-and-let-live policy should be adopted and adhered to in this respect.

The Manhattan Elevated Railway, which, after all, affords our nearest approach to rapid transit, advertises, in the "Official Railway Guide," the following schedules on Manhattan Island for its express trains:

Second Avenue,
South Ferry to 129th Street:

Miles	8.81
Minutes	40
Miles per hour	13.21

Third Avenue,
South Ferry to 129th Street:

Miles	8.48
Minutes	40
Miles per hour	12.72

Sixth Avenue,
South Ferry to 155th Street:

Miles	10.76
Minutes	49
Miles per hour	13.17

Ninth Avenue,
South Ferry to 155th Street:

Miles	10.07
Minutes	42
Miles per hour	14.39

Including the initial and terminal points, there are advertised as being on the

Second Avenue	27 Stations in	8.81 miles.
Third Avenue	38 Stations in	8.48 miles.
Sixth Avenue	31 Stations in	10.76 miles.
Ninth Avenue	29 Stations in	10.07 miles.

But the express trains stop at comparatively few of these stations.

The number of stops made by their express trains is unknown to me, but, of course, accessible to you.

The speed of the Manhattan Company's other, local, trains is much less.

Now the ordinary or local trains of the new "Tunnel Company" will meet with no competition as to speed of a higher order than that which is or may be afforded by the trains of the Manhattan Company.

It would, therefore, seem necessary that you now require of the tunnel company a guarantee of such minimum speed on its ordinary trains as it can perform and you may deem satisfactory.

The only thing which I have found in the tunnel company's proposition in respect to speed applies solely to express trains, and is as follows:

"No train to be deemed an express train except one which is scheduled to run, and, barring accidents, does customarily run, over its entire route below Ninety-sixth Street at the rate of 20 miles an hour, and for at least 2 miles below Forty-second Street at the rate of 30 miles an hour."

It is not stated that intermediate stops are to be made below Forty-second Street, and from the different speeds offered above and below that street, it is to be inferred none will be made by express trains.

The distance from Forty-second Street to the southern terminus will, if the latter be placed at South Ferry, amount to about 4 miles. Time, eight minutes.

The distance from Ninety-sixth Street to South Ferry will be about 6.75 miles. Time, a trifle over twenty minutes.

While I would deprecate a discussion of details, and do

not advocate trying to bind the tunnel company too strictly, I beg to submit from the printed schedules of the Illinois Central Railroad Company what is being done in Chicago.

The plant comprises, in addition to side tracks, the exclusive use of two main, or running, tracks, from the initial station, Randolph Street (in the business center) to the next station, Van Buren Street (64-100 of a mile), four running tracks thence to Sixty-seventh Street (8.21 miles from Randolph Street), and two running tracks thence out of town.

There is a local service stopping at every station (seventeen stations in 8.21 miles, from Randolph Street to Sixty-seventh Street, inclusive), and also an express service. Both start on the same tracks from Randolph Street Station, each stops at Van Buren, and the express trains run thence to Hyde Park (6.38 miles from Randolph Street) without stopping, and thereafter make various stops.

ILLINOIS CENTRAL R. R.

Local Suburban Trains.

Randolph Street to Douglas Station:	
Miles	4.01
Stops at all stations	8
Minutes	13
Miles per hour	18.51
Randolph Street to South Park:	
Miles	6.88
Stops at all stations	14
Minutes	22
Miles per hour	18.76

ILLINOIS CENTRAL R. R.

Express Suburban Trains.

Randolph Street to South Park:	
Miles	6.88
Stops	4
Minutes	13
Miles per hour	31.75
Van Buren Street to Hyde Park:	
Miles	5.74
Stops	2
Minutes	9
Miles per hour	38.27

I have, throughout this letter, included the initial and the terminal stations; the express trains make no intermediate stop between Van Buren Street and Hyde Park

The motive power used by the Illinois Central consists of steam locomotive engines, most of which were built many years ago. If the tunnel company is to be tied down to electricity as a power, it cannot, in the present state of the science, be required to make the speed of our trains. We believe, however, that before long it may become possible to move trains by electricity on our schedules, and we have been carefully watching developments in that direction for many years.

On the other hand, the use of electricity as a motive power, in an underground tunnel, will admit of thoroughly heating the stations and platforms, and of using, throughout the year, side-loading cars. We found, during the World's Fair, that the use of such cars effected a great saving of time at stations.

Without professing to know, I should guess that the tunnel company could safely covenant to put in stations averaging about half a mile apart (those of the Manhattan Company averaging a little less than one third of a mile apart), and to run their local trains at a minimum speed of 15 miles per hour, including stops at each, from Forty-second Street south, and also to guarantee a minimum speed of 17 miles per hour, including a stop at each station for the whole distance from Ninety-sixth Street to the southern terminus.

This would give from Forty-second Street to South Ferry a local schedule of sixteen minutes, and from Ninety-sixth Street to South Ferry one of twenty-seven minutes, with corresponding time from intermediate points.

Unless from and to all stations something faster than the so-called express service of the Manhattan is guaranteed and furnished, the tunnel company will neither furnish rapid transit nor be able to survive in competition with the Manhattan.

A guarantee of such speed will prevent an amalgamation with the Manhattan far more effectual than any statutory prohibition, which, after all, is subject to repeal. It will also stimulate the Manhattan to do better, and in my judgment to fare better thereby.

II.

The right to charge an extra fare up to not exceeding ten cents on express trains should be granted, (*a*) in order to prevent those trains being overcrowded by passengers wishing to ride only from one station to the next and incommoding those performing a longer journey, while saving but a fraction of their own time; (*b*) in order to induce the carrier at all times hereafter to keep up that service to the highest standards of safety, efficiency and speed, and thereby make life livable in the upper part of Manhattan Island and the annexed district; (*c*) because the length of the journey, 6.75 miles now, and potentially much more, justifies the charge, especially in view of the tremendous verdicts now so often awarded in personal injury cases, and the expense to which carriers are put through the wiles of shyster lawyers and perjured witnesses in such cases.

Disregarding persons of ample means, to whom the extra five cents each way *per diem* or $36.50 a year is of no consequence, there are occasions in the life of all, except the absolutely penniless—festivals and funerals, times of illness and complete exhaustion, the necessity to catch a train or meet an appointment—in which they would gladly pay five cents for extra comfort and speed in transit. That our civilization and methods of life have advanced to this point is shown by the universal use of sleeping, dining and drawing-room cars on railroads, of providing staterooms as well as mere sleeping berths on all our river and sound steamers.

That the public will gladly pay an extra fare for higher speed was demonstrated in Chicago in 1893, although as a people we were all then economizing severely.

This is made clear by the following extracts from published reports.

Annual report of the Illinois Central Railroad Company for the year ending June 30, 1894, page 1:

"During the six months, from May 1 to Oct. 31, 1893, there were carried, at a uniform fare of ten cents for a journey of over 9 miles, 8,780,616 passengers on the special World's Fair trains, without serious injury to any of them. In the regular suburban trains there were carried during that period 9,358,695 passengers, and the travel in the other passenger trains was also unusually large. The universal satisfaction with the facilities afforded, as expressed by the public through the press and by the directors of the World's Columbian Exposition in formal resolutions, redounds highly to the credit of the service and of the officers and employees engaged therein. The fact that the fare charged by the company was double that of its principal competitor, the elevated railway, demon-

strates that the public are willing to pay reasonable rates for adequate service, when performed with promptness, safety and comfort to the passenger."

Mr. H. N. Higinbotham, president of the World's Columbian Exposition in his report to the board of directors of that corporation, dated Jan. 1, 1898, states, at page 306, that the Illinois Central Railroad Company estimated the number of passengers carried upon its trains between the city and the fair as follows:

Express or special World's Fair trains	8,779,393
Local suburban trains	9,559,791
Other trains	1,003,600
Total by I. C. R. R.	19,342,784
And on the next page (307) he gives the number landed in the fair grounds by the elevated railroad as	4,352,409
Dividing the number carried by the Illinois Central by two, so as to get at the actual number of passengers brought to the fair, we have..	9,671,392

From which we must infer that at that time and place two-thirds of those who traveled by rail preferred to pay ten cents for a quicker, instead of five cents for a slower, service.

The initial stations of the Illinois Central Railroad, and of the elevated railway referred to, were within about a quarter of a mile of each other, and the latter had the more central location. The elevated also enjoyed the advantage of picking up passengers at many intermediate stations, which the Illinois Central could not do on its special World's Fair trains, but only on its regular suburban trains, and to a very limited extent, if at all, on its other trains, referred to by Mr. Higinbotham.

III.

At the risk of getting into details, let me also suggest that the tunnel company be required to find a seat for each passenger. This can be done. It was done, with few and rare exceptions, all throughout the summer of 1893 in our World's Fair trains. It is done daily on the London underground railways, indeed on all English railways with rare exceptions. The use of side-loading cars makes this possible, and it was largely from my experience while traveling abroad that I insisted on the use of that form of car for that special service. It also has the merit of economy of space by giving a much greater seating capacity in proportion to length of train, and consequently of platform. The latter will prove a vital consideration to the tunnel company.

IV.

You have doubtless gone too far to now take up one more suggestion which has been "borne in" on me.

As yet electricity has not been applied in such a way as to give a service equal in speed to that furnished by the Illinois Central in Chicago by using steam. After the most careful, painstaking and patient investigation, we have been forced to adhere to the use of steam, although anxious on many accounts to substitute electricity.

In a tunnel, steam would be intolerable, witness the London underground steam railways.

While I believe electricity can be hereafter so used as to develop schedules about equal to those which we now have in use in Chicago, there is as yet nothing to show that better can ever be done through the use of electricity. Our investigations teach us that with each added unit of speed the cost increases more rapidly where electricity is used than where steam is used.

When your commission began its labors, and even when it formulated and promulgated its plans, the success of the underground trolley had not been demonstrated here in New York. You therefore turned to an underground railway as the only solution.

If not too late, might I suggest at least the consideration of the following plan:

The city has been for many years widening West Street, and has the similar improvement of South Street in view. Why not build on each of these streets (widened) a four-track elevated railroad on which express and local trains can be run as fast as are those of any railroad, and with the same indefinite possibilities as to speed in the future?

In order to avoid the long bend of the East River, which culminates in Corlears Hook, the line on that side of town might leave South Street in the neighborhood of Pike, run through private property to the southern terminus of Essex Street, along that street (widened) until Avenue A is reached, and thence up that avenue.

The other line on the west side might take up the general course of Eleventh Avenue, or possibly Twelfth.

Roughly speaking, the distance between Avenue A and Twelfth is a trifle over 2 miles.

Given two such railroads as are herein suggested, with an express service on each at the rate of at least 40 miles an hour, and local service at at least 20, and trolley lines across town on suitable streets, making 6 miles an hour—as the distance from the Battery to Harlem Bridge is less than 9 miles—one could go from any central point down-town to his home on Manhattan Island below 130th Street in twenty-three and one-half minutes, as follows:

Battery to Harlem,

Express 9 miles at 40 miles per hour.... 13½ minutes.

Across town,

Trolley 1 mile at 6 miles per hour..... 10 minutes.

Total ..... 23½ minutes

This would be something worth having.

The New York Central & Hudson River Railroad might accept the use, during the night, of two tracks on the west side line, from its depot in St. John's Park, to, say, Thirtieth Street, and give up its tracks in Eleventh Avenue and other streets south of, say, Thirtieth Street.

The use of the remainder of two tracks for freight purposes during the night would prove a great source of revenue, relieve our congested streets, make property along both lines valuable for storage purposes and equip this city, as it never can in any other way be equipped, to handle freight cheaply and promptly in competition with other ports and cities.

The magnitude of the interests involved and the possibilities now in sight must excuse so long a letter.

With renewed congratualtions and best wishes for an ultimate, complete and final success, believe me,

Very respectfully yours, Stuyvesant Fish.

To the Hon. Alexander E. Orr,
Chairman of the Rapid Transit Commission.

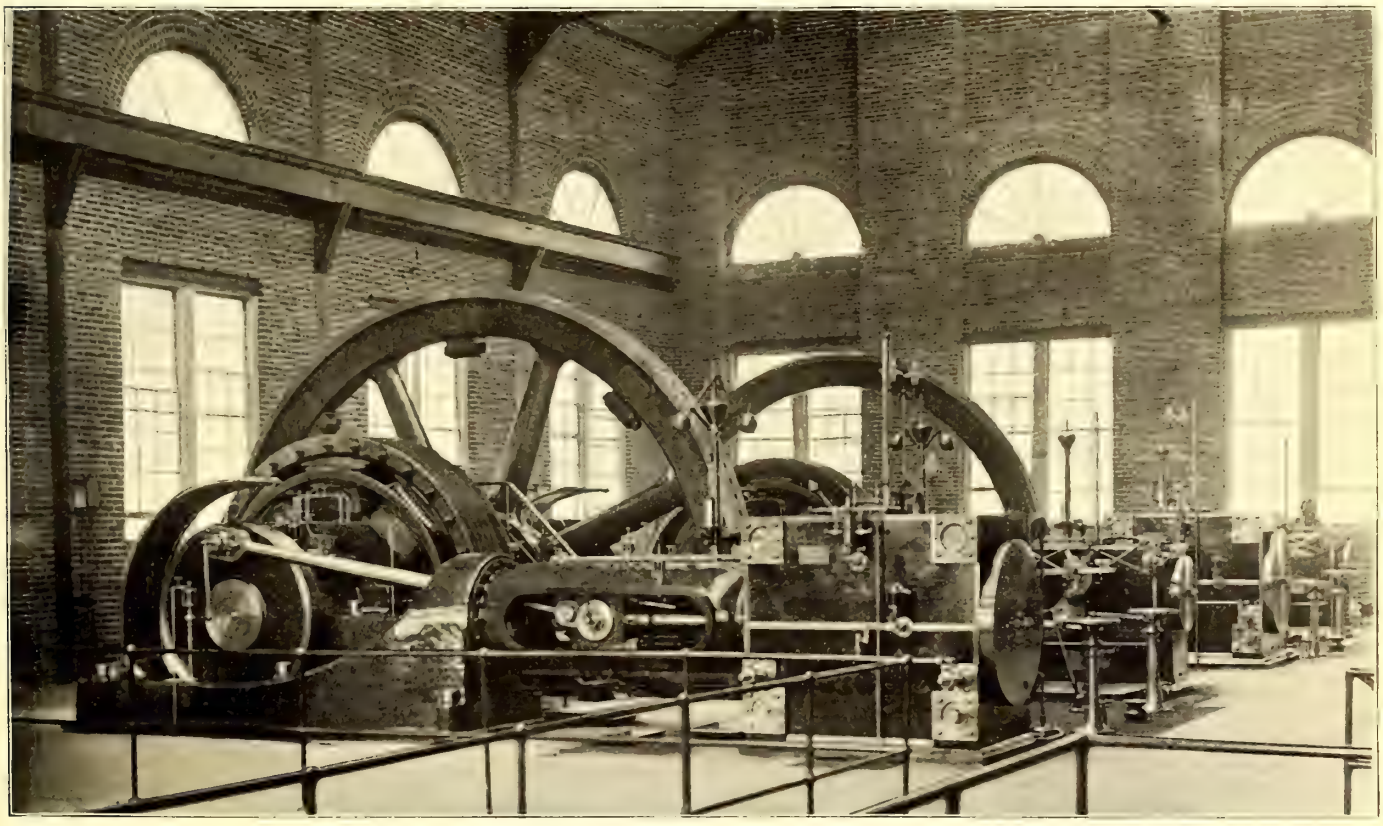
Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, MAY, 1899. No. 5.

ANALYSIS OF THE OPERATION OF AN INTERURBAN RAILWAY

The district around Cleveland, Ohio, has become widely known from the number and extent of the interurban electric railways which radiate from that city as a center. The growing number, throughout the country, of railways of this character makes a study of the results secured on some of the older interurban lines a particularly interesting problem. The subject differs in a number of particulars from that of the ordinary street railway, owing (1) to the distance over which power is transmitted before reaching the cars, (2) to the size and weight of the cars operated, and (3) to the high speeds attained. The road selected for study in this article is that of the Lorain & Cleveland Railway Company, one of the more recent of the Cleveland interurban lines. The length of this road from Rocky River, the terminal of the Cleveland City Railway, to Lorain, is 18.5 miles. The track is built over private right of way. There are practically no grades or curves. The schedule running time between these terminals is three-quarters of an hour, and as there are numerous stops, a speed of from 45 to 50 miles or more is often made over a considerable portion of the route. To keep up the schedule it is not only necessary for the cars to make the high speed mentioned, but also to accelerate rapidly. For this reason, each car, which weighs about 22.5 tons, is equipped with four General Electric 50-h.p. motors. Upon reaching the eastern terminal of the line at Rocky River, the cars pass over the tracks of the Cleveland City Railway Company, a distance of 8.5 miles, to the Public Square in Cleveland. On this portion of their route the cars are supplied with current from the power station of the Cleveland City Railway.

During the winter months, the cars operate on an hourly schedule, and during the summer run every half hour. When running every hour there are only from two to three cars at any one time between Rocky River and Lorain, which is the section fed from the power house of the Lorain & Cleveland Railway Company. When the cars are run on the half-hourly schedule, there are from four to five on this section, with the addition often of excursion cars. It is very evident that with a few cars, each equipped with four motors geared for high speed, and starting with a rapid acceleration, the fluctuations of load in the power house must be large, and the machinery installed must necessarily be designed for a wide range of load, and be reliable when operating under large overloads.



INTERIOR OF POWER STATION, LORAIN & CLEVELAND RAILWAY

ROAD AND LINE WORK

The road being on private right of way, the roadbed was built similar to steam road practice, being ditched on

each side and gravel ballasted. The ties are of 6-in. x 8-in. x 8-ft. oak, spaced 24 ins. on centers. The rails are 70-lb. A. S. C. E. standard, with suspended joints and standard four-bolt splice bars. The sidings are 1500 ft. long, with combination spring and throw switches, supplied by the Cleveland Frog & Crossing Company, and fitted with regular steam railroad night and day signals. The curves into these sidings are very easy, so that the cars run into the switches and out again at nearly full speed, with very little swaying. The overhead material is very heavy in all its parts. The poles are 30 ft. 7 ins. in height, with all poles on curves trussed to an anchor behind them, and all poles are braced with a 4-in. x 6-in. x 8-ft. brace placed against the pole about 4 ft. above the ground, and



EXTERIOR OF POWER STATION

the other end against a 4-ft. stake driven with a piledriver. This has been found necessary, as the two No. 000 trolleys suspended over the track make a very heavy load on the cross suspension. It was found almost impossible to keep the poles from springing in without this additional brace, but by means of it the line has gone through an exceptionally hard winter and the soft weather of the spring with very few repairs.

The line extends 12 miles east from the power house and 6½ miles west. The feeders are all of 300,000 c.m., one going 11 miles east, one 10 miles and one 9 miles; and one going 2 miles west, and one 5 miles. By using the double trolley all overhead switches are avoided, so that the cars enter and leave the turnouts without danger of the trolley leaving the wire.

In this connection it is interesting to note that on account of the high speeds and large current taken from the wire the tension of the trolley against the wire has been fixed at from 35 lbs. to 40 lbs., which is much higher than common practice. The trolley wheels are 6 ins. in diameter, with ⅝-in. pin, 2 ins. long, but they are now being changed to wheels 7 ins. in diameter. The life of trolley wheels will not exceed one week, which shows the excessively hard usage to which they are subjected.

ROLLING STOCK

The car equipment at present consists of ten regular passenger cars and two combination passenger and baggage cars. These are equipped with Brill No. 27 trucks, and weigh about 4800 lbs. each. The wheels are 33 ins., with 2⅝-in. tread and 1-in. flange. As electric brakes are used, which are applied direct to one wheel of each pair, the wheels themselves differ in weight, the brake wheel weighing, when new, 520 lbs., while its companion weighs 460 lbs. The motors have thirty-three teeth on the pinion and fifty-two on the gear, which gives a ratio of 1.579.

The car bodies are also of Brill make, and are 34 ft. 6 ins. long and 42 ft. 6 ins. over all, 8 ft. 4 ins. wide, and 12 ft. 6 ins. from track to trolley base. Each car has a telephone with extension rod, for connecting at the contact boxes placed every quarter of a mile along the line, and there are also stationary telephones at every switch, at the ends of the line, at the power house, shops and superintendent's residence.

To carry out the analogy of the steam road practice still further, the cars are equipped with regulation railroad signals. Each car runs a total of 340 miles per day, 240 of which is on the company's tracks, the rest being in the city limits. This gives a total of 720 car miles per day on hourly service, which requires three cars, and 1440 car miles per day on half-hourly service, which requires six cars.

A record of the current and voltage of the car gave an average for one trip of 140 amps. and 565 volts. The record of speed test taken at the same time gave as follows:

LORAIN & CLEVELAND RAILWAY, SPEED TEST, DEC. 30, 1898.

GOING WEST	Distance	Time	Miles Per Hour
Lv. Rocky River double track....12:10.5	3.56	5½ min.	39
Ar. Dover Switch 12:16			
Lv. Dover Switch 12:17	4.52	6 "	45.1
Ar. Mitchell Switch 12:23			
Lv. Mitchell Switch....12:24	2.44	3 "	48.8
Ar. Avon Beach Park....12:27			
Lv. Avon Beach Park....12:28.5	1.39	1.5 "	55.5
Ar. Sheffield Switch 12:30			
Lv. Sheffield Switch 12:31	4.91	7 "	42.2
Ar. Reverse Curve 12:38			
	16.82	23m.	43.8
GOING EAST			
Lv. Reverse Curve.... 1:48	4.91	6 min.	49.2
Ar. Sheffield Switch 1:54			
Lv. Sheffield Switch.... 1:54	1.64	2 "	49.2
Ar. Avon Beach Park.... 1:56			
Lv. Avon Beach Park.... 1:59	2.44	3 "	49
Ar. Mitchell Switch 2:02			
Lv. Mitchell Switch 2:15	4.52	6 "	45.1
Ar. Dover 2:21			
Lv. Dover 2:21	3.84	6 "	38.5
Ar. Double Track 2:27			
	16.28	23m.	43.8

Increased distance going east over that going west is due to including the length of two switches on the trip east which were not counted in on the trip west.

This was a special test, and was not taken under operating conditions, as no stops were made between switches to take on or let off passengers. The records show a maximum of 55.5 miles per hour from Avon Beach Park to Sheffield switch, and a minimum of 38.5 miles per hour from Dover switch to Rocky River double track. The first is a straight, level track going west from the power

house, and the latter is the last stretch before reaching the city tracks, and contains two trestles, a drop under the Nickel Plate track combined with a reverse curve, all of which necessitate slowing up.

Referring to the power house report for week ending Jan. 1, 1899, the kw. hours for Friday were 2450, and the car mileage 720, which gives an output of 3.40 kw. hours per car mile, and at the rate given, of 6.4 lbs. of coal per kw. hour, this requires 21.8 lbs. of coal per car mile.

The average for the week was 823 car miles per day and 3227 kw. hours, which gives 3.9 kw. hours per car mile, and 21.5 lbs. of coal per car mile.

POWER STATION

The power station was illustrated and described in the STREET RAILWAY JOURNAL for April, 1897, and was then in course of construction. The plant was put in operation on Oct. 1, 1897, and has given very satisfactory results. The superintendent states that at no time has any part of the machinery had to be stopped because it was out of order, and that during the first year there was no expense for repairs.

The power house is located on the shore of Lake Erie, on a bluff, the top of which is about 22 ft. above the lake level. In order that the coal should fall by gravity from the coal bunker into the furnace, it was necessary to excavate about 16 ft., the excavation on the bluff side being carried right out to the beach.

The coal cars are run up an incline which brings them about 12 ft. above the ground level. The coal drops through the bottom hoppers in the cars into the coal storage. From the storage bins it passes through inclined chutes into the hoppers of the Murphy stokers. The inclined chutes are suspended from scale beams, and each chute load is weighed by Fairbanks scales. The average load is about 500 lbs. The ashes are removed from the pits by manual labor, as it was not considered advisable to install ash conveyors in a plant of this size.

The boilers now in place are four 300-h.p. Stirling boilers. The stack is of brick, 100 ins. in the clear, and 200 ft. high. In the breeching is a damper controlled by a Locke regulator. The water fed to each boiler is controlled by a Thomas boiler feed governor, and on each boiler there is also a Reliance column with high and low water alarm. In the pump pit are two Blake vertical condensers, and a Blake pump for fire and water works service, and which pumps to a 50,000-gal. tank located next the Park system. There is also a small Blake pump which draws from the hot well and discharges into a Stillwell & Bierce open heater; this pump is automatically governed by a Fisher governor. The water is drawn from the heater and fed to the boilers by either one of two Blake outside packed plunger pumps; these are also controlled by Fisher governors. The fire service pump and these two feed pumps are cross connected, and the low service pump drawing from the hot well is also cross connected with one of the feed pumps.

The water in the condensers is obtained through a 20-in. pipe, leading from the cold well outside the building. From the condensers the overflow discharges into a 20-in. pipe, and from the bottom of the pipe leading to such discharge a smaller pipe leads to the hot well.

The steam from the boilers passes through semi-circular bends, each of which has two valves, to a 20-in. header, and thence through Cochrane separators to the high pressure cylinder of the engine. A butterfly valve is placed in each line, and if the speed of the engine increases more than 10 per cent above the normal, the special governor operates this butterfly valve, shutting off steam from the engine, and at the same time making electrical connection which trips the generator circuit breaker on the switchboard. This prevents a flow of current from the switchboard to the generator, which would tend to make it act as a motor. This device was installed at the suggestion of Mr. Wason.

Each engine is a 20-in. and 36-in. x 48-in. C. & G. Cooper cross compound condensing engine, fitted with double eccentrics, and with Tripp's metallic packing. A Musgrave column is used in connection with the sight feed lubricator for the cylinders, and hand pumps are also provided. From the engine the steam passes through a Cochrane exhaust separator to the condenser, with a Blake relief valve in the connection to the atmosphere.



BOILER ROOM AND COAL SCALES

There is a complete system of lubrication of all machinery by gravity pressure from tanks in the boiler room above the boilers. These tanks are fed by pumping from barrels, or a Cross oil filter placed on the floor below the engine room floor and between the engine foundations.

The high pressure piping is all extra heavy flanged, tongued and grooved, and with copper gaskets. It is covered with Keasby & Mattison's magnesia sectional covering. The low pressure pipe is standard pipe covered with magnabestos. The valves are Crane extra heavy bronze seated, and all the larger ones are by-passed. The angle and globe valves are Jenkins'. The water of condensation from all the live steam piping is returned to the boilers by the Holly gravity system.

The generators are two 400 kw. Siemens & Halske, with outside armature and separate commutator. The switchboard has the usual number of instruments, those for measuring the current being of the Weston type. In ad-

dition there is a General Electric recording wattmeter and a Bristol recording voltmeter.

On the gage board there are, in addition to the usual gages, a recording steam gage and a recording draft gage, both made by the Bristol Company.

The traveling crane has a capacity for 15 tons and has two 10-ton trolleys, each fitted with triplex blocks. It was built by the Cleveland Punch & Shear Works.

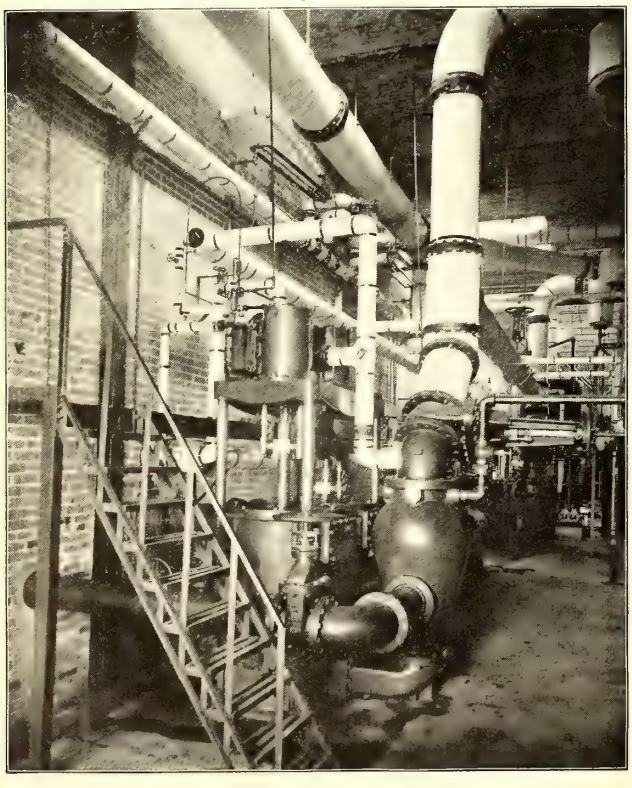
The building is a self-supporting steel structure, having steel roof trusses with steel purlins, the trusses resting on steel posts built into the brick walls. The floor of the engine-room is concrete, resting on hollow tile and supported by steel beams. The flooring between the engine foundations and the pump pit in the boiler room is concrete.

The labor in attendance on the plant consists of two engineers and two firemen and one man who unloads coal, cleans up the plant and acts as a general assistant. The chief engineer, one foreman and the general assistant are on duty during the daytime, and the second engineer and firman at night. These men will still be able to take care of the plant after it has been largely increased.

OFFICERS AND CONTRACTORS

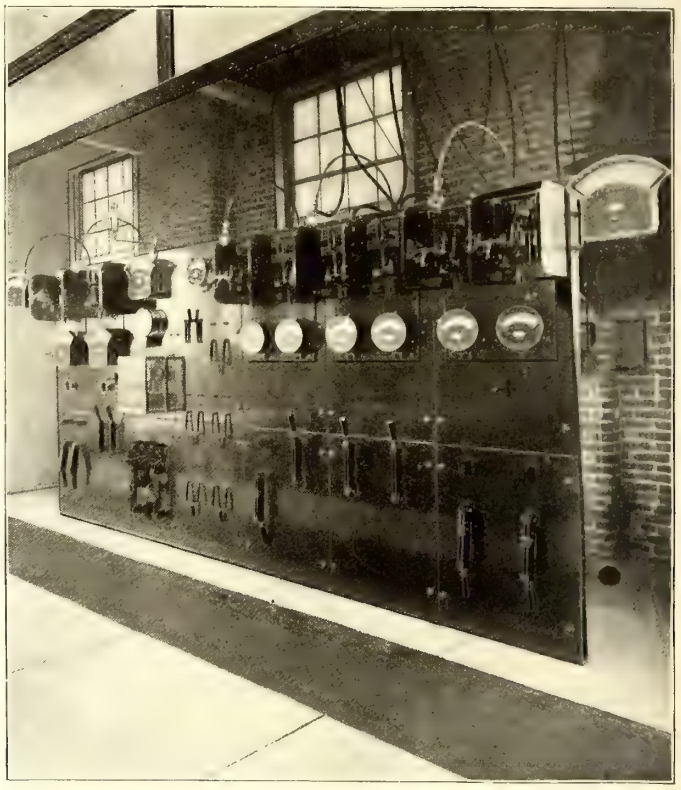
After a considerable portion of the civil engineering in connection with the road had been completed, and the equipment of the cars decided upon, the company engaged E. P. Roberts & Company to design the power station and supervise its erection. Prominent members of the company at that time, as at present, were B. Mahler, Henry A. Everett, E. W. Moore, and C. W. Wason, all well known in electric railway circles. Mr. Wason also acted as consulting engineer for the road.

E. P. Roberts & Company engaged as architect J. N. Richardson, and to design and inspect the steel work and the steel used in the boilers, the Osborn Company. J. N.



VIEW OF PUMPS

Richardson also designed the car houses for the company, and the Osborn Company inspected the steel for the track and designed some of the bridges. The building contractors were L. Dautel, for the mason work; J. W. Vanderwerf, for the carpenter work, and the Forest City Wire & Iron Company, for the structural steel. The piping contractors were Chafer & Becker, who had all the large pipe furnished by the Crane Company, of Chicago, who made



SWITCH BOARD

the piping in accordance with the drawings of the engineers.

TEST OF POWER PLANT EQUIPMENT

The following is the result of a test made upon the plant. During the time of the test the line was operated on a one hour schedule, by three cars running between the Puplic Square, in Cleveland, and the bridge at Lorain. This schedule was such that one car was on the Cleveland City Railway Company's line all the time, leaving only two regular cars to be supplied with power by the power house. In addition, there was a work train on the road, which sometimes took more power, for short intervals, than a regular car. The time table was so arranged that four cars were used with three crews, one car being kept at the Lorain end for inspection. Thus, a crew would bring in a car at the Lorain end, leave it there and take the car that had been at that point. This, of course, necessitated the running of this extra car to Lorain in the morning and back to the car house at night, a total distance of about 12 miles.

The first test, Feb. 12, 1898, was with two boilers feeding one engine, the generator connected to which supplied current for the regular operation of the line. On the second test, Feb. 14, 1898, the same engine as on Feb. 12 was used to supply the line, and the second engine was run on a steady load provided by a water rheostat. The steam used by these two engines could not be supplied separately, as there was no valve permitting this to be done.

The objects of the two tests were, first, to get the running efficiency of the plant; and, second, to obtain the efficiency of the engines and generators, under a full rated load. In order to accomplish this, it was necessary to obtain the variable load each day and to apply the results obtained on the test for variable load on the first day, to the variable load on the second, and to subtract such figures

from the totals obtained for variable and constant load and thereby obtain the values for constant load.

Although it was necessary to make assumptions as to certain steam consumptions by auxiliaries, it is thought that the results obtained are very nearly accurate, and sufficiently so for all practical purposes. That they are very close is proved by the fact that on the curve of performance for seven months the curve passes through the point obtained at the test, as described later. However, because of the assumptions made, it must not be thought that the engine performance at full load may not have been somewhat better than stated, and furthermore, it must be remembered that the cylinder ratio was for variable load, and therefore that the results at steady and rated load could not be as good as if designed for operation under such conditions. The principal value of the results of the tests is in showing the difference in efficiencies at rated load and at a small and variable load, and the test, taken in connection with the curve of daily performance, is of value in showing the result of increased average although greatly varying load, on the steam and fuel consumption.

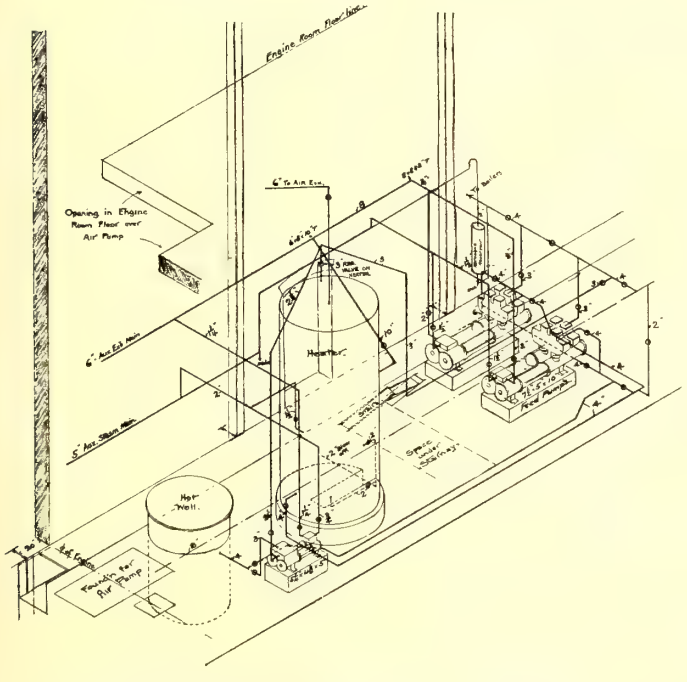
In the data following the tabulation, the numbers refer to the corresponding numbers in the tabulation.

INSTRUMENTS USED

All the gages, indicator springs, and electrical instruments were carefully calibrated by reference to standards.

The coal was weighed in the steel chutes, regularly in use, which are hung on Fairbanks scale beams. These scales were all tested by weighing a known weight on the test scales, and then hanging it on to the chute belonging to the scales to be tested. These scales are tested very closely, and proper correction was made in the coal weights for all differences.

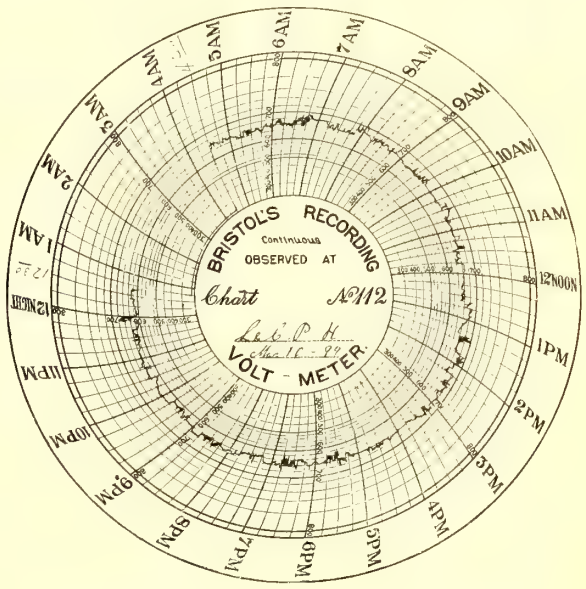
A large tank with an inverted funnel top, and a neck about 10 ins. in diameter, had been especially prepared for weighing water. This tank was filled from the service line by a 3-in. pipe closed by a quick acting lever valve, and



ISOMETRIC DIAGRAM OF PUMP CONNECTIONS

was emptied into a somewhat larger storage tank by means of a 4-in. pipe closed by a quick acting valve. In the 10-in. neck of the weighing tank an overflow pipe led to drain. As the tank was filled to this overflow, and allowed to drain from that point, the amount of water contained in the tank was identical for each filling. The tank was filled and then the water drawn off into a barrel placed on the test scales and thus weighed. This was repeated several times, and the readings gave only from .5 lb. to 1 lb. difference in 3676 lbs. for a full tank. The boiler feed pumps drew direct from the storage tank above mentioned.

It will be noted that the temperature of the feed was



VOLTMETER RECORD, MAR. 10, 1899

much lower than in practice because of the drawing from the tank, and not from the heater. The tables give the value of the difference.

BOILER TEST

1.	Date of trial	Feb. 12,'98.	Feb. 14,'98.
2.	Duration of trial	20.63 hrs.	20 hrs.

DIMENSIONS AND PROPORTIONS

		First day, two grates.	Second day, three grates.
3.*	Grate surface—length, 6 ft. 1 in.; width, 7 ft. 8 ins. Area ..... sq. ft.	143	214.5
4.*	Maker's rating ..... projected area.	92	138
5.*	Water heating surface ..... sq. ft.	6,076	9,114
6.	Super-heating surface ..... sq. ft.	0	0
7.	Ratio of water heating to actual grate surface	42.48	42.48
8.	Ratio of water heating to projected grate surface...	66.03	66.03

AVERAGE PRESSURES

9.	Steam pressure by gage ..... lbs per sq. in.	131.6	132.1
10.	Absolute pressure ..... lbs.	145.93	146.44
11.	Atmospheric pressure by barometer, ins. mercury.	29.25	29.26
12.*	Force of draft between damper and boiler, ins. of water ..... ins.	.2	.2

AVERAGE OF TEMPERATURES

13.	Of external air ..... degs. F.	42	33
14.*	Of feed water entering boiler ..... degs. F.	39	37.47
15.	Of boiler flue gases ..... degs. F.	425	522.2

FUEL.

16.	Size and condition, Wheeling Creek bituminous; quite dry.		
17.	Weight of coal as fired ..... lbs.	17,471	39,679
18.	Percentage of moisture in coal ..... per cent.	.36	.36
19.	Total weight of dry coal consumed ..... lbs.	17,408	39,536
20.*	Total ash, refuse and fine coal ..... lbs.	3.360	5,530
21.	Total combustible ..... lbs.	14,048	34,006
22.	Percentage of ash and refuse in coal ..... per cent.	19.3	14

ANALYSIS

23.	Carbon	70.62	Nitrogen	.93	
24.	Hydrogen	6.15	Sulphur	3.61	
25.	Moisture	.36	Oxygen	7.76	
26.*	Ash	10.57	H. U. per lb., by analysis.	13,522	13,522

Formula—H. U. $= 14{,}600\ C + 62{,}000\left(H - \frac{O}{8}\right)$

FUEL PER HOUR

27.	Dry coal consumed per hour ..... lbs.	843.8	1976.8
28.	Combustible consumed per hour ..... lbs.	680.9	1700.3
29.*	Dry coal per sq. ft. of grate per hour ..... actual.	5.9	9.21
	Projected	9.17	14.31

QUALITY OF STEAM

30.	Percentage of moisture in steam ..... per cent.	.49	.49
31.	Factor of correction for quality of steam	.9963	.9963

WATER

32.	Total weight of water fed to boiler ..... lbs.	120,528	506,183
33.	Water actually evaporated, corrected for quality of steam and leak ..... lbs.	119,683	304,352
34.	Equiv. water evaporated into dry steam from and at 212 degs. F. ..... lbs.	146,675	373,531

Factors, 1.2256 and 1.2273.

WATER PER HOUR

35.	Water evaporated per hour, corrected for quality of steam ..... lbs.	5,801.4	15,217.6
36.	Equiv. evaporated per hour from and at 212 degs. F. ..... lbs.	7,109.7	18,676.5
37.	Equiv. evaporated per hour from and at 212 degs. F., per sq. ft. H. S. ..... lbs.	1.17	2.04

	HORSE POWER		
38.	Horse power developed (34.5 lbs. water per hour into dry steam from and at 212 degs. F.	206	541
39.	Builders' rated horse power	600	900
40.	Percentage of builders' rated horse power developed	34.33	60.14
	ECONOMIC RESULTS		
41.	Water apparently evaporated per pound coal—actual condition—32 ÷ 17	6.89	7.71
42.	Equiv. evaporated from and at 212 degs. F. per pound coal (including moisture)	8.39	9.41
43.	Equiv. evaporated from and at 212 degs. F. per pound dry coal	8.42	9.44
44.	Equiv. evaporated from and at 212 degs. F. per pound, combustible	10.43	10.98
	EFFICIENCY		
45.	Efficiency of boiler—heat absorbed by the boiler per pound combustible, divided by the heat value of 1 lb. combustible	74.05	78.89
46.	Efficiency of boiler and grate; heat absorbed by boiler per pound dry coal fired, divided by the heat value of 1 lb. dry coal	59.78	67.02

NOTES RELATIVE TO TABLES.

Boiler Notes

Nos. 3 and 4.—In item No. 3 the actual area of the grate is used, but the makers of the furnace rated the grate surface in projected, or horizontal area, and the item No. 4 is given accordingly.

No. 5.—Three thousand and thirty-eight sq. ft. per boiler, or at a rating of 10 sq. ft., gives 303.8 h.p.

No. 11.—Although the force of draft is given as only .2 ins. of water as the average used, a draft of from 1.2 ins. to 1.3 ins. was at all times available by the opening of the damper, and is shown on the charts of the Bristol recording draft gage as a straight, or nearly straight line, reaching out to those values at intervals. This was done by changing the valves for the draft connection to the gage from between the boilers and damper to the outside of the damper. Several times during the second test the values for the boiler draft were as high as from .6 ins. to .7 ins. (See Recording Gage Charts.) Later Note.—Results in practice often show a utilization of 1 in. for short times.

No. 14.—Temperature of every tank of water was taken, and temperature in feed pipe to boilers.

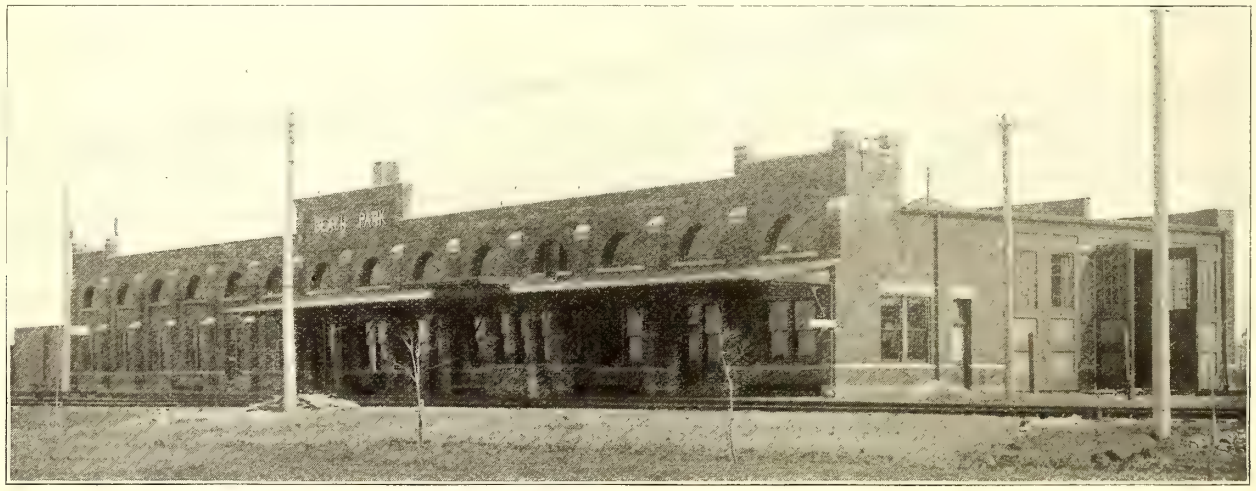
No. 21.—A considerable quantity of fine coal passed through the grates, and as it was inconvenient to return same to the furnace, it was put aside. This fine coal is ordinarily returned to the furnace, and thus is not lost in the ash. For these tests this waste amounted to 8.73 per cent the first day, and 3.43 per cent the second day. When the boilers are working up to their capacity, very little coal passes through.

No. 26.—The heat units per pound is given as the same for both days. The coal used had been in the bunkers for some time, and as the amount used for two days made very little difference in the size of the pile, it was assumed that the average of the samples for both days would give a fairer average than keeping the readings separate.

Formula used for heat value—14,600 C. + 62,000 $\left(H - \frac{O}{8}\right)$

No. 29.—Three calorimeters were used, but two of these were found to be unreliable, and so only the third, which was used on the engine in the second day's test, was used for data. This gave the amount of moisture in the steam after passing the separator, and the drip from the Holly system accounted for the rest of the entrained and condensed water in the steam system. From this total an allowance was deducted for condensation in the pipes, and the rest charged to entrained moisture in the steam from the boilers. This agreed quite well with the determinations by the above-mentioned calorimeter of the amount of moisture at the boilers on the first day's test.

		One Engine.	Both Engines.	Engine on Rated load.
	ENGINE TEST			
1.	Date of trial	Feb. 12, '98.	Feb. 14, '98.	Results
2.	Duration of trial	20 hrs. 38 min.	20 hrs.	Feb. 14, '98
	SIZES OF ENGINES			
3.	Diam. high-pressure cylinder..ins.	20	20	
	Diam. low-pressure cylinder....ins.	36	36	
	Length of stroke.....ins.	48	48	
4.	Diam. of fly wheel.....ft.	20	20	
5.	Weight of fly wheel .....lbs.	60,000	60,000	
6.	Rated strokes per minute.....	80	80	
7.	Rated horse power per engine....	600	600	
8.	Kw. output	2,544	9,024	6,644
9.	Rated capacity in kw.....	400	800	400
10.	Actual average output	123.3	451.2	332
	WATER CONSUMPTION			
11.	Total water fed to boilers.....lbs.	120,528	306,183	
12.	Total water lost through blow-off .....lbs.	554	900	
13.*	Lost through Holly system, 675 per hour first day.....lbs	13,925	1,145	
14.	Total water delivered to engine and auxiliaries .....lbs.	106,049	304,138	
15.	Water used by auxiliaries.....lbs.	33,161	59,435	
16.*	Water used by service pump second day .....lbs.	.....	2,835	
17.*	Water used by auxiliaries second day, deducting amount used by service pump .....lbs.	.....	56,600	
18.*	Total water delivered to engines and auxiliaries, after deducting service pump .....lbs.	.....	301,303	



TYPICAL WAY STATION AND CAR HOUSE

19.	Percentage of total water delivered to system which is used by auxiliaries, excluding the service pump:			
	First day = items 15 ÷ 14.....	31.3	.....	
	Second day = items 17 ÷ 18....	.....	18.8	
20.	Total steam and entrained water delivered to engines.....	72,888	244,703	
21.	Percentage of moisture in steam at engine, by calorimeter.....	.57	.77	
22.	Total dry steam at engines.....	72,472	242,819	
23.*	Proportionate amount of water used by engine No. 1 second day.....	.....	70,280	
24.*	Water used by engine No. 2 second day, steady load.....	.....	.....	172.53
25.	Average speed of engines.....	79.6	.....	76.4
26.	Average vacuum inches of hg.....	26.01	.....	26.2
27.	Average gage pressure at main header	131.3	.....	130.2
28.*	Average initial pressure in cylinders	.....	.....	125.5
	FUEL			
29.*	Total coal fired.....lbs.	17,471	39,679	
30.*	Total dry coal fired.....lbs.	17,408	39,536	
31.*	Total combustible .....lbs.	14,048	34,006	
	HORSE POWER			
32.*	Average i.h.p.....	.....	.....	534.32
33.*	Maximum i.h.p.....	.....	.....	568.8
34.*	Minimum i.h.p.....	.....	.....	239.4
35.*	Friction i.h.p.....	.....	.....	47.74
36.	Average electrical h.p.....	.....	.....	445.33
	CONSUMPTION AND OUTPUT PER HOUR			
37.*	Lbs. dry steam per i.h.p. per hr...	.....	.....	16.14
38.	Lbs. coal per i.h.p. per hr.....	.....	.....	12.03
39.	Lbs. dry coal per i.h.p. per hr....	.....	.....	12.08
40.	Lbs. combustible per i.h.p. per hr.	.....	.....	1.79
41.	Lbs. dry coal per i.h.p. per hr., with feed at 210 degs. F.....	.....	.....	1.68
42.	Lbs. combustible per i.h.p. per hr., with feed at 210 degs. F.....	.....	.....	1.44
43.*	Lbs. of coal per kw. hr.....	6.86	4.39	3.37
44.	Lbs. dry coal per kw. hr.....	6.84	4.38	3.35
45.	Lbs. Combustible per kw. hr.....	5.52	3.77	2.89
46.	Lbs. dry coal per kw. hr., with feed at 210 degs. F.....	5.98	3.74	2.72
47.	Ditto, combustible.....	4.82	3.15	2.32

EFFICIENCIES

48. Efficiency of engine, including shafting and brush friction, per ct.	.....	.....	91.05
49. Efficiency of generator (see note) per cent	.....	.....	91.48
50.* Efficiency of combination, per cent.	.....	.....	83.3

AVERAGE LOAD PERCENTAGE OF FULL LOAD

51. Engine .....per cent.	.....	.....	89.05
52. Gencrator .....per cent.	30.8	29.75	83.05

LATER NOTE

Results from operating conditions:

	Power Factor	Lbs. water per kw.-hr.	Lbs water per i.h.p. hr.
Test of Feb. 12, 1898.....	30.8	41.34	31.01
Maximum output for one day up to July 24, 1898, gives 5 lbs. coal per kw.-hr; this, with evaporation of 7.71, gives	47.2	38.55	28.91

This test of Feb. 12, 1898, gives the same results as the average for the same output during operation from Jan. 1 to July 24, 1898. See point No. 6 on curve, which shows the test of Feb. 12 reduced to feed at 210 deg., which is the ordinary temperature of the feed water.

Engine Test Notes

During the run on Feb. 12, Engine No. 1 furnished current for the road until 10.05 A. M., when the load was changed onto Engine No. 2, which finished the run. On Feb. 14 No. 1 ran the road, and No. 2 was used on the water rheostat.

No. 13.—The large amount of leak from Holly system the first day was caused by a defective valve allowing steam to blow through. This was fixed for the second day's run, and shows only the natural leakage due to condensed water from the piping system and separators.

Nos. 15, 16 and 17.—It was inconvenient to change the piping so as to get the actual steam consumption of the pumps, and it was decided to estimate this. The number of strokes of each pump were taken, and also the average steam pressure in the cylinders, and the head against which they were working, and the steam consumption estimated.

No. 18.—This is deducted because the service pump is not a station auxiliary, but furnishes water for use outside of the station.

No. 23.—The engine set running the road (No. 1) on the second day had slightly less kw. output than on the first. If the steam be taken at the same rate per kw. it would be incorrect, as at the lighter load the set is less efficient. The amount deducted was the *difference* in kw. for the two days multiplied by 50 per cent of the *rate* for the first day.

No. 24.—Obtained by subtracting (23) from the second item in (22).

No. 28.—Obtained from average of indicator cards.

Nos. 29, 30 and 31.—Copied from boiler test.

No. 32.—Average of twenty-nine indicator cards.

Nos. 33 and 34.—Obtained from indicator cards taken at time of maximum and minimum loads.

No. 35.—Average of five sets of cards.

No. 36.—Computed from switchboard readings.

No. 37.—From items 24 and 32.

Nos. 38 to 42.—Are figured from the engine consumption alone, and do not include pumps, etc., and are, therefore, lower than the amount which would be required to run the station under this load.

Nos. 43 to 47.—Columns Nos. 1 and 2 are figured from the total coal, and total kw. output for the two days, and include that due to the auxiliaries, while Column No. 3 is figured for the engine alone.

No. 48.—From items Nos. 32 and 35

Nos. 49 and 50.—From items Nos. 32 and 36 the item No. 50 is found, and dividing No. 50 by No. 48 gives No. 49, or, dividing the combined efficiency by the efficiency of the engine, gives efficiency of generator. These efficiencies would have beeen increased if the load had been more nearly full rated load.

DISCUSSION OF RESULTS OF TESTS

Owing to the exceedingly variable load, the kw. per pound of coal for the run on the road was very different from what it was for the test on approximately full load, and this was to be expected.

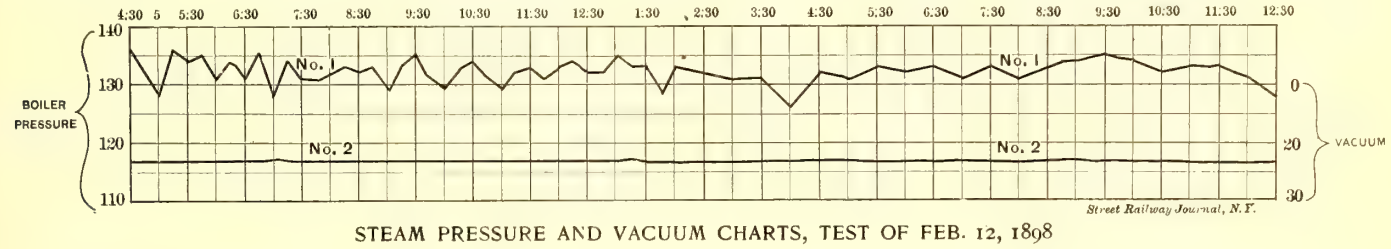
1. The boiler efficiency was not as high.
2. The percentage of steam used by the pump was much greater.
3. The engine efficiency was very much less.
4. The generator efficiency was very much less.

The record shows what the engine only would do if fully loaded, but this can never be obtained, as the pumps and the condenser must always be used.

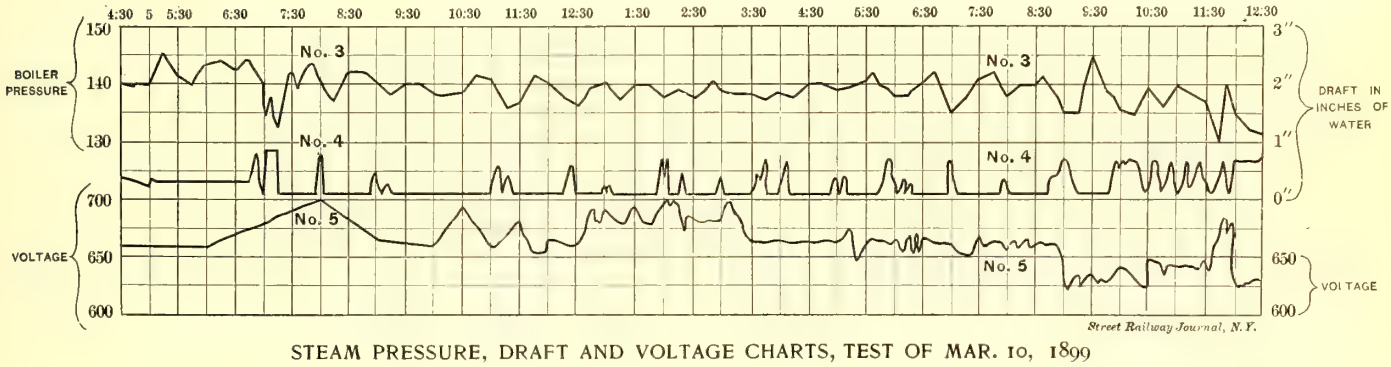
An approximate, but fairly close, estimate indicates that the plant at full load, and the same efficiency of boiler as at the time of approximately full load test, and the same fuel, would consume about 3.32 lbs. coal per kw.-hour; the combined efficiency of engine and generator being increased about 4 per cent. The boiler efficiency would be slightly higher, but probably 3.3 lbs. per kw.-hour is about the limit, a point unattainable, but valuable to know, for the sake of comparison of results obtained with what may possibly be considered, for this case, the theoretical limit.

Comparisons of daily output and coal consumption show the benefit of increased load on the station efficiency, and later, when more records have been obtained it was possible to plot a curve to obtain the average results, and to show how they compare with the theoretical point above mentioned.

It should be noted that the figure 3.3 lbs. per kw.-hour includes the auxiliaries which were taken for the estimate as using 14.5 per cent of the total steam. This would leave for the engine only 2.82 lbs. per kw.-hour, which, with a combined efficiency of 87.3 per cent, would give 1.83 lbs.



STEAM PRESSURE AND VACUUM CHARTS, TEST OF FEB. 12, 1898



STEAM PRESSURE, DRAFT AND VOLTAGE CHARTS, TEST OF MAR. 10, 1899

per i.h.p., and almost 2 per cent less for every 10 per cent error against the auxiliaries in the estimate of the steam used by the latter.

The success attending the operation of the road has been exceptional, and the officers whose capable management has secured this result are as follows:

B. Mahler, president, who gives the road his constant supervision; J. B. Hanna, vice-president; E. W. Moore, treasurer; J. C. Hoge, secretary; F. W. Coen, assistant secretary; W. E. Davis, superintendent.

The chief engineer of the power house is W. B. Stewart, who takes great pride in the appearance of the power house and gives it the most careful and intelligent attention. When the writer complimented the superintendent he was answered by the quotation that "it was the man behind the gun." Mr. Davis also stated that on the day previous to this statement, and also during the week of exceptionally cold weather, that the generator circuit breaker frequently operated at 1100 amps., and that 1000 amps. was carried for several minutes at a time.

It should be noted that 1100 amps. is 100 per cent overload.

THE RELATION OF THE LOAD FACTOR TO ECONOMY

The tests given above were made to determine the exact economy of the station under conditions as they existed upon two particular days, but the company has also maintained a continuous system of keeping records showing the relation between the coal consumption and kw.-hour output on different days. The coal is weighed, as stated, as it is fed into the hoppers, and the kw. hours taken from the wattmeter on the switchboard. The form in which these records are kept is given below, showing, as will be seen, the coal per kw. hour and per h.p. hour. The records for every twenty-four hours from Jan. 1, 1898, to July 24, 1898, were then plotted on a diagram, as shown on this page by O's. Later records are shown by X's. From the O records a mean line was drawn as giving the average consumption of coal per kw. hour with different load factors. This line is also a fair mean of the X points, as will be seen from its inspection, unless possibly that the line should dip a little more for large loads. To secure uniformity in records, all points are reduced to feed water at 210 deg. F. Point No. 1 was that determined by the test on Feb. 12, 1898, with a variable load, as given above. Point No. 6 is the same record, but with feed water reduced to 210 deg., and as will be seen, it lies directly on the average line. The following points, determined by a test on Feb. 15, 1898, were not put on the diagram owing to lack of room.

No. of Tests.	Character of Load.	Kw. H.	Feed Water 39 degs. F., lbs. per kw. h.	Feed Water reduced to 210 degs. F., l bs per kw. h.
1.	Combined variable and steady..	451.2	4.39	3.74
2.	Steady (engine load only).....	451.2	3.37	2.72
3.	Limit for full load (engines and pumps) calculated as stated under discussion of results..	.....	.....	3.32

It will be noted from the chart that the best result yet obtained is 50 per cent in excess of that which would be obtained at full load. The poorest (from the curve) is 120 per cent, and the average about 81 per cent. The variation in records for the same output is due, first, to the different amounts of coal in the hoppers and furnaces at the start and finish on different days; second, to the difference caused by the starting up of new boilers; third, to the difference in the character and combustion value of the coal; fourth, to the difference in the character of the load, and fifth, to the fact as to whether the service pump was used or not.

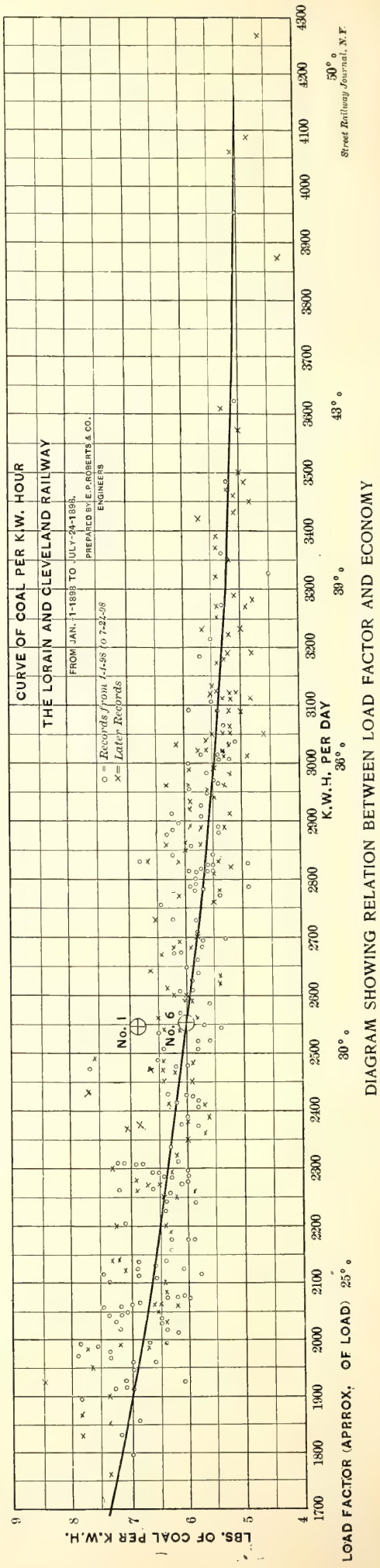


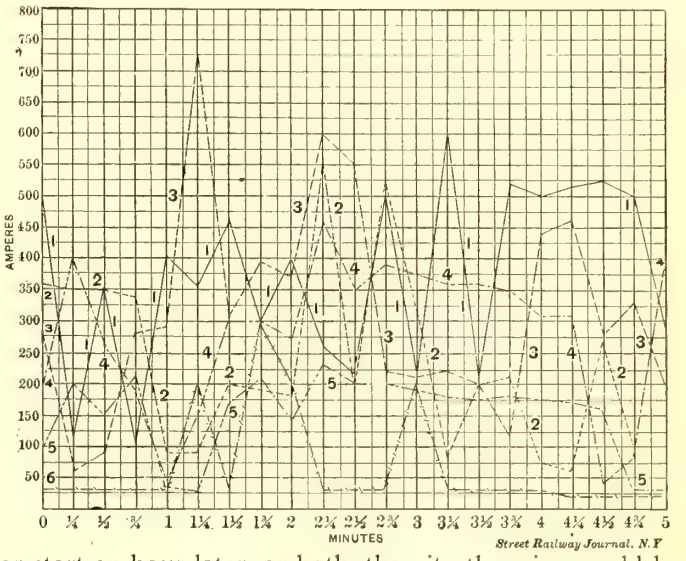
DIAGRAM SHOWING RELATION BETWEEN LOAD FACTOR AND ECONOMY

ECONOMY POSSIBLE FROM STORAGE BATTERIES

The results shown by the above curve will be found of interest to those considering the application of storage batteries to interurban roads. As is well known, the usual practice is to install a battery of sufficient size to take care of the overloads, the battery being charged at the time of underloads, and consequently the engine and generator running at all times at approximately rated load, with the result that the fuel consumption per i.h.p. and per kw. hour is greatly lessened.

One of the advantages derived from a chart and tests of this kind is the ability to determine the possible economy from the use of storage batteries as station regulators. When a plant is originally designed for the use of storage batteries, the steam end should be proportioned differently from when it is designed for exceedingly variable loads without the use of a battery. If the plant in either case were to be compound condensing, the ratio of the cylinders would be much greater for a storage battery plant than for one with variable load, and if batteries were not to be used and the decision were against compounding and condensing, the use of a battery might so modify the conditions as to make compounding and condensing advisable. In a similar way it might make advisable the use of economizers and induced draft in cases where otherwise it would not be advisable, or, at least, would be very questionable. A careful designer will also change the ratio of heating surface to grate surface and possibly the amount of each provided. If, however, the plant is one which is already in operation, as in the case of the Lorain & Cleveland Railway, the question of advisability of installing a battery auxiliary to take care of fluctuations under the present operating conditions, or to allow additional output without adding engines, boilers and generator, it would be considered along the following lines:

For the output now required for both the summer and winter traffic the curve shows the average coal per kw. hour, and the test indicates what result would be obtained if the load were constant. The percentage of saving of fuel would be as indicated by the figures given under "Discussion of Results of Tests," above. Whether such a saving would make it advisable to install a battery depends upon the price of coal, the amount used, the cost of the necessary battery, and the interest and depreciation charges which it is considered proper to allow, also whether any financial value shall be given to providing power which could be used for a short time in case of total break down. As a matter of fact, the importance of the latter consideration in a first-class modern station is small, but a practical economy is often secured by the use of a battery in allowing the station to shut down an hour earlier or start an hour later, or both, than it otherwise would by taking care of the first car out over the line, and the last car in.



It is by obtaining such data as above that exact designing can be accomplished, and both the Lorain & Cleveland Company, as represented by its officers, and engineers have shown a commendable spirit in allowing its publication.

THE LORAIN & CLEVELAND RAILWAY CO

POWER HOUSE REPORT.

Week ending *Jan. 1st,* 1899

DAY.	KW-HOURS 24 HOURS	COAL 24 HOURS	COAL PER K.W.H	COAL PER H.P.H.
Monday,	3871	16760	4 . 3	3 . 2
Tuesday,	2866	17355	6 . 0	4 . 4
Wednesday,	3055	16960	5 . 5	4 . 1
Thursday,	2376	16230	6 . 8	5 . 0
Friday,	2450	15900	6 . 4	4 . 7
Saturday,	4263	19950	4 . 6	3 . 4
Sunday,	3570	18310	5 . 0	3 . 7
Total,	22451	121465		

Average K. W. H. per Week, 3207
" " " " Hour, 185+
" Coal " K. W. H., 5 . 5
" Coal " H. P. H., 4 . 0

Remarks:

W. E. Davis, Sup't.

SAMPLE WEEKLY STATION ORDER

Quickly Baked Coils

BY J. F. HOBART

In cases where small coils are required for immediate use and there is no time in which to bake the shellac sufficient to hold them in place, they are made ready for instant duty by a method called "burning out" in the very few shops where I have ever seen the method used. Supposing the coil is a four-wire concern to form a part of the winding of an armature. It is wound into shape and held by several small metal clips so that it can be removed from the form on which it is wound and then immediately saturated with thick shellac varnish.

When possible, and that is in most cases, the shellac is applied before the coil is removed from the form, but in either case, after being shellacked, the coil is placed in the heat of a gasoline torch or Bunsen burner, and the shellac heated to the igniting point. It will blaze fiercely, and at just the right time—decided by experience—the blazing coil is removed from the flame and the blaze extinguished. The shellac must not be burned—that would spoil it for the purpose, but just enough of the alcohol is removed to make the shellac hard, but not brittle. A very little practice will determine just when to stop the firing operation, and a good coil can be quickly made ready for use by this process.

Under the average conditions a 22-ft. closed car or an eight reversible seat open car should be the limit for a single truck. Although there are single trucks which will carry a longer body fairly well, yet the increase in maintenance will, in most cases, warrant the use of double trucks. From paper at the Boston Convention, 1898.

Electric Railways in Paris, France

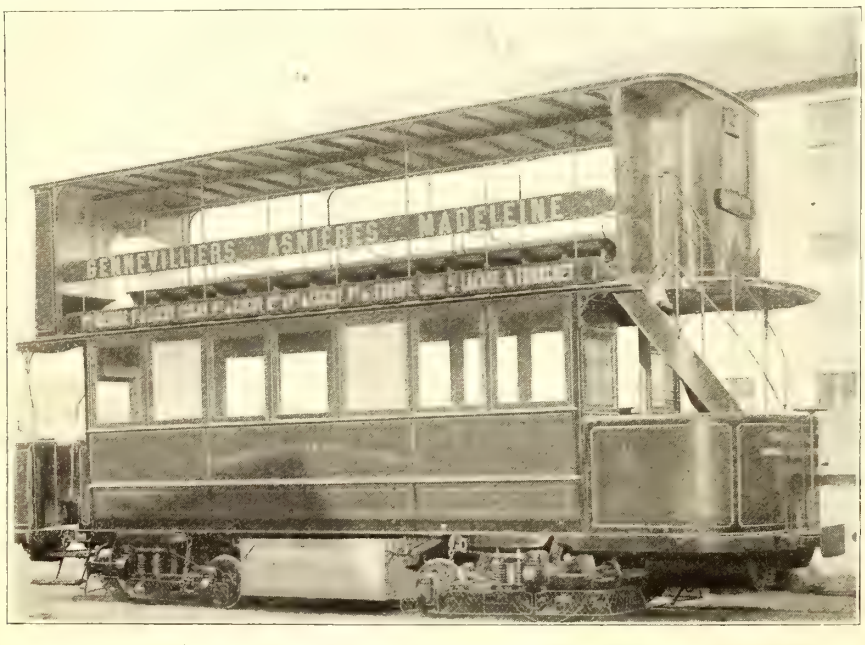
There are three companies which operate electric railways in the city of Paris—the Compagnie des Tramways de Paris et du Département de la Seine, the Compagnie Générale Parisienne de Tramways and the Compagnie du Tramway de Paris à Romainville. The principal line leaves from in front of the Madeleine, in the center of Paris. The power station is situated on the line of the road at Asniéres, and contains three engines, each connected to a Walker 200-kw. generator. Two types of cars are used, a single and double truck, both of which are illustrated herewith. The double-truck car, which is mounted on Brill maximum traction trucks, carries fifty-eight passengers, and weighs, complete, 17,000 kg., made up as follows: weight of car body, 4200 kg.; trucks and motors, 4700 kg.; battery, 3700 kg.; fifty-eight passengers and two employees, 440 kg. A full description of the car, which operates on the mixed trolley and accumulator system, was published in the Street Railway Journal (international edition) for July, 1898.

The Compagnie du Tramway de Paris à Romainville operates cars from the Place de la Republique, at the center of Paris, to the Port de Romainville, and thence to Coté de Noisy-le-Sec. The line was installed in 1896, is equipped with Claret-Vuilleumier surface contact system. The length in Paris is 4 km. of double track, and outside of Paris 3 km. of single track. The minimum curve radius is 25 meters, and the steepest grade is 5½ per cent. The power station is situated at Lilas, about two-thirds of the distance from the Paris terminal. It contains three boilers, four Corliss engines, four generators, and adjoining it is a car house for thirty cars. The cars are capable of carrying fifty-two passengers. They weigh 13,000 kg. loaded, and are operated by two 30-h.p. Walker motors.

The Compagnie Générale Parisienne de Tramways has a line 6.2 km. in length, part of which is operated by the trolley system and part by the underground conduit. There are seventeen motor cars, each equipped with two General Electric motors. The power station contains three Thomson-Houston 200-kw. generators.



ELECTRIC TRAIN, RAINCY-MONTFERMIEL RAILWAY



DOUBLE DECK STORAGE BATTERY CAR, PARIS



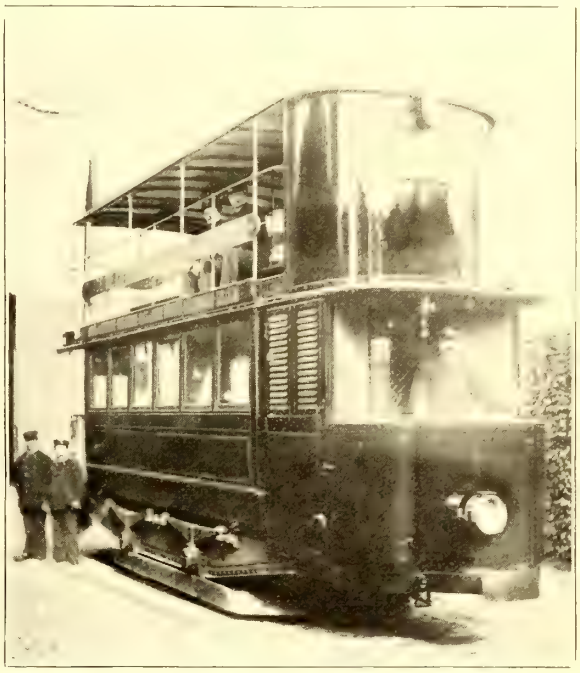
ELECTRIC TRAIN, RAINCY

The Compagnie du Tramway Raincy à Montfermiel, while not in Paris, is not far from it, and it is proposed to extend the road into the city, by way of Romainville. It extends from Romainville to Montfermiel, has a length of 7 km., and is equipped with the trolley system. There are ten motor cars, weighing 12,500 kg. each, equipped with two 25-h.p. Walker motors.

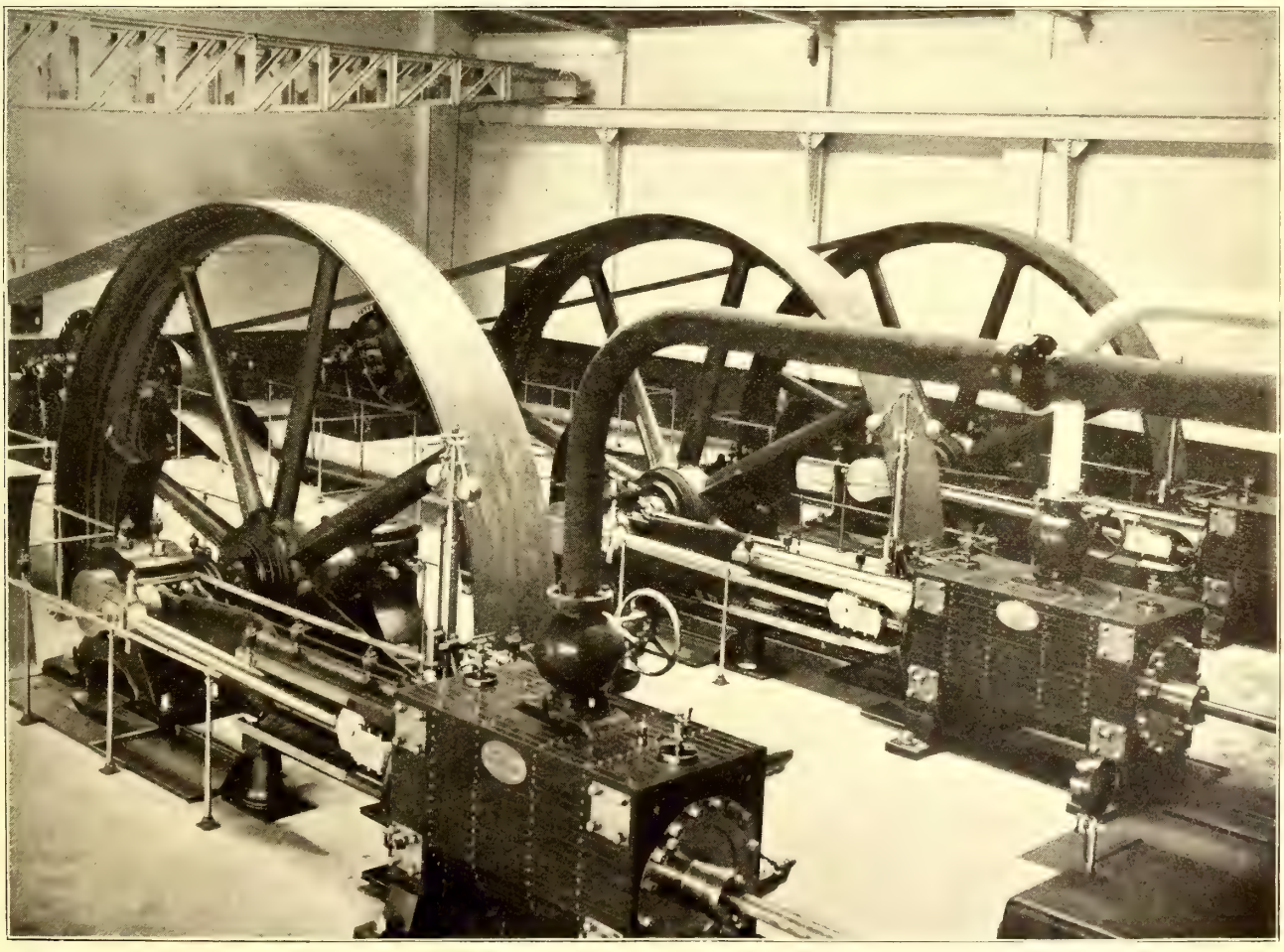
The following summary of the tramway companies in Paris is taken from "Revue des Transports Parisiens." There are nine companies, operating as follows:

1. Compagnie Générale des Omnibus. On Jan. 1 this company had 184.7 km. of track laid with Marsillon rail, 9.3 km. laid with Broca rail, 15 km. laid with Vignole or T rail, and 23.3 km. laid with "American" or strap rail. The company has fourteen Rowan (steam) cars, fifty-four Mekarski (compressed air) cars, fifty-nine Serpollet (steam) cars. The company had 4800 horses on July 1, 1898.

2. Compagnie des Tramways de Paris et du Department de la Seine. This company has 79.9 km. of track laid with Broca rail and 29.7 km. of track laid with Vignole rail, all operated by mechanical power, viz.: Lamm Francq (fireless) locomotives, Serpollet (steam) locomotives, accumulator cars, and, for a short distance in the outskirts of the city, a trolley line. The company has twenty Lamm Francq locomotives, twenty-two Serpollet motor cars, which are being replaced with accumulator cars, fifty-five accumulator motor cars, twenty-eight motor cars for a mixed trolley and accumulator service, and five trolley cars.



CAR ON SURFACE CONTACT SYSTEM, PARIS—ROMAINVILLE



ELECTRIC POWER STATION AT ASNIERES

3. Tramway à Vapeur de Paris à Saint-Germain. This company has seventeen 17-ton steam dummies.

4. Funiculaire de Belleville, the Belleville Cable Railway. This road is 2 km. in length, laid with Broca rails, and has twenty-one cars.

5. Compagnie Générale Parisienne de Tramways. This company has 111.9 km. of track, of which 60.9 km. is laid with Broca rails, 32.4 km. with strap rails, 9.8 km. with Marsillon rails, and 8.8 km. with Vignole rails. This company has 154 cars, all horse cars with the exception of a

short electric line, most of which is trolley, but a short portion is underground conduit.

6. Compagnie du Chemin de Fer de Paris-Arpajon. This company has five compressed air locomotives and



STORAGE BATTERY CAR, PARIS

twenty-one steam locomotives, but is proposing to install an electric system on part of its line. The track is laid with Broca, Marsillon and Vignole rails.

7. Compagnie des Chemins de Fer Nogentais. This company has 17.3 km. of track and owns nineteen compressed air motor cars and ten trail cars.

8. Compagnie des Tramways de Saint-Maur. This company has 12 km., and owns ten compressed air motor cars and eight trail cars. The line will be equipped with the trolley system soon.

9. Compagnie du Tramway de Paris à Romainville. This company has about 7 km. of track, and operates twenty electric motor cars on the Claret-Vuilleumier surface contact system.

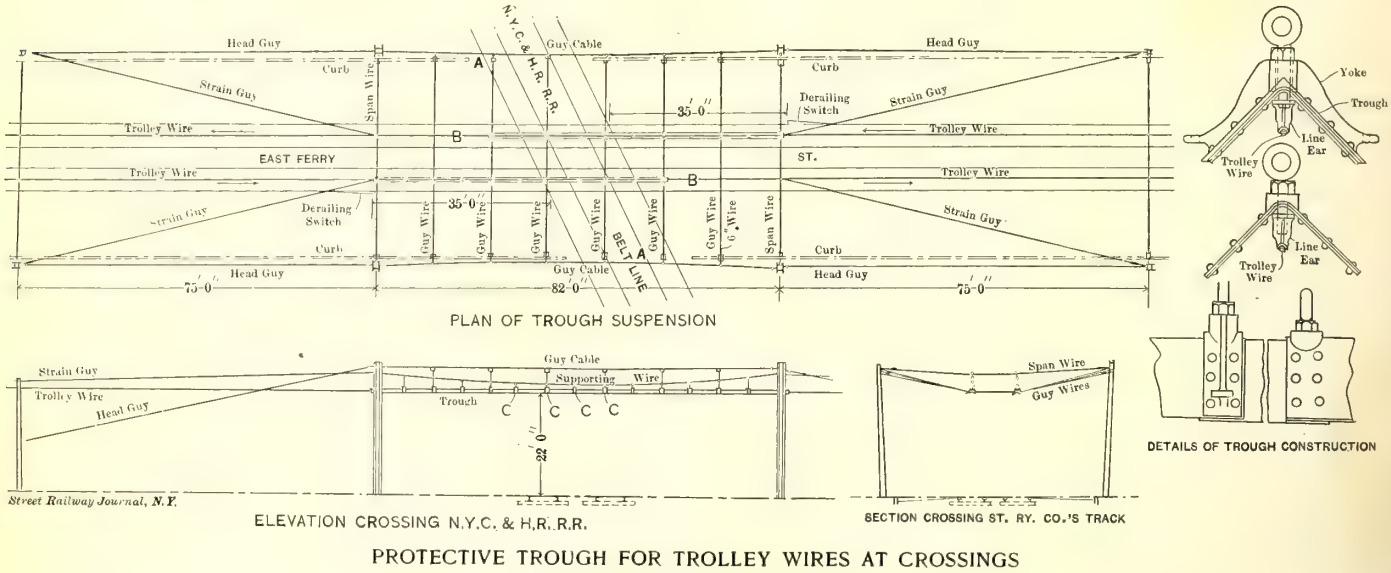
In addition an electric line will be started during the year by the North and South Tramway companies. The trolley system will be used outside of Paris, and the conduit system within the city limits.

Trolley Trough for Steam Railroad Crossing

The accompanying engraving shows a protective device for the trolley wire of electric railways at steam railroad crossings to avoid the possible danger of the electric car becoming stalled on the steam railroad track by either a break in the trolley wire or the trolley jumping off the wire at a critical time. The device was suggested by the engineer of the New York State Railway Commissioners and has been adopted by the Buffalo Railway Company at fourteen points where its tracks cross steam railroad tracks on grade. The accompanying drawing, for which the STREET RAILWAY JOURNAL is indebted to Robert Dunning, master mechanic of the Buffalo Railway Company, shows the construction of the device, as well as the method of supporting it.

The trough is constructed of two sheets of hard drawn brass in sections 8 ft. long, riveted together with copper rivets, and attached to heavy yokes, shown in the detail drawings at the right. The trough is not insulated from the trolley wire, but in metallic contact with it. One end of the span wire is attached to the ends of the yokes, and the other end to heavy box-plate poles, which are 33 ft. long, and set 7 ft. in the ground so as to maintain a height of 22 ft. A two-track crossing, such as that shown in the engraving, requires eight poles of this character, four used in supporting the trough, and the other four for the head guys.

The guy cables, shown by *AA* in the plan, are made up of two $\frac{3}{8}$-in. steel cables twisted together, and from these, smaller cables are run to the trough to prevent its swaying. These smaller cables are shown by *CC*, and are insulated from the supporting guys and from the trough. This method of suspension permits the adjustment of the level of the trough to any desired height.



PLAN OF TROUGH SUSPENSION

DETAILS OF TROUGH CONSTRUCTION

ELEVATION CROSSING N.Y.C. & H.R.R.R.

SECTION CROSSING ST. RY. CO.'S TRACK

PROTECTIVE TROUGH FOR TROLLEY WIRES AT CROSSINGS

The angle of some of the tracks of the Buffalo Railway protected in this way is such that a curve on each side of the crossing is necessary, but the engineers have been able to protect the crossings without much trouble. They consider the device a good one, as it is practically impossible for the trolley wire to break, there being no strain upon it, but if it should part, the inverted trough will catch the trolley wheel and afford a metallic circuit to carry the car over the crossing.

The Boston Elevated Railway Company is planning to install a large power station at Lincoln Wharf. It will contain six 3000-kw. units.

Overhead Line Construction I.

BY ALBERT B. HERRICK

The overhead line is one of the most important parts of the equipment of an electric railway, and one in which good construction counts for as much in percentage of first cost as in any other part of the installation. I feel, therefore, that a practical exposition of some of the main principles relating to the erection and selection of apparatus and methods of construction will be of interest to co-workers in the railway field. Taking up the line, the question of poles and of which is the most economical pole line to erect immediately rises. This is largely a matter of local figuring, for in the case of suburban towns wooden poles may often be obtained at such a low price that the line can be renewed once, or perhaps twice, during the life of an iron pole at approximately the same cost.

In a trolley line, where continuity of service depends on the stability of the structure carrying the conductors, the whole overhead construction and trolley wire alignment is dependent upon the rigidity and stability of the poles. Care should be taken, therefore, when deciding between wooden and iron pole construction, to consider not only first cost, but also local climatic conditions, which sometimes seriously affect the life of wooden poles, but which usually have no effect on well-painted steel poles. For instance, the soil in the streets of a large city is usually charged with gas and ammonia, a condition which induces premature rot in wood.

The life of iron poles can be assumed as thirty-three years, provided the poles be painted with a good anti-rust paint every six years, and on this assumption there is an annual depreciation of 3 per cent in an iron pole line. Considering now the life of wooden poles, it should be remembered that there are a number of places in wood where rot starts besides in that part which is buried. Every bolt and nail entering or piercing the wood opens up a place where moisture can enter and rot begin. An average of eleven years' life for *city* and suburban construction is a fair assumption, which gives a depreciation of 9 per cent per year. The investment, based on these figures, presents the following comparison between iron and wooden poles where used for trolley line construction, and shows the profit in using the best material:

With an iron trolley pole, set so as to bear a strain of 600 lbs. at 22 ft. above the ground, and buried 6 ft. 2 ins. in concrete setting, the cost per mile will be as follows: Poles, set 100 ft. apart, 104 poles, at $17.50, will equal $1,820; digging and setting in concrete, at $4.30, will equal $447.20; painting poles, at 30 cents, will give $31.20. The poles should be painted once each six years, which will cost $31.20, making five paintings at $31.20, or a total of $156. The total construction and maintenance per mile will cost $2,454.40, which when divided by the life of thirty-three years, will give a depreciation of $74.37 per annum.

Wooden poles of hard pine, planed and chamfered, will show the following necessary expenditures: One hundred and four poles per mile, to fill the same specifications regarding height as the steel poles—104 poles, at $6.30, will equal $655.20; labor erecting and digging, at $2.65, will equal $275.60; painting poles, at 40 cents, will give $41.60; making a total of $972.40. At the end of six years the painting must be done again at a cost of $41.60, and at the end of eleven years there will be an expenditure for a new pole line, or $972.40. Adding the expense of re-aligning span wires, $240 per mile, will give a total expenditure at the end of thirty-three years of $3,522, and with a depreciation per year of $106.73.

The comparison now stands: Total cost of steel poles for thirty-three years, $2,454.40, and for wooden poles, $3,522. This gives a difference in favor of the steel poles of $1,067.60 per mile. The depreciation rate of $74.37 for steel poles and $106.73 for the wooden poles gives a difference of $32.36 per annum per mile. If interest was charged against the invested amounts for the term of life of property, it would reduce somewhat the showing in favor of the steel pole, but in any method of figuring the relative values from an investment standpoint the showing is greatly in favor of the iron pole line. From an engineer's standpoint the superiority of the iron pole presents many advantages besides the lasting qualities, which directly affect the operation of the road. The item of re-

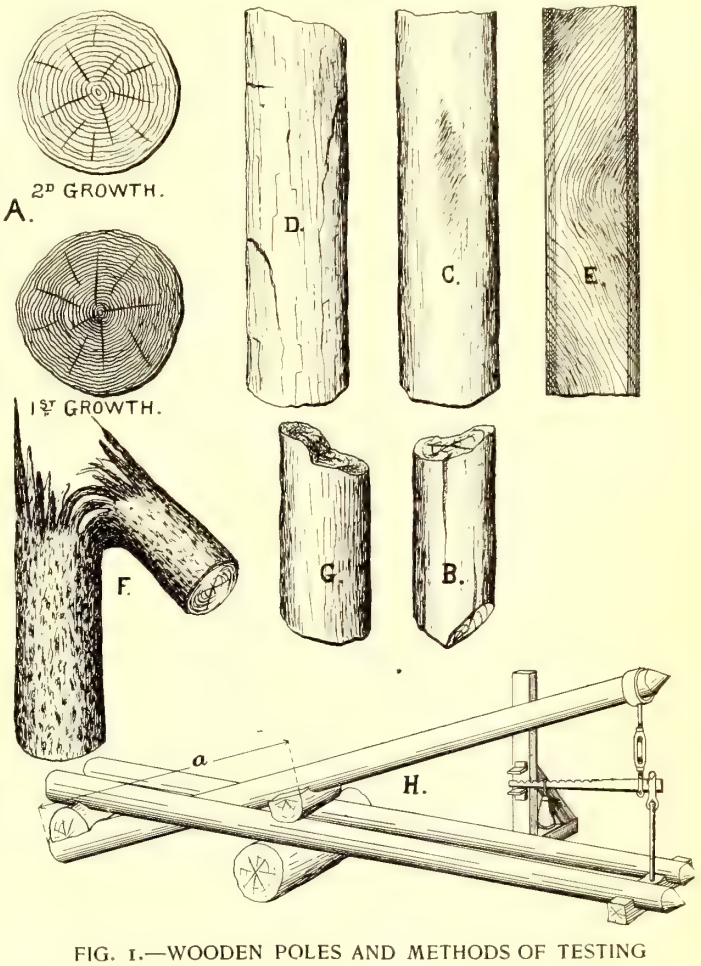


FIG. 1.—WOODEN POLES AND METHODS OF TESTING

equipping and renewing, which involves the adjustment of span wires and trolley wires, is directly contingent on the removal of poles, and should properly be charged against the wooden pole line, since it is obviated by the use of iron poles. The expense of keeping a trolley line taut and in good alignment, which insures the trolley keeping contact with the trolley wire, is largely dependent upon the rigidity of the pole line, and it is well known that eight years ago iron poles were manufactured in order to gain these results.

As previously stated, however, certain local conditions may be favorable to the use of wooden poles, and the essential features of a good wooden pole line will now be considered.

WHAT CONSTITUTES A GOOD WOODEN POLE LINE

Wooden poles are divided into classes dependent on their form, growth and symmetry. The woods usually chosen are chestnut, hard pine and cedar. As a rule, the

dimensions of round wooden poles should bear the relations in the table on page 279. Cedar poles over 47 ft. long should not be used, as the wind and conductor strains are liable to break them down. All first-class chestnut poles should be second growth—that is, a pole grown from an offshoot of a chestnut tree that has been cut down. This can be determined by the annual rings being larger and of a lighter color, as shown at *A* in Fig. 1, or by the knot holes being nearer the top of the pole. If the bark is on the pole the serrations should not be deep in second growth chestnut.

A pole should be fairly round, and not vary more than 10 per cent from true diameter in all around dimensions.

In order that the pole line have a neat appearance, the poles must be straight; no deflection greater than 4 per cent should be allowed from the center line. A pole

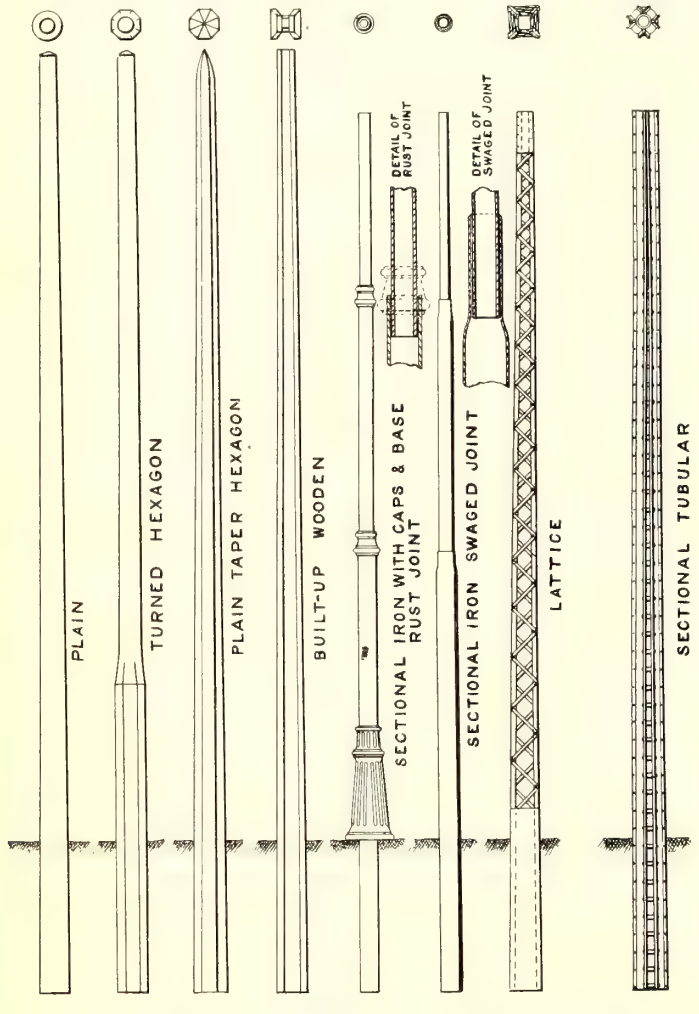


FIG. 2.—SHAPES OF STANDARD AND SPECIAL POLES

should be cut down when the sap is not running, either in midwinter or summer, in order to give the best life, as the sap contains the elements that decompose and start dry and wet rot.

After the pole is cut it should be allowed to stand with the bark on it, if exposed to the sun and weather, to season; otherwise it will be sun-checked—that is, cracks running parallel to the trunk shown at *B*, and exposing the interior of the pole to rot. A wind-shaken pole, shown at *D*, is one which has been subjected to severe wind storms during growth, and which has fractured the fibres and permanently weakened the pole.

Heart rot in second growth chestnut is generally near or at the butt. If a pole is affected by rot where it is exposed after peeling, internal rot will show on the surface of the pole by dark spots over the affected parts; when exposed for any length of time fungi will grow on the outside of the pole over the rotten portions. Knot holes larger than $\frac{3}{4}$ in. within 10 ft. of the butt greatly decrease the strength of the pole, for at this point the greatest strain comes. Knot holes where the core has dropped out or is loose indicate premature decay in poles. These points are given to indicate what to look for in the selection of first-class poles.

Chestnut deteriorates rapidly when the surface sap wood is cut, and for this reason hard pine is usually used where special shapes, such as hexagon, octagon, beveled or turned poles, are required. These are not, as a rule, made longer than 40 ft. In the selection of sawed poles the heart should be central to the axis of the pole. Wavy grain lines, as at *E*, on a sawed pole indicate it was gotten out of a crooked log, and heavy side strains are very liable to fracture such timber.

Cedar has neither the elasticity nor tensile strength of chestnut or hard pine of the same size, the fracture being a sharp one across the fibre, as shown at *G*, while chestnut still maintains its fibrous fracture when broken, as shown at *F*. Cedar, however, can be secured of very uniform sizes, and in some sections the increased size necessary to equal chestnut and hard pine in tensile strength still makes them a cheaper pole.

IRON TUBULAR POLES

Iron tubular poles are made up to 50 ft. high; both the standard pole and the extra strong poles are made to meet the variations in line strains. Taking one length most commonly used, which is 31 ft., they are usually divided into five classes:

	Lateral strain in lbs. to show 6 in. deflection. Pounds.	Pounds which will give permanent set of ½ in. Pounds.
No. 1	350	700
No. 2	500	1,000
No. 3	700	1,200
No. 4	1,000	1,700
No. 5	2,000	2,600

The test should be made when the pole is set in a proper concrete bed 6 ft. deep, and the strain applied to the top of the pole.

The poles should be as nearly round as possible; should not deviate more than $\frac{1}{8}$ in. between maximum and minimum diameter, and thickness of tube should not vary more than 1-32 in.; $\frac{1}{4}$ in. is the greatest deviation that will be allowed from true diameter at the top of the pole. As these poles are made up of sections, some provision should be made to test them where these sections are mechanically connected together. One provision inserted is that the pole should be dropped a distance of 6 ft., butt foremost, on a solid foundation, three times without the joints loosening.

There are two ways of connecting the different lengths—one is by heating the larger pipe, and, while hot, swaging the larger pipe down to the smaller cold pipe, over a length of about four times its diameter; when this joint cools the shrinkage of the outer pipe grips the inner pipe; tests of these joints usually show that they are stronger than either of the single pipes to both compression and lateral strains.

A guard ring slipped over the pole to rest on the earth at its base has been used, but water is retained here, rusting the pole at the point where it has to bear the greatest strain; and these have been removed in a number of cases and the life of the pole prolonged.

The other method is to introduce between the inner and outer pipe a rusting mixture, usually of sal ammoniac and iron filings; in oxidizing this mixture increases its volume, thus expanding and making a union between these sections. In testing this class of pipe for deflection the joints sometimes yield and show more permanent deflection than is caused by the pipe alone. These pipes are usually constructed by uniting three sections of round pipe.

The following weights and lengths are usually carried in stock:

27 ft. long, 240 to 350 lbs., standard; 335 to 560 lbs., extra strong.
28 ft. long, 250 to 610 lbs., standard; 345 to 1,175 lbs., extra strong.
30 ft. long, 270 to 780 lbs., standard; 375 to 1,380 lbs., extra strong.
35 ft. long, 800 to 1,050 lbs., standard; 890 to 1,670 lbs., extra strong.
40 ft. long, 850 to 1,530 lbs., standard; 1,335 to 2,355 lbs., extra strong.
45 ft. long, 1,174 to 1,665 lbs., standard; 1,835 to 2,600 lbs., extra strong.
50 ft. long, 1,345 to 1,800 lbs., standard; 1,995 to 2,835 lbs., extra strong.

STANDARD IRON TROLLEY POLES.

Nominal Inside Diameter	Thickness.	Length of Section.		Length of Pole.	Weight.	Deflection at Top of Pole when set in 5 feet of Ground.				
						500 lbs.	750 lbs.	1000 lbs.	1500 lbs.	2000 lbs
Ins.	Ins.	Ft.	Ins.	Ft.	Lbs.	Ins.	Ins.	Ins.	Ins.	Ins.
4	No. 4	7	6	.....	.....	.....	....	.....	....	.....
5	No. 3	3	6	28	450	5	8	10¼	20	.....
6	9-32	14	0	.....	....	.... ..	...	.....	... ..	.....
4	No. 4	8	0	... ..	....	.....	....	.....	.....	... .
5	No. 3	9	0	30	515	5	10	17	26	.....
6	9-32	16	0	.....	.....	....	...	.....	.....	.....

EXTRA IRON HEAVY POLES.

4	11-32	7	6	.....	... .	.....	.	... ..	.....	.....
5	3-8	9	6	28	708	9-16	5	7⅛	.....	.....
6	7-16	14	0	. .	.....	.....	.....	.....	.....	.....
5	3-8	8	0	.....	.. .	.....	.....	.....	.....	.....
6	7-16	9	0	30	1025	.....	7¼	8½	.....	18
7	7-16	16	0	....	.....	.....	.....	.....	..	.... .
6	7-16	8	0	.....	.....	.....	... ..	.....	....	.....
7	7-16	9	0	30	1380	.....	.....	5⅛	7¼	9½
8	1-2	16	0	... ..	....	.....	.....	.....	.....	.....

DIMENSIONS OF ROUND WOODEN POLES.

Length in Feet of Pole.	At Butt. Cir. in Inches.	At Butt. Diameter in Inches.	At Top. Cir. in Inches.	At Top. Diameter in Inches.
30	33	10⅝	18	5¾
35	36	11½	20	6⅜
41	39	12½	23	7⅜
47	44	14	23	7⅜
52	47	15	23	7⅜
57	50	16	23	7⅜
68	53	16⅞	23	7⅜
73	56	17⅞	23	7⅜
84	64	20⅜	25	8

In the specifications for poles the above points, which are desirable, can be incorporated.

SPECIFICATIONS FOR WOODEN POLES

A selected lot of poles costs more than the run of the stock, yet in ordinary trolley line construction money can be saved by designating exactly how many of each class of pole will be required, the best and most uniform poles being for streets and highways, and the poorer qualities used along the country roads. Corner poles, and where extra span weights are to be supported, should be specially listed in the specifications; also stubs and anchors or foundation timbers. By careful attention in listing what is required for the complete pole line a saving of pole cost and time can be effected.

Specifications are varied for every class of line construction, but the usual clauses which relate to the class of pole to be delivered are as follows:

Round poles, first class.

There are to be (——) poles, (——) ft. long, with an average butt diameter of (——) ins. and an average top diameter of (——) ins., to be a gradual taper from the bottom to the top, to have no deflection bend or twist which will give the pole a greater deflection than (——) per cent from the true axis, that the pole shall be peeled clean of bark and fibre, that sun cracks shall not show on the surface of the pole, neither shall it be wind shaken or checked; no knots over (——) ins. will be passed in this class. The butt shall be sawed square and the top chamfered at an angle of 45 degs., the knots shall all be trimmed close, gains for cross arms to be cut (——) ins. from the bottom of the chamfer, and to be cut (——) ins. deep and (——) ins. wide. These poles will all be of (——) wood and show no signs of dry or wet rot.

For square sawed poles the specifications vary in this way: The pole shall be (——) ins. by (——) ins. at butt and (——) ins. by (——) ins. at the top; shall be planed and chamfered, the heart of the tree shall be central to the long side of the timber; where this pole is to be beveled on the edge the width of the bevel should be given, also where it is to begin, how far from the butt of the pole. In hexagon poles the length of the sides of the hexagon, as well as the diameter of the pole, should be given, as also the taper of the poles. In fancy turned poles the height of hexagon and beginning of turned part of poles should also be given. Built-up poles are special, and need drawings to clearly define the design. The length of a wooden pole may vary within such wide limits that sizes will have to be selected to give ample factor of safety for the line strains thrown on them, and depends on the soundness and preservation of the wood to maintain the line in service. A pole that has been thoroughly weather cured standing is stronger than a new pole which is partially green. A green pole shows greater deflection and less tensile strength than one that has been standing some time, so lumbermen do not like to be bound in a specification to the deflection and breaking strains which are applicable to iron poles, and they are not usually inserted.

SPECIFICATIONS FOR IRON POLES.

The weight and dimensions of each section and total length of pole are usually specified. The composition of the metal required may be specified, seamless steel tube now being generally used. The method of putting the sections together may be restricted in the specifications; the tensile strength, as well as the deflection and permanent deflection for different strains, are usually incorporated. To be delivered painted with (——) coats of anti-rusting paint is required both inside and out; also a turned plug of wood driven in at the butt end, and sometimes at the top, are necessary where they are to be handled much in transportation. Collars, flanges and tops are accessories in most cases on the pole. Manufacturers can drill any holes in the pole without any appreciable advance on the first cost. These holes, with their sizes, should be located and specified.

Lattice poles vary so much in the angles and spacing of the lattice, the slope and character of base, that the contractor or manufacturer should indicate what is desired or what will be furnished by a drawing. The pole can be specified regarding its mechanical strength and deflection the same as the round pole.

Fancy and special poles are not standard, and cannot be subject to general specifications, unless the product of a single manufacturer is to be adopted.

For shapes and special poles see Fig. 2.

STRENGTH OF AND METHODS OF TESTING WOODEN AND IRON POLES

The method usually given to test a pole is to set it the proper depth in the ground and apply a tackle to the top and draw it up with a given tension and note the deflection. The way it is usually applied is that the tension is usually put at an angle from the ground; the tension is partly borne by the pole and partly given to springing the pole over; the ratio of the two depends on the angle of application. Any yielding in foundation is liable to be charged to elasticity. If the pole is planted in cement, several days should

be allowed for it to set before the test, which makes the test a lengthy affair. I have found that the following will give all the practical results necessary, and can be readily constructed and calibrated on the spot. (See *H* in Fig. 1.) For this testing rig two of the largest and most symmetrical poles are selected; they are then laid by the side of each other and separated far enough apart to allow any of the poles to be tested to lie between them. They are braced together at two points, the distance *A*, from the bottom of the foot brace to the top of the head brace, to be the depth of setting to be employed in this pole. Sufficient area to these braces should be given so the strain applied will not crush the fibre of the pole under test. A 12-in. turnbuckle, a 1 to 20 steelyard, with a 100-lb. weight, completes the outfit. One arrangement can be made as above. The weight on the steelyard is fixed, and, after the bridle is put over the pole, the turnbuckle is tightened until the steelyard is balanced. When the specified tension is applied the deflection of the pole is measured by a mark on a board opposite the pole under test.

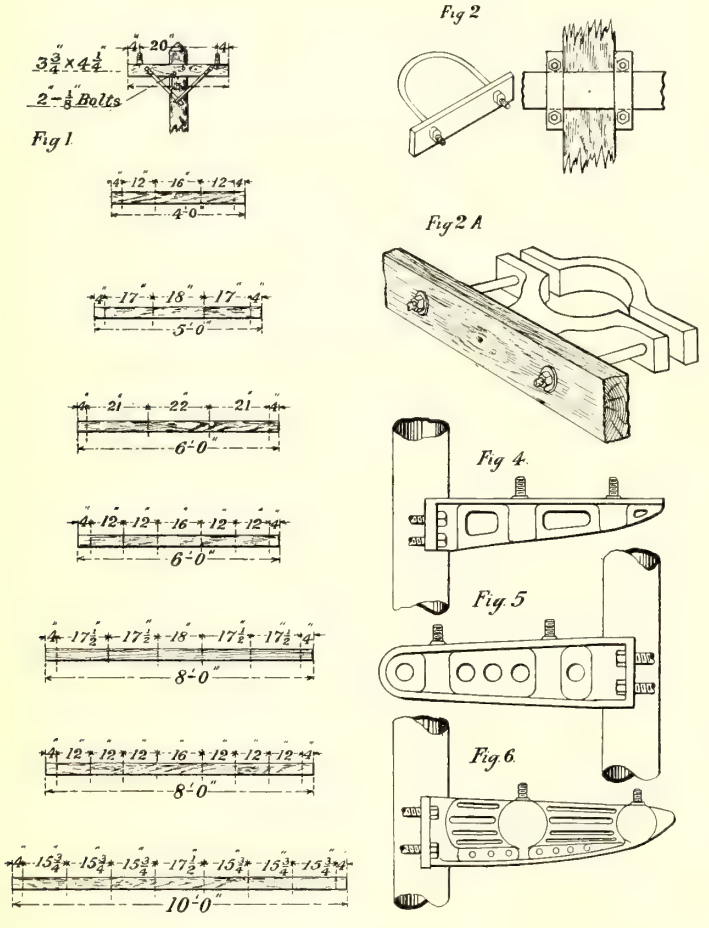


FIG. 3.—CROSS ARMS

This deflection is composed of the yield of the braces and the flexibility of the crib, but the pole on returning will show the permanent deflection, which will be the difference before and after the strain. Iron poles can be tested by the same method by substituting an iron pole for the wood, and the steelyard should be provided with a ratio of weights, so as to reach a 2000-lb. strain where extra heavy poles are to be tested.

The elasticity of wooden poles is approximately as follows where the pole is 30 ft. long and placed 6 ft. in the ground:

Round bottom.	Top.	Deflection.	Chestnut.	Cedar.
10⅝ in.	5¾ in.	7 in.	340 lbs. to 510 lbs.	360 lbs. to 406 lbs.
11½ in.	6⅜ in.	7 in.	405 lbs. to 680 lbs.	432 lbs. to 540 lbs.
12½ in.	7⅜ in.	7 in.	490 lbs. to 935 lbs.	495 lbs. to 675 lbs.

The above was the average of a number of experiments.

CROSS ARMS, SIDE ARMS AND BRACKETS

The standard cross arms usually kept in stock are given in Fig. 3, with the dimensions and spacing for pins Cross arms are usually kept in white or Norway pine or long leaf yellow pine. The tensile strength of Norway pine is approximately 10,700 lbs. to the sq. in., and the breaking cross load for long leaf yellow pine is 21,300 lbs. per sq. in. The breaking cross load for the standard size of cross arm is 5060 lbs. for white pine and 3820 lbs. for yellow pine. Records show that the long leaf pine is 40 per cent stronger, but the yellow is more durable, as it does not rot so readily where the iron bolts pierce the cross arm, which is the point at which the cross arm has to bear the greatest strain. In order to avoid piercing the wood at this point with wood poles and also where wooden cross arms are used on iron poles, straps and plates are employed, as shown in 2, Fig. 3. The pole is gained in the regular way when wooden, but where the pole is iron a saddle is cut into the cross arm to make it fit the pole and thus increase the bearing area of the cross arm. No. 2 A, Fig. 3, shows a cast-iron fitting to attach a wooden cross arm to an iron pole. For securing cross arms to poles in railroad feeder work use ⅝-in. bolts or ½-in. lag screws. The cross arms should be planed straight grained and painted with two coats of Prince's metallic paint, made up in the proportions of 7 lbs. to 1 gal. of pure linseed oil.

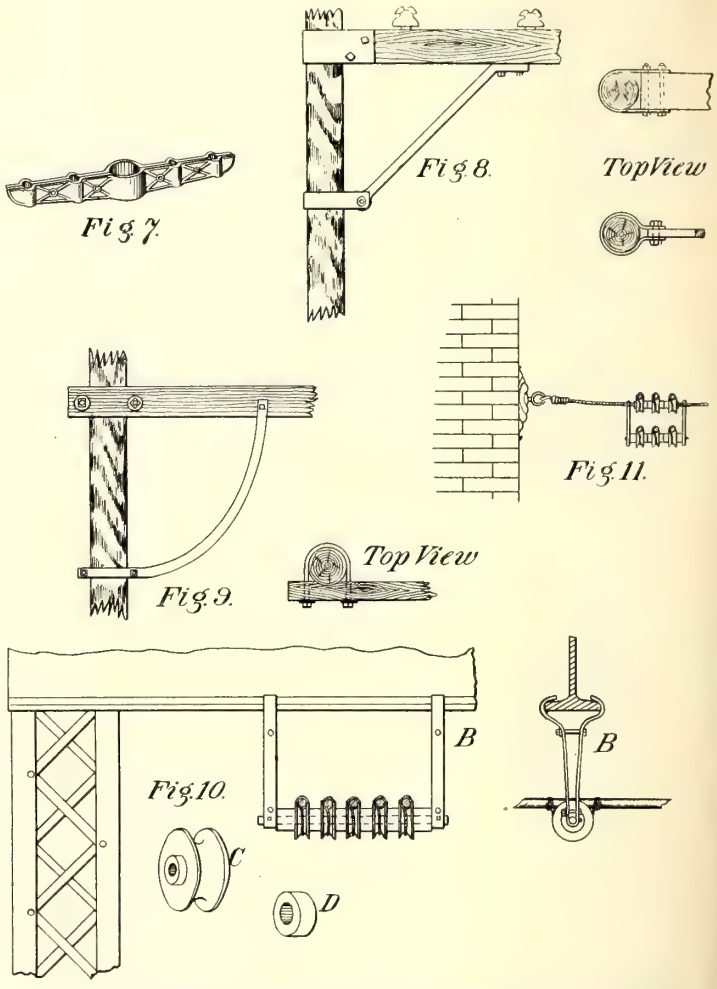


FIG. 4.—CROSS ARMS, SIDE ARMS AND SPECIAL METHODS

Three designs of split cast iron brackets are shown in 4, 5 and 6, Fig. 3. The two halves clamp the pole by two bolts which pull them together; the threads of the top bolt catch the whole strain in this method of fastening. The diameter of the pole at point of connection with cross arms can only vary 1 in. for this style of fastening. Instead of a cast-iron cross arm a sheet-steel punched cross arm,

made in two duplicate halves, is shown in 7 in Fig. 4. The elasticity of the two halves allows for considerable variation in the size of poles. Four bolts hold the halves together and either iron or wooden insulator pins can be used. Side arms are very useful in dodging trees; where the poles have to be set at a fixed distance from the curb the arm may be swung either side of the pole, and the feeders in this way cleared of tree contacts. Nos. 8 and 9 show the two, three and one pin arm method of fastening.

In some instances the feeders have to be supported on structures. No. 10 shows them carried under an elevated railroad. At *A* is shown the general arrangement, at *B* the suspension irons, at *C* the porcelain insulator, at *D* the spacing washer between insulators. A $\frac{3}{8}$-in. iron pipe threads these insulators; these supports are placed every 12 ft. to 25 ft. and no tie wires are used. No. 11 shows how a wire support is made where house connection can be made, but no pole can be set. The feeders are tied in the insulators in this case, and the span wire is also insulated by strain insulators.

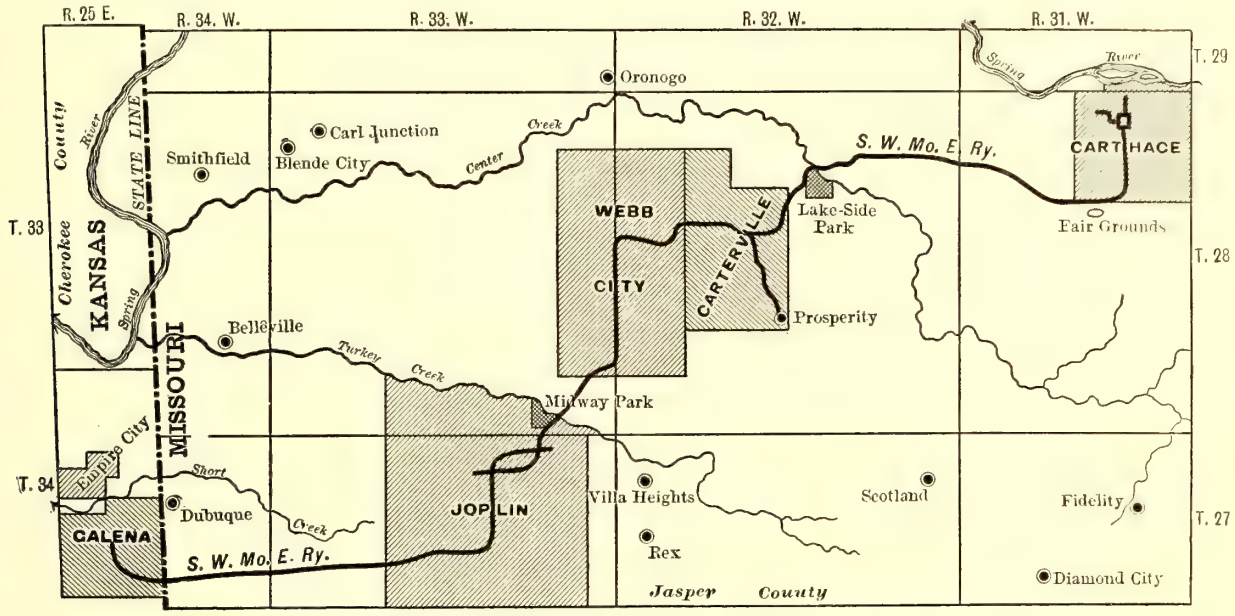
Electric Railway at Amiens, France

The tramway system at Amiens consists of four lines, radiating from a central point and comprising about 18.7 km. of track. The entire system has recently been equipped electrically by the French Thomson-Houston Company, and is now in operation. The track is laid with 36-kg. Broca rails, and there are twenty-eight motor cars, each equipped with two 35-h.p. motors. The cars are divided into two sections, first and second class, each capable of seating ten passengers, while the two platforms together will hold eighteen passengers. The car weighs 8500 kg., and is capable of making speed at 25 km. per hour on a level.

The power station contains three 150-kw. units, with Corliss horizontal simple engines, with cylinder dimensions 560 mm. x 1220 mm., and running at 72 r.p.m. Each engine is belted to a generator of the six-pole type, and running at 400 r.p.m. The Standard overhead trolley system is used, and special attention was given to securing a light-appearing line by the use of ornamental poles.

Large Interurban Electric Railway in Southwestern Missouri

The Southwest Missouri Electric Railway is an evolution from a mule road, the only remaining vestiges of which are a wooden car barn, still used for a car house, and a few of the little cars, now in use as suburban passenger stations and as business quarters for a shoemaker and a newsdealer. The progenitive mule road to which reference is made was built in 1890 by A. H. Rogers, now president of the surviving company. It extended from the west end of Webb City to the east end of Carterville, a distance of $2\frac{1}{2}$ miles, and was operated with mules from Sept. 1, 1890, until March 1, 1893, when it was sold to the present company, reconstructed and extended from its former Webb City terminus south and west to Joplin, a distance of 6 miles, and from its former Carterville terminus east and south a distance of 2 miles to Prosperity, a rich mining camp.



MAP OF SOUTHWEST MISSOURI ELECTRIC RAILWAY

In 1890-'91 an electric railway was built in Joplin, extending from East Joplin to and through Joplin proper and to the suburb of Blendville—just south of Joplin—a distance of 5 miles. This railway was absorbed by the Southwest Missouri Electric Railway Company in 1895, and in 1896 was extended from the Blendville terminus west to Galena, Kan., a distance of 7 miles. In 1895 an electric railway was constructed from Carterville to Carthage, a distance of 12 miles; this property was also purchased in 1896 by the Southwest Missouri Company. Thus, at the present time the Southwest Missouri Electric Railway Company owns and operates an interurban electric railway system, the main line of which connects Carthage, Carterville, Webb City and Joplin, Mo., and Galena, Kan., with branch lines; Carterville to Prosperity, Joplin proper to East Joplin, and Carthage square to the two railway depots. In addition to the interurban service given, a city service is maintained in Joplin and in Carthage. The total mileage is 35.

Carthage, the eastern terminal of the system, is the county seat of Jasper county, and was a town of considerable size long before any of the neighboring mining towns came into existence. It contains many handsome residences, fine churches, good schools, and is enjoying a healthy growth. Carterville and Webb City are twin cities, whose existence is due to the discovery in 1873 of

rich deposits of lead and zinc in Center Creek bottoms, between the two town sites. Both of these places are prosperous, well-built towns. The main office, main power house and car house of the electric railway are in Webb City, as geographically it is in the center of the system. Joplin came into existence in the year 1869 as a mining camp pure and simple, and has grown to be a considerable railroad center, as well as a mining metropolis. Here are located large foundries, machine shops and smelting works, and the city is the headquarters of the zinc interests of the United States. Galena, Kan., is a typical mining town, and a good portion of the town site, as well as its contiguous area, is devoted to mining. The weekly output from the Galena mines alone will average $50,000.

The value of the output of zinc and lead ore from what



POWER STATION AT CENTER CREEK

is known as the Joplin district, for 1898, was $7,500,000; for 1899 it will reach $10,000,000. In 1895 the average price for zinc ore (Jack) was $20 per ton, now it is bringing $43 per ton. The population of Carthage is 12,000; of Carterville, 4500; of Webb City, 7500; of Joplin, 20,000; of Galena, 10,000.

POWER STATIONS

The power houses of the Southwest Missouri Electric Railway Company are two in number; one is in Webb City, the other at Lakeside Park. The Webb City station is of brick, 71 ft. x 140 ft., and the engine room is 71 ft. x 80 ft.

The equipment consists of one G. E. 225-kw. M. P. generator, belted to a single expansion Cooper-Corliss engine, and two Westinghouse M. P. 150-h.p. generators, each belted to a single expansion Cooper-Corliss engine. In addition, this station contains two D-62 generators used as boosters for furnishing power to the Galena section of the road, the extreme end of which is 15 miles from this power house. The boiler room measures 71 ft. x 45 ft., and contains five tubular boilers. Back of the boiler room are the coal bins, into which coal is dumped directly from the car standing on a private switch. Water for this plant is obtained from a well 250 ft. deep, and passes through a Cookson 1000-h.p. heater.

The power plant at Lakeside Park, on the bank of Center Creek, is a combination station and car house. This building is 90 ft. x 115 ft., and is equipped with two condensing Bates-Corliss engines, each driving by rope transmission a Walker M. P. 200 kw. generator. The boiler room measures 45 ft. x 45 ft., and contains two tubular boilers.

The voltage carried at the power house is 600 on the generators and 800 on the boosters. The greatest drop at any place on the line is down to 450 volts, under heavy loads.

The company has three car houses, one at Lakeside Park, as stated, one in Webb City, and one in East Joplin. During the present season an additional car house will be erected at Galena.

TRACK AND ROLLING STOCK.

Cedar poles and No. 0 trolley wire are used in overhead construction, and the track bonding is made up principally of No. 0000 copper bonds, though a number of plastic bonds are also in use. The feed wire comprises nearly 300,000 lbs. of copper. Double poles and span wire overhead construction prevails throughout. The overhead material is General Electric make, and the copper bonds were supplied by the American Electrical Works.

The track is laid with 50-lb. T rails throughout, except on Main Street, Joplin, and Main Street, Galena, where 56-lb. girder rails are employed. These rails are spiked to white oak ties of standard railroad size, and the entire roadbed is ballasted with tailings from the mining plants. These tailings provide a ballast that tamps nicely, and afford an easy-riding and solid track.

The two main streams crossed—Turkey Creek, near Joplin, and Center Creek, between Carterville and Carthage—are spanned by steel truss bridges resting on cut-stone abutments.

The rolling stock consists of ten single-truck cars, twelve double-truck closed cars, eleven double-truck open cars and three trail cars. The cars are heated by electric heaters and Baker hot-water heaters, and all interurban cars carry Wagenhals electric headlights. The motor equipments are made up of S. R. F. 30, G. E. 1200, Walker



STANDARD DOUBLE TRUCK CAR IN JOPLIN

5-A, Westinghouse No. 3, No. 12-A's, No. 49 and No. 38-B motors. The electric heaters are of the American and Consolidated types.

The managers of the company state that they have not yet found any trolley wheel that can always be depended upon to stay on the wire. The main remedy for the trouble of trolleys jumping the wire is found in good line work and attention to the trolley rope by conductors while passing around curves, etc.

Two parks are owned by the company—Midway Park, near Joplin, and Lakeside Park, between Carterville and Carthage. The latter represents an investment of $20,000. At Lakeside the company owns a small hotel, surrounded by a beautiful lawn, for the convenience of its employees

at the Lakeside station and car men whose run is out of the Lakeside car house.

Very little trouble is experienced in the country sections with snow, as the snow does not get deep enough to interfere with the operation of the cars. In the cities, however, it does become an obstruction. The company owns a snow plow of its own manufacture, which is used in cases of deep snows, but for the average storm, where only the city streets are to be contended with, the main reliance is placed upon salt. One salting of the track will not only remove an existing snow, but will also cause the next one that falls to melt rapidly.

CAR SERVICE

The interurban car service is divided into two divisions —the eastern and western. The former is between Joplin and Carthage, and is approximately 20 miles in length. On this division regular cars leave each terminal every thirty minutes from 6 A. M. until 11 P. M., and reach the opposite terminal one and one-half hours later. To this regular service the company added on March 1 a special service of fast electric cars known as the Empire County Express. These cars are operated every ninety minutes from 8 A. M. to 11 P. M., and reduce the running



VIEW OF TRACK BETWEEN JOPLIN AND WEBB CITY

time between Joplin and Carthage from one and one-half hours to one hour flat. Trips have been made by these cars in forty-eight minutes, including the four regular stops and four stops for railroad crossings, making an average running time of 25 miles per hour.

This fast car service, though operated over a single-track road, does not conflict in any way with the schedules of the slower cars, and has worked out to entire satisfaction from the outset. The cars used are new from the shops of Jackson & Sharp Company, and are mounted on Jackson & Sharp trucks. The bodies are 38 ft. over all, are fitted with smoking compartments, and (with motors) weigh about 31,000 lbs. each. They are equipped with hand brakes and heated with electric heaters. The motor equipments are G. E. 1200's and Westinghouse 38-B, one to each truck. The express service has proven a success, and seems to have increased the receipts of every car in service.

The western division is between Joplin and Galena, and is approximately 10 miles in length. On this division regular cars leave each terminal every thirty minutes from 6 A. M. till 11 P. M., and the running time is forty-five minutes from terminal to terminal.

The movement of the cars is regulated by a car dispatcher located at a telephone switchboard in the Webb City office. At each switch and terminal there is a telephone, through which the conductors communicate with the dispatcher and receive orders from him. The rules governing the telephone dispatching system are as follows:

"Cars must run as closely to schedule time as possible, and each conductor must communicate by telephone with the car dispatcher at time of leaving car house and at each passing point and terminal, wherever there is a telephone, and must govern the movement of his car strictly by orders received from dispatcher,



1000 FT. CURVE

proceeding from station to station only on orders. He must not allow his car to go beyond any meeting point without orders, whether he meets another car or not.

"When two cars meet, the conductor of the car first to arrive will report, and repeat orders received, to both his own motorman and to the conductor of connecting car, and the motorman of latter must not proceed till ordered or signalled so to do by his conductor.

"No extra car nor work car must leave the car house without reporting to and receiving orders from the dispatcher, and all such cars must move only in accordance with orders received from dispatcher."

When the express car service was started a great deal of dissatisfaction was manifested by patrons of the line who were accustomed to take the cars at points where the fast



OPEN CAR AT LAKESIDE PARK

cars would not stop, and considerable trouble was experienced in overcoming their objections, but nearly every one has now adapted himself to the new order of things, and peace prevails. This, and similar instances, show that a large amount of diplomacy is required on the part of the manager of an interurban railway in dealing with different communities and adverse personal interests; but it has been shown to be a fact that adherence to principles of equity

and fairness by the management of such an enterprise will silence factious opposition.

FARES

The fare from Joplin to Carthage is 20 cents. Express cars do not stop at any 5-cent collection point, and on these cars fares are collected in two instalments of 10 cents, and are rung up as collected. On other cars between Joplin and Carthage, which stop everywhere, fares are collected from passengers' starting point to destination at one collection, and identification slips are given him, a yellow slip indicating 10 cents, a green slip 15 cents, and a red slip 20 cents. At each regular collection point the conductor starts at the front of the car and rings up one fare for each passenger, gathering up yellow slips on second collection, green ones on third and red ones on fourth.

The fare between Joplin and Galena is 10 cents, and is collected and rung up one fare at each collection point.

The company's rule respecting half fares is given below in full:

"Children over five years of age and under twelve are to be carried for half-fare, but the half-fare privilege is to be strictly confined to children between ages above stated. Conductors will keep a supply of half-fare tickets on hand, and all transactions with half-fare passengers must be with half-fare tickets. Conductors will sell one half-fare ticket for five cents, punching same in presence of passenger from whom the five cents is received; this is not to be rung up, but on next collection the ticket is to be taken up and rung up. A half-fare ticket in possession of a half-fare passenger, if punched with the regulation punch mark, is to be accepted for one half-fare and rung up. Half-fare tickets are to be punched only in presence of passenger, and half-fare tickets when taken up, must not be reissued."

This system has in several years of practice proven that it overcomes all objections to ordinary methods of handling half fares. The conductor buys these tickets at the office for 5 cents each, and issues them as provided in the rule given.

Free transportation is given to those so favored in the form of coupon ticket books—each book containing 100 coupons. These coupons are accepted by the conductor as of the value of 5 cents each, and are rung up as other fares. Virtually no transfer system exists; the number of transfer tickets issued per day by all the conductors will not average more than twenty-five.

No freight is carried except such as can be taken on the front platform of the passenger cars. Each conductor carries a schedule of rates to be charged, and conductors are allowed to retain 20 per cent of all money received from this source, dividing it with his motorman. The charge for a trunk or baby carriage is 25 cents, regardless of distance, and for a bicycle 10 cents. The conductor issues to the passenger a receipt for amount received for carrying his freight, and turns in stubs to office.

Between July 11, 1897, and Jan. 8, 1899, the company maintained a rate war with a parallel steam road, as described elsewhere. The total receipts for the year ending Aug. 31, 1897, were $117,127.53, during this year being free from steam competition up to July 11, 1897—ten and one-half months. The total receipts for the year ending Aug. 31, 1898, were $115,050.11, in spite of fierce steam competition during the entire year, and with rates cut to one-third of the regular amounts after June 5.

The partial restoration of rates on Jan. 8, 1899, had an immediate effect in increasing receipts, and the addition of the rapid service between Carthage and Joplin, inaugurated Mar. 1, had a still further effect—the receipts for March, 1899, exceeding those of March, 1898, by more than $4,000, and were greater than for any previous month in the history of the road, in spite of weather very unfavorable for street railway operation.

Extensive additions and improvements will be made during the present year, particularly along the lines of increased motive power, greater car speed and additional rolling stock and equipments.

The officers and heads of departments of the company are: A. H. Rogers, president and treasurer; E. Z. Wallower, vice-president; A. G. Knisely, secretary; E. J. Pratt, superintendent of motive power; C. E. Baker, superintendent of transportation; J. M. Maret, superintendent of tracks, lines and bridges; H. T. Morrison, superintendent of repair shop.

Electric Railways in Europe

The accompanying table, taken from a recent issue of "L'Industrie Electrique," shows a summary of the length, station capacity and number of motor cars in the different countries in Europe, brought up to Jan. 1, 1899, with the totals at Jan. 1, 1898, for comparison:

Country.	Total Length of Lines in Km.	Total Power Capacity of Stations in Km.	Total Number of Motor Cars.	Character of Equipment.						
				Number of Trolley Lines.	Number of Conduit Lines.	Number of Surface Contact Systems.	Number of Accumulator Lines.	Number of Mixed Lines.		Total Number of Lines.
								Trolley and Accumulators.	Trolley and Conduit.	
Austria-Hungary	113.2	3,604	291	12	2	..	..	..	..	14
Belgium	69.0	2,415	107	6	1	..	1	..	..	8
Bosnia	5.6	75	6	1	..	..	..	..	..	1
England	211.1	10,507	398	19	1	8	1	..	..	29
France	487.5	18,718	759	42	2	1	6	4	1	56
Germany	1402.8	30,378	3,140	63	..	..	4	4	2	73
Holland	3.2	320	14	..	..	..	1	..	..	1
Ireland	22.8	646	32	1	..	1	..	..	..	2
Italy	146.9	6,620	318	12	..	..	1	..	..	13
Portugal	2.8	110	3	1	..	..	..	..	..	1
Roumania	31.4	590	48	2	..	..	..	..	..	2
Russia	40.7	1,950	95	4	1	..	..	..	..	5
Servia	10.0	200	11	1	..	..	..	..	..	1
Spain	104.7	2,450	144	7	..	..	..	..	..	7
Sweden and Norway	24.0	875	43	3	..	..	..	..	..	3
Switzerland	200.7	6,665	325	32	..	..	..	..	..	32
Total	2876.4	86,123	5,734	206	7	10	14	8	3	248
Total January 1, 1898	2359.3	68,106	4,514	172	8	8	13	3	..	204

LETTERS AND HINTS FROM PRACTICAL MEN

Notes on the Standard Rules and Regulations as Reported by the A. S. R. A. Committee, IV

SCHENECTADY RAILWAY COMPANY,
SCHENECTADY, N. Y., April 19, 1899.

EDITORS STREET RAILWAY JOURNAL:

Continuing the comparison and analysis of the "Standard Rules and Regulations" of the A. S. R. A. committee, we wish to know:

10. Are they couched in plain, terse language, so as to be easily understood and remembered and—if necessary—memorized? This point has been partly answered previously (under head No. 5), but something more needs to be said on the subject, as the construction and language of the rules is an important point. The committee appears to have had a dread of "elegant phraseology"—whatever that may mean to them—and to have been led by that dread into phraseology that was inelegant, incorrect and misleading. To go over all the instances of this in the rules would be vexatious and tiring. We will be content with one of the worst specimens—Rule 33 for Conductors, which says:

"Lights: It is your duty to test lights and see that they are in good order before leaving depot, and you also must be very careful and particular that the headlight (in the direction the car is moving) is lighted, and must see that your car is provided with switch light plug before leaving depot."

The actual purpose of this rule of fifty-seven words can be much more clearly, correctly and thoroughly expressed in one of thirty-five words, as follows:

"Car lights: Before his car leaves the depot he will, by actual test, make certain that *all* lights are in good order, and that the necessary chimneys, the incandescent lamps and fuse links (or fusible plugs) are in their place on car."

The rule as given by the committee states that "it is your duty to, etc." This is entirely unnecessary, for if a certain instruction or command is placed in the rules, it goes without saying that it *is* the employee's "duty" to obey it, and—if it is addressed to one employee or class of employees—it is the "duty" of that employee or class of employees only. The same remarks apply also to the phrase "you also must be very careful and particular," and, in addition, this phrase is easily capable of a double meaning, either of which may be correct. As written, "you *also* must be very careful, etc.," it means that some one besides the conductor "must be very careful, etc.," whereas the true meaning of the phrase is "you must *also* be very careful, etc." In either case the language is unhappy, and if it means what it says, that the conductor is to be responsible for the burning of the headlight, that duty has already been placed on the motorman, under "Rule 17 for Motormen." It would certainly be poor discipline to give the motorman a specific duty, and under another head to give the same duty to the conductor. No specific duty capable of *always* being done by *one* employee should ever be divided among two or more. It divides the responsibility into fractions, lessens the interest of each one in that duty, and increases the chances of neglect. If a duty is so important that it must be done at all hazards, and if there is a fear that no one employee can be trusted to do it, it should be made the duty of some *official* to check its performance, but it should not be made the duty of a fellow employee of the same or inferior grade. In this instance the duty referred to is plainly the duty of the motorman—and no one else; for the headlight, whether it be oil or electric, is peculiarly the light of the man who runs the car, and on him should devolve the responsibility of seeing that it is in perfect order before he starts from the depot with it. He should be the one that should make certain that all necessary renewal parts liable to be needed while it is in use are in their place on the car, and on him alone should be the responsibility of its being lit at the proper time, and kept lit when and as long as it is necessary.

If we read the phrase the other way, as calling the attention of the conductor to the headlight as being the especial light to be looked after, it is still unnecessary, the italicised word "all" in the amended rule covering the ground thoroughly. The last part of this rule is unnecessarily verbose, and is also rendered obscure by the use of the local word "switchlight-plug." As this word is used in connection with the lights it is supposed to mean a "fuse-plug," "fusible-plug," or "fuse-link," either of which are better understood names for the article in question.

While a great many of the rules are unnecessarily loaded with words which frequently befog their meaning, others are so curt as to not fully express or explain themselves, or cover the subject of the rule. As has been stated in a previous article, "brevity must be sacrificed to perspicuity." A rule must, above all, be clear as to its meaning, but that clearness must be shown in the fewest and best chosen words; every word and sentence should be scrutinized and its meaning well weighed before it is allowed to go. All unnecessary words and phrases should be cut out—but no more. There is a happy medium between going naked and smothering one's self in unnecessary and clogging garments; and this applies to rules. Few people have the gift of extemporaneously saying the right things in the right words, and almost as few have the gift of writing them. It therefore behooves any one making a rule or order to see that it is first written so as to clearly express its full meaning and intent—that it is both clear and comprehensive—and after that is done to prune out the unnecessary words and phrases—to "boil it down to clear syrup!"

11. Are they arranged in some definite, connected and consecutive manner, and divided into groups having specific relation to certain persons, duties, responsibilities, acts or things? They certainly are not! To speak plainly, they are jumbled together in a very careless manner, and the employee who was compelled to pick out and remember the rules appertaining to him or his department would be entitled to hearty sympathy. While this point is not a vital one, while a set of good rules might be shaken up in a hat, printed as they come out, and possibly no great harm be done, still it would be easier for all concerned to have them in logical shape for better, safer and easier reference and remembrance. It costs very little in labor to put them in such shape if the principles that underlie such an arrangement are defined, understood and followed.

As a beginning, the rules in any one rule book should be consecutively numbered with a single series of numbers. There is no reason for numbering the "Rules for Conductors" with a series of numbers and the "Rules for Motormen" with a similar series, so that there is a "Rule 1" and "2" and "3," etc., for each. If it is desired to have the employee so conversant with the separate rules that they can be called to his attention and memory by number only, it will be just as easy for him to remember the first rule of his department as No. 19 as it will be if it is No. 1. Besides this, it is much easier for the superior officers or officials who have supervision over *all* the rules to remember them and place them if there is only one series of numbers. Finally,

it is much less productive of confusion and mistakes in notices or orders relating to the rules to have only one rule of each number instead of half a dozen "No. 1's" or "No. 9's," which depend for their identification on the name of some department or class being tacked onto them. The only reason for numbering as given by the committee is that it permits the addition of new rules at the end of those applying to each department without breaking the continuity of the numbers or using fractions or letters. In a well-considered and up-to-date set of rules the need of an absolutely new rule that cannot be temporarily added to an existing rule is—or should be—a rare occurrence, and where it does occur frequently it is a pretty sure sign that the rules, as a whole, need readjusting and rearranging. If, however, it is thought probable that there will be a need for additional rules before such a rearrangement is necessary, it is an easy matter and one productive of no evil or confusion to leave a few unoccupied numbers at the end of each section or department, these numbers to be given to the new rules as they are made.

Even worse than the system of numbering as adopted by the committee on some of the rules is the system of no numbers at all, as under "General Rules" and "Depot Masters," the designation of which could only be by "line No. so and so" or "paragraph such and such," a most cumbersome, confusing and impossible arrangement.

The first principle, therefore, in the arrangement of the rules is that all the rules in any one rule book should be consecutively numbered, without regard to departments or any other division.

The next point is to prefix each rule with a short heading, giving the object of the rule or the subject or subjects treated by it. In practice it is wise to have these headings printed in a display type, so as to quickly catch the eye of a person not familiar with the rules.

The next thing is to group the rules under proper heads or sections, relating to the departments, or classes or divisions of employees. As we are now considering only two classes, conductors and motormen, these groups will only number three—one for both and one for each.

The next is to subdivide these groups according to the relations of these two classes of employees. The relations that any traffic employee works under are as follows:

I. To his employer.

II. To his superior officers and officials.

III. To his subordinates.

IV. To fellow employees having the same duties as himself.

V. To fellow employees having different duties from himself, but with whom he will be thrown in working contact.

VI. To the materials, tools, apparatus, appliances or machinery under his charge, or used or operated by him.

VII. To the general public.

VIII. To persons not belonging to, or not having authority from his employer, but who may have relations with or authority over him under laws, ordinances, or general or local customs.

Keeping in mind these separate relations, the grouping of the rules for conductors and motormen naturally divides itself into:

A. An "Introduction" or "General Notice," in which the employer states the general duties, responsibilities, requirements, etc., common to all employees, and the principles underlying the duties of the employees for whom the rules following are made.

B. "General Rules for both Conductors and Motormen," stating fully their relations with their superior officers and officials, and with one another, with the general public and with outside parties in authority, where such relations are *general*, and identical for both conductor and motorman.

C. "Special Rules for both Conductors and Motormen," stating requirements, defining responsibilities and instructing in duties common to both.

D. "Special Rules for Conductor in relation to car."

E. "Special Rules for Conductor in relation to passengers."

F. "Special Rules for Motormen in relation to car."

G. "Special Rules for Motormen in relation to passengers and general public."

H. The bell and gong signals, and the rules specially and solely applicable to them.

I. Specific instruction in regard to special apparatus and localities, or to local customs, laws, ordinances, etc., relating to the employer—as represented by the conductor and motormen—or *directly* applicable to them.

Under these groups the rules should be arranged as much as possible in a natural sequence, taking up the different duties and responsibilities as nearly as possible in the same order as the employee will meet with them in actual practice. The following are given as suggestions for this arrangement:

Rule 1.—General requirements.
Rule 2.—Rules and orders.
Rule 3.—General conduct while on duty.
Rule 4.—"Time" and "Pay."
Rule 5.—Absence from duty.
Rule 6.—Resignation and discharge.
Under "Special Rules for Conductors and Motormen:"
Rule 10.—Uniforms.
Rule 11.—Badges.
Rule 12.—Other company property.
Rule 13.—Taking out and bringing in cars.
Rule 14.—Defects in track, line, etc.
Rule 15.—Articles sent by car.
Rule 16.—Disablement of car.
Rule 17.—Leaving car while on run.
Rule 18.—Disturbances, ejections, etc.
Rule 19.—Accidents.
Under "Special Rules for Conductor in relation to car:"
Rule 25.—Responsibility and authority.
Rule 26.—Care and condition of car.
Rule 27.—Trolley.
Rule 28.—Safety-gates, bars, nets, etc.
Rule 29.—Direction or route signs.
Rule 30.—Grade crossings.
Rule 31.—Place and actions on car.
Rule 32.—Articles left on car.
Rule 33.—Running and schedule.
Under "Special Rules for Conductor in relation to passengers:"
Rule 40.—Non-riders.
Rule 41.—Collection of fares.
Rule 42.—Keeping order on car.
Rule 43.—Conversation with passengers.
Rule 44.—Stopping for passengers.
Rule 45.—Assisting passengers.
Rule 46.—Looking out for passengers.
Rule 47.—Calling streets, etc.
Rule 48.—Platforms and steps.
Rule 49.—Smoking and spitting.
Rule 50.—Intoxicated persons.
Rule 51.—Disorderly persons.
Under "Special Rules for Motormen in relation to car:"
Rule 55.—Responsibility and authority.
Rule 56.—Who may run car.

Rule 57.—Care and condition of machinery and apparatus.
Rule 58.—Special points to be observed in relation to machinery and apparatus.
Rule 59.—Special points to be observed in regard to running.
Rule 60.—Speed.
Rule 61.—Headway.
Rule 62.—Schedule.
Rule 63.—Grade crossings.
Rule 64.—Right of way.
Rule 65.—Block of road.
Rule 66.—Sand boxes.
Rule 67.—Headlight.
Rule 68.—Track signals.
Rule 69.—Use of foot-gong.

Under "Special Rules for Motormen in relation to passengers and the general public:"

Rule 75.—Looking for passengers.
Rule 76.—Blocking of track.
Rule 77.—Ambulances, fire wagons, processions, etc.
Rule 78.—Alarms and warnings.
Rule 79.—Danger and risks.

After these may be placed the bell signals and all rules relating *exclusively* to them. Also, copies of, extracts from, or directions in regard to laws, ordinances, etc., to be observed, or peace or other officers to be obeyed or reported to.

Under each one of the above—or similar—headings should be grouped everything appertaining to the subject contained in that heading that applies to that particular employee or class of employees. The different divisions of this subject had best—for easy reference—be paragraphed. For instance, under "Rule No. 41.—Collection of Fares," should be stated in separate paragraphs the following points:

The different kinds and amounts of fares to be collected.
When and how they are to be collected.
When and how they are *not* to be collected.
When and how they are to be registered, or otherwise publicly recorded.
When and how they are to be privately recorded.
When and to whom they are to be "turned in."
Regarding errors in regard to collection of fares or of making change.
Regarding disputes concerning same.
Regarding errors in registering or recording fares.
Counting and checking passengers.
Instructions in regard to setting, changing, handling, etc., of registers or other recording or checking devices.
Change.
Tickets.
Full instructions in regard to transfers.
Free riders other than employees.
Riding of employees.
And any other specific instructions as to local or special procedure or customs regarding fares.

The above classification, grouping and paragraphing may seem like an appalling and unnecessary mass of detail, but nothing has been suggested but what is necessary to make the rules quick and easy of reference and easily remembered—surely two very important points. As to the number and title of heads, or rules, given, there are few but what are general and can be used in full by the smallest of roads, while a road much larger or more complex would very probably have to add considerably to their number.

H. S. Cooper.

(To be Concluded.)

Heavy Snows in Montreal

Montreal Island Belt Line Railway,
Montreal, April 11, 1899.

Editors Street Railway Journal:

On the introduction of electric railways into Canada it was prophesied that snow would be an insurmountable



DEEP SNOW NEAR MONTREAL

difficulty. I inclose a couple of photographs of "difficulties" on our line. This drift was so hard that it would hold a shovel so firmly that the latter could be broken off, and it would quite easily bear a man's weight.

This storm was fought with shovels and a Ruggles ro-



A TYPICAL DRIFT

tary plow, equipped with four G. E. 1200 motors. The plow alone would handle a considerable amount of soft snow, but banks of this description are not to be overcome by such mild persuasion. Some of our cars are furnished with noses, but are not of much use when the snow is too deep.

I may say that we have some 12 miles of track, on which the snow fell on March 28 to a varying depth of from 2 ft. to 10 ft., and all hard packed.

While the difficulty was not insurmountable, I think all will admit that it was a difficulty.

Our Lady of the Snows.

The Breakage of Car Axles

St. Louis Car Wheel Company,
St. Louis, Mo., April 14, 1899.

Editors Street Railway Journal:

I have read with interest the discussion in your columns on the breakage of car wheel axles, and think a large factor in accidents of this kind is the condition of the track. Where the railway has light T rails and bad joints, some disasters of this kind must be expected with light or low grade axles. It is also necessary to have the wheels properly adjusted to the track gage, for if too narrow between flanges they impinge on guard rails, in frogs and at crossings, and if too wide are grinding continually against the inside of the rail heads, all of which produces undue strains upon the axle. With 18-ft. closed cars bodies or ten-bench open cars, 33-in. wheels, good track and a speed not exceeding 12 miles an hour, an axle of $3\frac{3}{8}$ ins. diameter, if of good material, should stand all the proper strains that are likely to come upon it in service. We have fitted many hundred of wheels, a large proportion of which have been 36-in. wheels, upon axles of that size made of hammered steel, and I do not remember of a single breakage except in collision or derailment. It is supposed that the axles are properly trammed when under the cars; if not, that will cause another strain on the axle.

Our experience with rolled steel for axles has been most unsatisfactory, so much so that we have abandoned its use for axles entirely and use hammered steel instead, as mentioned above, and have found it most satisfactory. Again, a good many car builders and street railway superintendents (or their truck men) when pressing street car wheels on the axles leave them wide in the gage, making the flange run close to the rail in order to prevent lateral play on the car as much as possible. This is very good practice when the tracks are kept in first-class condition, straight and level, and when the rail joints are well kept up, but if otherwise, a close working flange is pretty severe on the axle, as the crowding of the flange, when added to the strain of the load bearing on journals outside of the wheels, tends to bend it continually.

Our practice in pressing on is to leave a little lateral play between flange and rails, and having received no "kicks" from our customers we consider the practice a good one. Alexander Magee, Foreman.

A Method of Increasing the Life of Gears and Trolley Wheels

Denver, Col., April 10, 1899.

Editors Street Railway Journal:

During the early and dark days of the electric railway we used a trolley wheel of about one-half the diameter of those required by modern practice, and pressed harder against the wire. When made of brass they would not last over three days, but the metal was gradually made harder, until finally we used steel, tempered file hard. These wheels proved to be desirable, electrically, and quite durable.

In later experiments with motors and boxed gearing, of my own design, to deaden the noise and lubricate the gears we supplied them liberally with common bar soap and oil. This proved to be quite desirable for the purpose intended. and besides it showed another remarkable feature. The face of the teeth of the gearing were soon covered with a thin scale of foreign material, which prevented the metal from wearing. This material became flint hard, and required a cold chisel to remove it.

The writer is of the opinion that trolleys which will last ten times as long as those in common use, and car gearing that will not become noisy and wear, are within reach. I do not supply the exact specifications, but leave room for a little study and experimenting on the part of the railway master mechanic. John C. Henry.

Babbitt Melting Forge

Brooklyn, N. Y., April 4, 1899.

Editors Street Railway Journal:

In many shops it is customary to melt babbitt metal in the smith's forge—a very wasteful and vicious method, when it is considered that the forge fire gives too intense a heat for properly melting babbitt, and that babbitt metal injures the working of the forge whenever any of the metal finds its way into and remains in the tuyre. Lead there will effectually prevent the welding of iron as long as it is exposed to the action of the vapor of the lead.

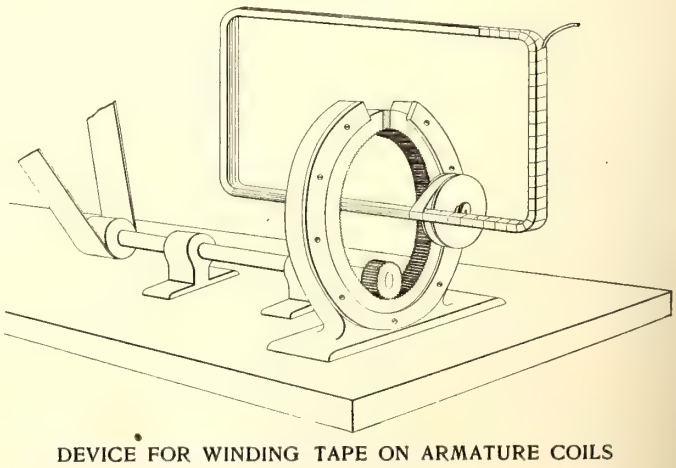
A much better way, and a cheaper one, too, is to rig up a little gas bench for the melting of small lots of babbitt. When a quantity of it is to be handled a furnace similar to that used for melting out—and melting in, too—the lining of axle and motor boxes will do. But, the gas bench, that is made of one or two heavy gas burners similar to those used in kitchens for cooking. They are placed in an iron bench, and proper iron bearers rigged for holding the ladles in place. With this rig the heat can be regulated at will, and there is no danger of melting out the bottom of the ladle before the workman is aware that it is even red hot and before the babbitt is fairly warmed through.

James Francis.

Quick Method of Winding Tape on Armature Coils

The winding of armature coils is a tedious and rather expensive job, on account of the labor required to wind the tape on the coil. Mr. Sheldon, of the Indianapolis Railway Company, has made a very ingenious and simple winding device by which the coil of tape is reeled around the armature coil. The accompanying engraving shows the general construction of this tool. The large external gear was cast from a lawn-mower casting, and gave very excellent results.

The spool on which the tape is wound is secured to a



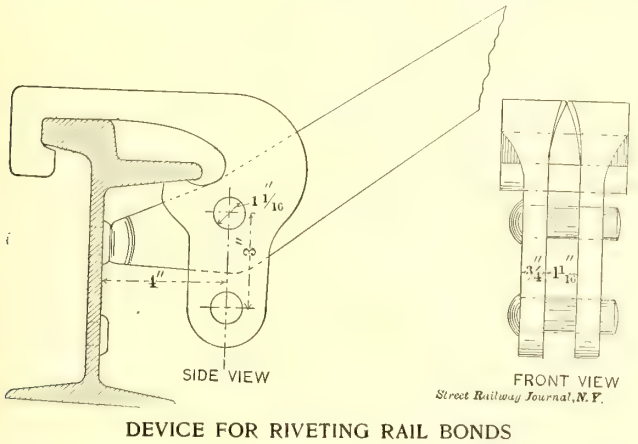
DEVICE FOR WINDING TAPE ON ARMATURE COILS

stud projecting from the rotating internal gear wheel. In order to introduce this coil into the center of the rotating ring, a diagonal slot is cut across the gear, and when the slot is opposite the opening in the containing bearing for this ring the coil can be introduced into the center of the ring. The device is then started up, and the tape is wound

on the coil as it is fed along through the center of this rotating ring. More or less tension can be given to the spool containing the tape by increasing or decreasing the pressure on the friction surfaces. The ring makes about 60 to 100 r.p.m., depending upon the character of the coil. It gives excellent results, and labor can be cut down about two-thirds by the use of this machinery instead of hand work. The perspective drawing of this arrangement is shown in the engraving, and details can be changed to suit any conditions which the repair man may consider desirable.

Device for Riveting Rail Bonds

On the Cleveland Electric Railway an ingenious method of holding the rail bonds in place while they are being riveted is employed. This consists of a hook lever, which is



DEVICE FOR RIVETING RAIL BONDS

placed over the head of the rail, and to which is connected a long bar which can be brought with heavy pressure against the head of the lug. This holds the rivet firmly while the riveting takes place. The arrangement is shown in the accompanying diagram.

Accident Instructions

The New Orleans Traction Company has recently issued such a set of instructions for government of its employees in case of accident, which gives in concise form the rules to be followed in case of accident. These instructions are printed on a large sheet, and have been posted in all the stations of the company.

The company has adopted the custom of teaching the employees topically by large cards of this kind, each referring to some special field of their work, rather than to embody the rules governing their duties in a book. This practice has been adopted because it has been noticed that by posting in the conductors' and motormens' rooms separate cards for the several sub-divisions of their duties discussion is more likely to be provoked, and this seems to breed greater familiarity with the subjects presented.

The company has been giving some special attention to the matter of accidents, with the result that its record during the past year has shown about 33 1-3 per cent improvement as compared with the previous year, with a 26,000 car-mile daily run.

ACCIDENTS

The term ACCIDENT includes injury to PERSONS or PROPERTY, COLLISIONS, BREAKAGES of all kinds to the CARS, EJECTIONS, PERSONAL TROUBLE in car between EMPLOYEES and PASSENGERS, or between PASSENGERS, and any event of any name or nature occurring upon a trip, wherein damages occur to PERSONS or THEIR PROPERTY, to CAR, to VEHICLES, or wherein the possibility of damages may arise from any action of EMPLOYEES or PASSENGERS themselves, whether complained of or not.

CONDUCTORS are not permitted to use discretion as to reporting or not any occurrence included in above statement, but must report promptly all matters coming within above list.

Reports must be TRUTHFUL and state EXACT facts, without FEAR, FAVOR or PREJUDICE, and no attempt must be made in a report to SHIELD any employee, or to CONCEAL any of the circumstances surrounding the occurrence reported. Reports must state FACTS which can be SWORN TO IN COURT by the employee reporting or by the party or parties named as witnesses. INFERENCES, OPINIONS and SUGGESTIONS must be stated as such, and not as facts. Report must give:

1st. DATE OF ACCIDENT AND EXACT TIME OF DAY WHEN IT OCCURRED.

2d. EXACT PLACE OF OCCURRENCE; full name and address of party injured, or likely to have been injured, either in person, property or feelings; the owner of property damaged or doing damage to company's property; if vehicle, name of driver, license number and year of issue.

3d. NATURE OF ACCIDENT, and cause of its occurrence. THIS CAUSE MUST BE CAREFULLY ASCERTAINED.

4th. FULL NAME AND ADDRESSES of all passengers, bystanders, and employees, as far as possible, whether they saw how the accident happened or not.

5th. DISTANCE WHERE CAR STOPPED, after the accident happened, from place on the street where accident occurred; measurement to be made by stepping the distance from the front end of car to point of accident. This measurement should be witnessed by a bystander, or some one not connected with the company.

6th. Statement of injuries or damages as well as any expressions of opinion from bystanders regarding the accident.

Above report must be filled out upon blank for that purpose, signed by the conductor and motorman, and left at the station, after turning in the car.

In the event of personal injury, care must be taken to render all the necessary assistance and attention to person injured.

The most TRIVIAL and apparently UNIMPORTANT ACCIDENT or OCCURRENCE in or about the car, even where a person declines to give name, claims no injury, or seems to regard the whole matter as trifling, must be REPORTED with as much care as though the damage or affair was of the utmost importance.

All accidents must be telephoned to general office of company as soon as possible, and especially in the event of a serious accident, the general office must be notified IMMEDIATELY so that prompt aid may be furnished and investigation begun pending the full report.

It is expected that a report will be made of all accidents or injuries that may occur on the track, or within 10 ft. of same, whether the car was concerned in the accident or not.

Attention is specially called to question arising between CONDUCTORS and PASSENGERS, as to the PAYMENT of fare, CHARACTER OF MONEY OFFERED, CHANGE FURNISHED, TRANSFERS or other COMPLAINTS leading to DISORDERLY, or BOISTEROUS conduct, in each of which events conductor must secure POSITIVE PROOF and EYE WITNESSES, so as to be able to clearly substantiate the truthfulness of his report in court, particularly before any EJECTION or ARREST is attempted, and full report of same must be promptly made in accordance with above rules. NO EJECTION must be made without FIRST REFUNDING FARE.

Conductors or other employees MUST NOT TALK about, or GIVE ANY INFORMATION WHATEVER concerning an accident to any person, other than the proper officer or person delegated with the authority of the company to investigate the occurrence, and all questions asked of any employee of company, except by person or persons above named, must be answered by directing the questioner to general office for information.

Employees must not VISIT an INJURED PARTY, or FAMILY, to make inquiries or discuss accident without authority of company.

The above rules must be STRICTLY OBSERVED, and too much stress cannot be laid upon their importance. If any doubt as to their meaning in any respect exists in the minds of employees, they should consult, for their own protection and the company's, their station foreman.

C. D. WYMAN, General Manager.

New Orleans, La., April, 1899.

Cars should be sponged off daily with clear water, and any accumulation of dirt removed as far as possible with a chamois skin and sponge—care being taken to rinse off the grit before rubbing with sponge or chamois. Once every thirty days the car should be thoroughly washed down, using a good grade of soap. From paper at the Boston Convention, 1898.

STREET RAILWAY JOURNAL

MAY, 1899.

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, BEARD BUILDING, 120 LIBERTY STREET.

BRANCH OFFICES:

CHICAGO.....Monadnock Block.
PHILADELPHIA.....929 Chestnut Street.
LONDON.....39 Victoria Street, Westminster.
PARIS.....50 Boulevard Haussman.
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ST. PETERSBURG.....Alexander L. Lineff, Ligovka, 67-22.

Long Distance Telephone, "New York, 4044 Cortlandt."
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada.....$4.00 per annum.
In all Foreign Countries, per annum.....$6.00 / 25l / 31 fr

Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

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Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

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Address all communications to

The Street Railway Publishing Co.,
Beard Building, 120 Liberty Street, New York.

The theorists and social reformers who claim to represent the enlightened and progressive element of the people of New York, but who certainly do not speak for the millions of "strap hangers" who suffer daily discomforts in the travel to and from their business, have succeeded in influencing Governor Roosevelt to take a somewhat decided stand against the granting to the Rapid Transit Commission of the City of New York the power to confer a perpetual franchise upon the group of capitalists which was prepared to spend $60,000,000 in bringing about genuine rapid transit in the boroughs of Manhattan and The Bronx. The offer to expend this money has therefore been withdrawn, the Metropolitan syndicate stating in a characteristically direct and candid manner their unwillingness to appear before the public as a "grabber of franchises," and their equal unwillingness to expend so large a sum of money upon a short tenure of privilege. It is hardly to be believed that so favorable an opportunity to secure a great public benefit at private expense and risk should be allowed to pass away, but it is impossible not to see that the growing tendency in municipal administration is to drive the hardest, sharpest bargain possible with public service companies, obtaining for the city treasury the last penny of profit, and leaving to the companies little margin for the larger improvements and extensions which are often unprofitable at first, but which the future would justify were the conditions more secure and the bargain more equitable. The people will inevitably suffer in the long run from a narrow money-making policy of this kind, but the latter is popular, and enables astute politicians to court and win public favor and office.

* * * * * *

The really incredible thing is that a man so broad-minded and sensible as Governor Roosevelt should be impressed with so superficial a view of the true interests of the city of New York as is taken by the "reformers," and should be so deceived by the sophistry of their arguments. Again and again have the opponents of a perpetual franchise urged the impossibility of making a bargain to-day which would properly protect the city's interests one hundred years hence. Again and again have they calmly ignored the workings of the Metropolitan syndicate's proposition to pay 5 per cent of the gross receipts to the city, and have wilfully or carelessly asserted that the city would get no more in future than at present. What are the real facts of the case? They are, obviously, that, as the travel increases with increase of population, the city's revenue increases in the same ratio. Moreover, this 5 per cent of the *gross receipts* really means a far larger percentage of the *net profits*—a percentage so large as to amount to a very profitable "special partnership" obtained by the city in the rapid transit enterprise. As we do not remember to have ever seen the real character of this "special partnership" clearly brought out and explained in the many discussions in different cities about the proper basis of franchise remuneration, it is worth while here to show in some detail exactly what "5 per cent of the gross receipts" really means in this particular case.

Clauses 7 and 8 of the Metropolitan syndicate's proposition read as follows:

7. The city to receive as compensation, in addition to the services rendered and in lieu of all other charges upon the franchise granted hereunder, an annual rental equal to 5 per cent on the gross receipts from the operation of the new road, provided that whenever any such payment shall leave the receipts insufficient to pay the rental of 5 per cent on cost of construction and the operating expenses, including taxes, the percentage to be paid shall be abated accordingly.

8. The real and personal property forming part of said railway to be exempt from taxes until it pays 5 per cent, as provided in section 15 of the rapid transit act, with the amendments proposed by the commission in the bill now pending before the Legislature.

If the new tunnel railway earns, in competition with the present surface and elevated lines, $7,500,000 gross per annum, or nearly as much as the present Manhattan elevated system is earning, and expends 50 per cent of this sum in operating expenses proper, it will turn over to the public treasury, in the form of taxes on real and personal property and agreed rental to the city not less than 10 per cent of the gross receipts, or $750,000, and will have left for its stockholders their 5 per cent guaranteed rental upon

their $60,000,000 investment, or $3,000,000. In other words, $7,500,000 is the minimum gross earning power of the tunnel railway by which its projectors will be able to make 5 per cent interest upon their investment and pay all the city's rental and taxation charges as agreed. Under these circumstances, and assuming this $3,000,000 to be merely "interest," and not in any sense "profits," the public would obtain all the "profits," leaving nothing for the controlling syndicate; or, put in another way, the public would obtain 20 per cent of the entire earnings from operation applicable to return on investment without itself making any investment whatsoever. Now, what may be expected of the future? Suppose that with the increase of population there comes a proportionate increase in traffic, such that fifty or one hundred years hence the tunnel railway will earn $25,000,000 gross. It cannot, of course, do this without making constant additions to its capital account in the way of extensions, increase of equipment, etc., and we will be well within limits in taking the aggregate investment account for a $25,000,000 gross earning power at $80,000,000. Let us see, then, what proportion of the earnings from operation and of the true profits the public would obtain at various stages of development between these maximum and minimum limits:

Investment.	Gross Earnings.	Operating Expenses.	Interest on Investment.	Rental and Taxes 10 per cent.*	Profit to Private Capital Above. Interest on Investment and Taxes.
$60,000,000	$7,500,000	$3,750,000	$3,000,000	$750,000	———
65,000,000	10,000,000	5,000,000	3,250,000	1,000,000	750,000
70,000,000	15,000,000	7,500,000	3,500,000	1,500,000	2,500,000
75,000,000	20,000,000	10,000,000	3,750,000	2,000,000	4,250,000
80,000,000	25,000,000	12,500,000	4,000,000	2,500,000	6,000,000

* The average city and State taxes paid by the Manhattan (Elevated) Railway Company of New York during the last five years amount to 7.2 per cent of the gross receipts.

It appears from this table that, as before stated, on a basis of $7,500,000 gross earnings the public will get all the profit above the interest, and private capital nothing; with $10,000,000 earnings the public will get 57 per cent of the profits and private capital 43 per cent; with $15,000,000 earnings the public will get 37½ per cent of the profits and private capital 62½ per cent; with $20,000,000 earnings the public will have 32 per cent of the profits and private capital 68 per cent; and with $25,000,000 earnings the public will have over 29 per cent of the profits and private capital less than 71 per cent. Even at $50,000,000 gross earnings, assuming $100,000,000 accumulated investment, the public would obtain 25 per cent of the profits above interest. In all cases the public will get 20 per cent of the entire net earnings. Does this partnership seem inequitable or against good public policy? Can the social reformers really hope that a municipal administration can so manage an enterprise of this highly technical character as to surely bring a larger sum into the public treasury, and at the same time to serve the whole public as well as can be done through private enterprise? Can Governor Roosevelt himself, with his intimate knowledge of the way in which public affairs are conducted by politicians, really believe that better results to the public can, in the long run, be obtained by municipal ownership or management?

* * * * * *

There are other phases of the Metropolitan syndicate's proposition which do not seem to be clearly appreciated by the public. The State does not hesitate to grant to a steam railroad company a perpetual franchise and the right of eminent domain, by which it can lay out a route across fields and roads and through cities and towns, as it pleases, and own such route forever. Why, therefore, should private capital be debarred from undertaking the work of constructing a tunnel beneath the surface of a city at an expense per mile enormously greater than any railroad is called upon to bear? Again, one of the chief advantages of the present proposition for rapid transit in New York lies in the surface connections and transfer arrangements, by which the surface system acts as a collecting and distributing agent for the subway. The Metropolitan Street Railway Company's surface franchises are perpetual, and even if a short-time franchise only were granted for the tunnel, with a provision for revaluation at the end of each of successive periods, the city would practically be forced to come to the terms of the surface railways in order to maintain the advantage of the distributing and collecting media. In spite of the withdrawal of the Metropolitan propositions, we sincerely hope that some means may be found to bring about rapid transit in New York at the earliest moment. The tunnel is an inevitable necessity, however long its building be postponed, for it will be wholly impossible five or ten years hence to carry on the surface or elevated lines of the city the people who will demand transportation facilities. The city is growing at so rapid a rate and the lines are, even at present, so congested with traffic, that nothing is more sure than that in some way new facilities must be provided.

It looks as if we were to have a municipal ownership experiment in Detroit, and perhaps another in Toledo. On the whole, we are inclined to welcome the carrying through of such a proposition in a single American city, feeling confident, as we do, of what will be the result. Perhaps it is as well, too, that Detroit is the first city selected to enjoy the benefits of municipal ownership so freely promised by "Pingreeism," for three-cent fares are already established in that city on many of the street railway lines, and we presume that the first decision made by the new owners will be to reduce fares to this figure on all. If a municipality can operate a street railway system on a three-cent fare basis, and make money in doing it, we all want to know it; while the cost of the experiment, if unsuccessful, can be distributed upon the large mass of taxpayers with less individual suffering than upon a smaller group of street railway stockholders. A month hence we hope to know on what basis the purchase is to be made and the possibilities of profit or loss to the city.

It is becoming more and more a recognized fact that electric railway operation is more akin to steam railroad operation than to the former horse car service, so far as the duties and abilities required of the employees are concerned. The modern electric car is a machine, not an omnibus, and all machinery such as that carried on a car should be in charge of persons having a knowledge of its proper maintenance. An example of the increasing similarity of electric cars with steam locomotives, and the necessity of the establishment of a proper system of inspection and supervision is illustrated by the increasing use of air brakes. We believe that where this type of brake is employed good results would be obtained by an extension of the system of training to this part of the equipment.

This is not founded upon the ground that the air brake is a more delicate part of a car equipment than the motors or controller, but as any piece of machinery can be abused by unintelligent handling, there is no more reason why street railway companies should not instruct their employees as to the proper method of handling street car brakes than steam railroad companies. The history of the latter has shown that the best results follow the establishment of schools for instruction of employees as to the operation and inspection of air brakes, and that the outcome warrants the expenditure of the effort has been proved beyond the possibility of doubt.

An exceedingly interesting and able argument in rebuttal of the excessive claims for taxation of street railway companies by municipalities was recently presented by John W. Boyle, president of the Utica Belt Line Street Railroad Company, in an attempt in that city to compel a railway to pay for the cost of pavement between its tracks and for two feet outside. The question is discussed from both a legal and a moral standpoint, and while Mr. Boyle takes occasion to point out a number of the popular fallacies and prejudices under which the railway company has to labor, he shows that while more beneficial to a city than a manufacturing establishment employing the same number of persons, it differs from the latter in that when overtaxed and persecuted it cannot shut down or remove its plant to another city, and for this reason is made the target of all kinds of oppressive measures. The pavement tax is particularly onerous in that the railway company is probably the only taxpayer which does not use one foot of the pavement, but furnishes and keeps in repair, at its own expense, that portion of the street on which its wheels revolve; in fact, a good pavement is a detriment to the railway company, if it exercises any effect upon its business. The usual argument, Mr. Boyle contends, for assessing railway companies is that they occupy the streets, and have thus a valuable franchise. While it is true that the cars are on the streets, this also applies to other vehicles, the only difference being that a car occupies, in proportion to the number of persons carried, a very much smaller proportion of the street than do the other vehicles, and that, while on the street, they have no exclusive right of way, but are bound under the most strict penalties, in the way of damages from accidents, to avoid collisions with other occupants. No one ever rides in an electric car under compulsion, or for the benefit of the railroad, but solely for his own convenience, and if a person decides the convenience is not worth the nickel, he keeps the nickel and walks. It is no answer to this to say that many ride from necessity, because the exigencies of their business demand it, and pay the fare under protest. There are people who pay under protest for the food they eat and the clothes they wear; but when the food has been furnished them at the lowest market price, and the clothing for less than any other merchant of the city sells it, the protest carries little weight. If people ride from necessity, then the railroad becomes a necessity to the city, which is what the railway companies claim. Altogether, the argument, which is printed in pamphlet form, will be found most readable and valuable.

It is not often that the engineering public has the privilege of reading and digesting such a clear, intelligent and convincing report on the electrical equipment of a large city tramway system as has just been presented to the Glasgow Corporation by H. F. Parshall, its consulting engineer, a full transcript of which appeared in our columns last month. Not only are such reports in this country presented to the directors of private companies and jealously withheld from the public, but electric traction in this country has been more a matter of development in each city than of the intelligent laying out of complete plans beforehand. Great Britain is fortunate in having an opportunity of drawing upon the world's experience in the construction of municipal and private plants, and we have no doubt that the opportunity will be taken advantage of in a majority of cases. Mr. Parshall's experience has been so wide and his practice so uniformly successful that his recommendations to the Glasgow Council have peculiar weight, and may well be studied by street railway managers in America, as well as in Europe. His most important recommendation is that a high tension three-phase main generating station, with several rotary transformer sub-stations, forms a system of generating and distributing power more economical than is that of several separate 500-volt direct-current generating stations. This is undoubtedly the best engineering practice of to-day, as shown by the decisions in its favor made by the Metropolitan and Third Avenue companies in New York, by the Edison Electric Lighting Company of Brooklyn, and by the Central London Underground Railway. The advantages are a less capital expenditure in buildings, generating plant and real estate; greater latitude allowed in the selection of a power station site, where coal and water can be obtained at minimum cost; less working cost for labor and repairs, due to the minimizing of the skilled force necessary for operating the plant, and to the economy always found in the operation of large instead of small units; the greater flexibility of the system with respect to future extensions, and the placing of new sub-stations wherever desired; and the relatively shorter time taken in constructing the plant, by which the superior economy of electric traction over horses can be more quickly realized. Mr. Parshall's estimates of the relative investment costs and operating expenses of the two forms of generating and distributing plants is interesting. For the three-phase rotary converter plan, the investment cost is placed by him at $1,580,000, while for the five separate generating stations it will be $1,950,000, these figures not taking into account cost of ground and railway connections, which, if included, will bring about a result much more favorable to the single generating station. The total power operating expenses for the three-phase system, exclusive of maintenance, depreciation, interest, insurance and taxes, are estimated by Mr. Parshall at $.0046 per kw. hour, and including maintenance and fixed charges, at $.0106; while the power operating expenses proper for the direct current generating stations would be $.0075, and including depreciation and fixed charges, $.0147. These figures do not include interest on the cost of sites and railway connections. The annual estimated saving in Glasgow in using the tri-phase distribution, based on a 600-car plant, is estimated by Mr. Parshall at over $100,000.

A Formula for Train Resistance

BY HENRY GRAFTIO

The question of train resistance is one that has attracted the attention of many prominent engineers. Besides the high scientific interest which the subject posseses, it has also a practical value of the highest importance, for a more accurate knowledge of all the factors of train resistance can only contribute to the finding of means to diminish them. As the STREET RAILWAY JOURNAL has been paying particular attention to this subject during the past few months, it may be of interest to its readers to have given briefly some of the results secured abroad in investigating this problem.

During the last few years some very interesting and complete tests on the resistance of trains and locomotives have been made in France. Some of these tests indirectly, and some directly, are likely to confirm the opinion expressed by Mr. Angus Sinclair, of "Locomotive Engineering," and of Mr. Lundie, that at high speeds the resistance of trains seems to increase as the first power of the speed. For a long time the general opinion prevailed that the resistance of trains must follow a parabolic law. This was due in a large measure to the general adoption of the well-known formula of Newton.

$$R = k S v^2$$

for the resistance of a moving plane surface in free air. But all evidence now seems to prove that this theory is wrong. As it is quite impossible to find an expression for air resistance on moving bodies by pure mathematical deductions in the present state of our knowledge of aerodynamics, it is manifestly wrong to admit *a priori* for air resistance, a theoretical expression similar to that of Newton's, or by finding by experiment within restricted limits—coefficients more or less accurate to extend their application to limits outside of the experiments.* Only experiments made on very large scale can be considered as reliable.

Among the experiments on air resistance those of Mr. Crosby occupy in the mind of the writer one of the first places, being conducted on a very large scale and with bodies that were really moving in the air. Mr. Crosby's curves† are represented in Fig. 1. Some experiences on air resistance made in France seem to contradict these results; but this is due almost entirely to the fact that in investigating the laws of air resistance Newton's formula was adopted *a priori*, and all efforts were directed to find the most probable value for k. Thus M. Poncelet expressed the opinion that up to 50 km. the resistance of air on a parallelopiped body is practically expressed by Newton's formula by putting k. = 0.08. Messrs. Cailletet and Colardeau, from experiments made on the Eiffel Tower, consider this value to be too large and within the limits 0 km. to 90 km. per hour, consider k. = 0.07. But here was another cause for error, viz.: the fact that the velocity of the wind was measured by anemometers, and therefore not in so accurate a manner as by the speed of moving bodies as in Mr. Crosby's tests.

The noteworthy and most reliable experiments made on train resistance in the United States by a great specialist on this subject, Mr. Angus Sinclair, invariably showed at high speeds the relation

$$R = a + bv$$

between the limits of 60 km. and 120 km. per hour, and the no less remarkable experiments made in France seem fully to confirm the theory that the resistance of trains is rather a hyperbolic function of the speed, and at high speeds can be expressed by the equation of a straight line. In confirmation of this may be cited the tests of the well-known and eminent engineer of the state railways of France, M. Desdouit, the inventor of the pendulum apparatus for measuring acceleration. From exceedingly careful experiments made on the lines of the French state railways this engineer found that the resistance of the locomotive,

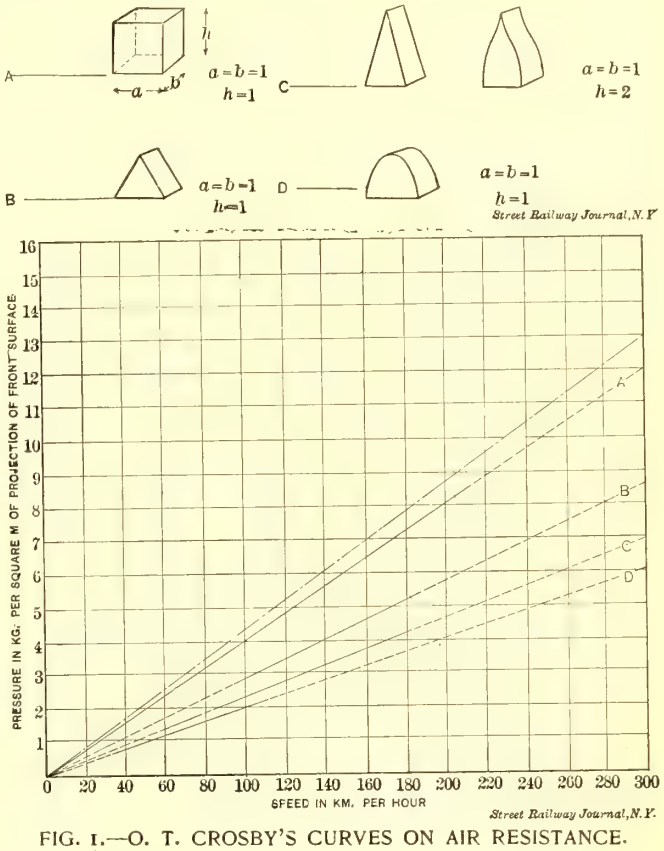


FIG. 1.—O. T. CROSBY'S CURVES ON AIR RESISTANCE.

with the tender, within the limits from starting up to 80 km., increased very nearly as a hyperbolic function of the speed of the form

$$R = a + \sqrt{b + cv^2}$$

The curve represented by this formula for a passenger locomotive weighing, with its tender, 55 tons (36 tons + 19 tons), and running with the steam shut off, is plotted as No. 1‡ in Fig. 2. As can be easily seen, at speeds higher than 40 km. the resistance increases very sensibly as a linear function of the speed.

On the same sheet is plotted another curve, No. 2, connecting three points, and also based on M. Desdouit's data. This curve seems to indicate that at high speeds the resistance of the locomotive increases with, but not so rapidly as, the speed. I do not consider this curve as improbable.

On the same sheet are plotted two curves, No. 3 S and No. 3 β, that are deduced from experiments made on the Paris-Lyons-Mediterranean line with new compound cylinder express locomotives by M. Privat, the engineer of that railway. These experiments were carried out by M. Privat in a very reliable manner, and were published partially in the "Revue Generale des Chemins de Fer" in 1896. In his very interesting article M. Privat discusses principally

* Given a certain number of points representing in an approximate manner (as is the case here) values of a function, as found by experiment, it is possible to plot many curves that will be more or less accurate within the small limits, but when extended will prove absolutely wr ong.

† See transactions of "American Institute of Electrical Engineers," February, 1891, and STREET RAILWAY JOURNAL, April, 1891.

‡ This curve represents the resistance on level track and in a perfectly calm atmosphere. M. Desdouit especially insists on the latter condition. The resistances expressed by the above curve include all elementary resistances due to vertical and horizontal shocks on the rails, friction of journals, friction of wheels on rails produced by the manner in which the wheels are fixed to the axle, side friction of flanges of wheels, resistance of the different parts of the mechanism, and finally, air resistance. Pneumatic effects of pistons in cylinders were practically eliminated by using such admission valves that the effect of vacuum due to the cut-off was practically nil; but all these resistances are considered by M. Desdouit to be small, as compared to air resistance.

the working of the compound system at different speeds, admissions in high and low pressure cylinders and the work performed. He plotted a series of curves showing the total amount of indicated power developed by the locomotive in hauling trains at various speeds and ratios of admission in the two cylinders. All these curves were reduced to the case of moving on a level and with no acceleration. Deducing the power required for hauling the train, he found curves showing the power required for moving the locomotive and tender alone, for the case of a level track and no acceleration.

I have plotted these curves in Fig. 3. The heavy lines here correspond to the case of an admission of 0.7, and the light lines to admissions of 0.4-0.5,in the *low* pressure cylinders. Numbers 0.2, 0.3, 0.4, 0.5 on both series of curves show ratios of admission, viz.: 0.2, 0.3, 0.4 and 0.5 in the *high* pressure cylinders. It is easy to see that the ratio of

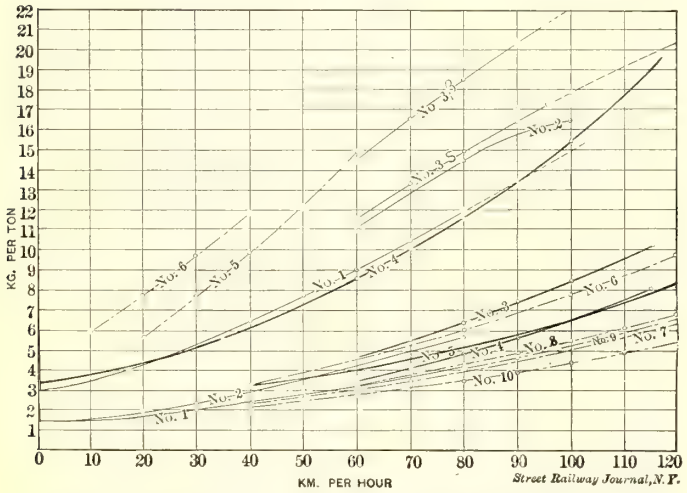


FIG. 2.—GROUP OF CURVES FOR RESISTANCE OF LOCOMOTIVES (WITH TENDER) AND FOR CARS ONLY.

Upper curves for locomotive and tender only.

Nos. 1 and 2.—Desdouit [French State Railways]. L = 55.

No. 3 β.—Maximum resistance deduced from M. Privat's experiments [French P. L. M. Ry]. L = 84.2.

No. 3 S.—Minimum resistance deduced from M. Privat's experiments [French P. L. M. Ry]. L = 84.2.

No. 4.—Barbier [French Northern Ry.] L = 93.5.

Nos 5 and 6.—Gen. Petroff.

Lower curves for cars only.

No. 1.—Desdouit [French State Railways] Q = 75, n = 8.
No. 2.— " " " " Q = 75, n = 3.
No. 3.—Barbier [French Northern Ry.] Q = 206, n = 15.
No. 4.— " " " " Q = 296, n = 7.
No. 5.—French Western Ry.
No. 6.—French Northern Ry., from Gen. Petroff's formula, Q = 206, n = 15.
No. 7.— " " " " " " Q = 206, n = 7.
No. 8.—Canadian Pacific " " " " " Q = 152, n = 5.
No. 9.—Pennsylvania Ry, " " " " Q = 162, n = 5.
No. 10.—Russian Railway, " " " " Q = 390, n = 13.

admission in the low pressure cylinders has a visible influence on the resistance of the locomotive.

Taking the mean of each group of light and heavy curves we obtain the probable average power required for moving the locomotive and tender under most favorable and most unfavorable conditions of resistance in functions of the speed. These mean curves are plotted in Fig. 4, and are slightly curved.

Without making a great mistake we can *a priori* assume them to be of the form

$$W = a + b\,v + c\,v^2$$

and find most probable values for a, b and c. Doing this we have very nearly

$$W_{min} = -40.2 + 1.64\,v + 0.0437\,v^2$$
$$W_{max} = -135 + 4.5\,v + 0.0375\,v^2$$

but only within the limits from 60 km. to 95 km.

Now if we put R as the resistance of the locomotive and tender (weighing 84.2 tons*) in kg. per ton of weight we shall have

$$W = \frac{R \times 84.2 \times v}{75 \times 3.6}\text{; whence}$$
$$R = \frac{3.2}{v} W$$

or, substituting values for W_{max} and W_{min}, we have

$$R_{min} = 5.24 + 0.14\,v - \frac{129}{v}$$
$$R_{max} = 14.38 + 0.12\,v - \frac{432}{v}$$

again only in limits from 60 km. to 95 km.

These two curves are shown by No. 3β and No. 3S in Fig. 2. While perhaps not being absolutely accurate, they

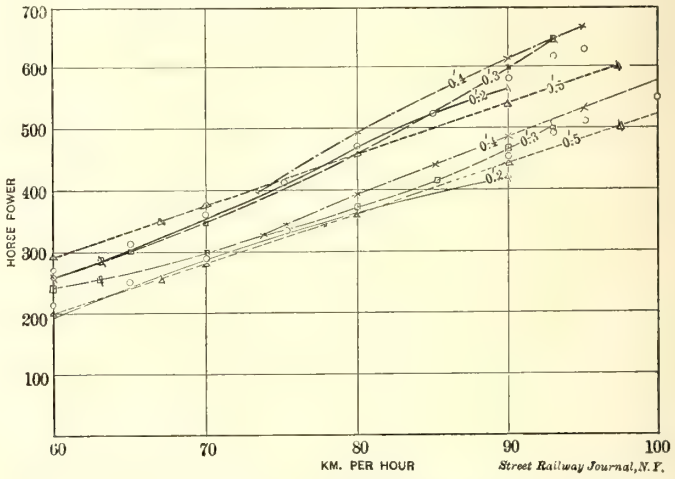


FIG. 3.—CURVES SHOWING POWER (NUMBER OF I.H.P.) REQUIRED FOR HAULING THE LOCOMOTIVE AND TENDER AT DIFFERENT RATES OF ADMISSION.

The lower curves show power required at most favorable ratio of admission, *i. e.* 0.7 in low pressure cylinders and the following ratios in high pressure cylinder.
———————— = 0.2.
———— ———— ———— = 0.3.
— . — . — . — = 0.4.
— — — — — — — — = 0.5.

The upper curves show power required at unfavorable ratio of admission *i. e.* 0.4 to 0.5 in low pressure cylinder and the following ratios in high pressure cylinder.
———————— = 0.2.
———— ———— ———— = 0.3.
— . — . — . — = 0.4.
— — — — — — — — = 0.5.

can be considered characteristic and in a certain accord with M. Desdouit's opinion. Of course, between these two limiting curves we could plot a multitude of others, more or less inclined, depending on the ratios of admission in the high and low pressure cylinders. But in the case of the continuous use of an admission of 0.7 in the low pressure cylinders we have the limiting curve No. 3S, that seems to indicate that the resistance of the trial locomotive, when well governed, increases rather more slowly than the speed, or, at least, very nearly as a linear function of the speed, again within limits from 60 km. to 95-100 km.

In the same diagram is plotted the curve, No. 4, found by M. Barbier during a very extended set of experiments made recently on the French Northern Railway with two new, fine four-cylinder compound express locomotives, designed by M. Du Bousquet. A very complete report of these tests, made by M. Barbier, appeared in a series of articles published by the "Revue Generale des Chemins de Fer" in 1897-1898. The curve No. 4, which is taken from this paper, has a slightly parabolic form.

$$R = a + b\,v + c\,v^2$$

The very low resistances given by this curve are due largely to the fact that the weight of the tender was considerable (43 tons) as compared to that of the locomotive (50 tons).**

Also in Fig. 2 are plotted two curves, Nos. 5 and 6,

* By "tons" in this article, the metric ton = 2200 lbs., is intended.

** The writer is not disposed to criticise in any way M. Barbier's very complete and reliable experiments and deductions, but may not a curve of a hyperbolic form, if taken a *priori*, instead of a parabolic one, prove no less accurate and concordant with the series of points found by experiment?

given by General Petroff, now Assistant Minister of Ways of Communication. Both are represented by the parabolic equation

$$R = a + b\,v + c\,v^2$$

Curve No. 6 represents the resistance of a freight locomotive, and No. 5 that of a passenger locomotive. The points for these curves were established at comparatively small speeds. For high speeds they give too large results, and General Petroff himself admits that in the case of the curve No. 5 at speeds from 80 km. to 100 km. the resistances given by this curve must be reduced by about 20 per cent.

All these considerations seem to strengthen the opinion that at high speeds the resistance of the locomotive increases very nearly with the speed. The latest experiments on air resistance seem to prove that this factor increases as the first degree of speed, and air resistance is the largest part of the total resistance of the locomotive. On the other hand, the friction in journals diminishes at high speed, because of a better oiling, but as the coefficient of friction is very small,* it need not be taken into account when considering the resistance of locomotives.

Before passing to the resistance of trains of cars and of complete trains the writer thinks it may be interesting to point out a well-known way, if adopted in the right manner, of lessening the resistance of air to the motion of the locomotive.

Some years ago shields for reducing the air resistance were tried on the Paris-Lyons-Mediterranean Railway. These shields were of about the same size and shape as an ordinary nose snow plow, but were carried higher on the locomotive, partly hiding the stack. It was found, however, that the useful effect of these shields in reducing air resistance was not considerable, and they were abandoned. Such an arrangement lessened the front pressure, but as it was open at the back, it had as an effect the forming of a vacuum at the rear of the shield with consequent eddy currents, increasing the resistance. If completed to the back part of the locomotive the shield would have proved far more efficient. Experiments made on the French Western Railway with the first Heilmann electrical locomotive in 1894 seem to confirm this opinion.

RESISTANCE OF THE CARS FOLLOWING THE LOCOMOTIVE

The resistance of the cars only of a train, that is, the total resistance of the train minus that of the locomotive, is plotted in the lower series of curves in Fig. 2. It will be remembered that the resistance curve of a locomotive is generally of a hyperbolic form, and in some cases the curve is concave on the axis of X (such as shown from M. Privat's test). On the other hand, almost all curves for resistance of the cars are of a well-marked parabolic form. These latter curves seem to be reliable, as the resistance of the cars can be measured accurately by means of a dynamometric car, and consequently the values can be found more accurately than that of the resistance of the locomotive alone or of the complete train.

It is easy to see from a glance at Fig. 2 that these curves for car resistance do not coincide in shape. This is caused by the fact that the respective importance of each of the different factors which make up the resistance varies with the number of cars in the train, the distances between the cars, the load on each axle, and the number of axles per car, as well as within certain limits with the conditions of track, weight of rails, size and number of ties. The influence of the latter factor can be appreciated by considering that the effect of the forward wheels upon an elastic track is to produce a continuous wave immediately in front of the wheels. This factor, of course, affects the resistance of the locomotive more than that of the cars, on account of its greater weight. Most of the existing formulæ do not include all of these various factors.

In the lower series of curves plotted in Fig. 2, Nos. 1 and 2 are those of M. Desdouit. Both of these are for a train weighing 75 tons, the first for a train of eight four-wheel cars, and the second for a train of three eight-wheel cars. It is easy to see that the second curve shows a lower resistance. This is due mainly to the fact that the number of spaces between the cars is less, and, therefore, that the resistance of the air in the shape of eddy currents and partial pressures on the fronts of the cars is less, there being fewer car fronts. It is also due, however, to the fact that the running was smoother with bogie trucks, horizontal shocks on the rails being fewer and

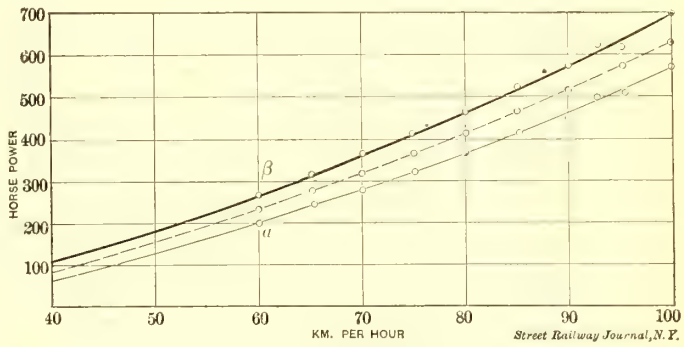


FIG. 4.—MEAN OF CURVES SHOWN IN FIG. 3.

(β) Mean of upper curves shown in Fig. 3.
(α) " " lower " " " Fig. 3.
" " α and β

smaller. So far as the first factor is concerned, a vestibuled arrangement between the cars would have reduced the resistance; and so far as the second factor is concerned, it is needless to say that every side shock involves a loss of energy in the form of *vis viva*.

So far as the friction of the journals is concerned, there is practically no difference, whether the cars are mounted on bogies or on two axles, like a single-truck electric car, or some of the freight cars in Europe, since, as has been already stated, the coefficient of journal friction is very small (only about 0.005). This disposes, by the way, of the question of roller bearings on cars, showing that they have no value from a practical standpoint.

Curves Nos. 3 and 4 are due to M. Barbier, and are the result of very extensive tests made by him several years ago on the French Northern Railway.* Here, again, the influence of the trucks and number of cars is very marked; curve 3 corresponding to a train of fifteen four-wheel cars, and curve 4 to a train formed by seven eight-wheel cars mounted on bogie trucks. The weight was the same in both cases, *i. e.*, 206 tons. Curve No. 5 was found in 1897 by a test of trains made up of four-wheel cars running on the French Western Railway. All of these five curves do not differ materially from each other. Finally, curves Nos. 6, 7, 8, 9 and 10 were plotted from a formula suggested by General Petroff.

While most of the other formulæ are of the shape

$$R = a + bv + cv^2$$

and therefore can be applied only in cases similar to those for which the constants a, b and c were established, General Petroff's formula for *resistance of cars only* is

$$R = 1.2 + \frac{0.6n}{Q}v + \frac{0.03}{Q}(1 + 0.004n)\,v^2$$

where

* The coefficient of friction is generally taken = 0.05, but General Petroff considers 0.005 a closer valuation.

* See "Revue Générale des Chemins de Fer," 1897.

R = resistance in kg. per ton (metric) of train (cars only)
Q = weight of the train (cars only) in tons (metric)
n = number of cars
v = speed in km. per hour.

This formula was found by means of a very careful and scientific study of *all* the causes for resistance, and as the air resistance is not so large a factor in the total resistance of the cars of a train as it is in the resistance of a locomotive running independently, this formula gives much closer results for all cases than the Petroff formula for the resistance of a locomotive. This latter, as has been previously stated, is not quite correct, because of the narrow limits of speed between which the tests were made, and because of the false assumption that Newton's formula for air resistance, *i. e.*, $R = k S v^2$, is correct.

Having once established the general form of his equation for the resistance of cars, General Petroff found the most probable values of coefficients from a very large number of experimental data. Curves Nos. 6 and 7 in Fig. 2 correspond to the case of a train on the French Northern Railway, such as used by M. Barbier's experiments. The weight of the train (cars only) in both cases was 206 tons, number of cars, fifteen for curve No. 6, and seven for curve No. 7. It is easy to see General Petroff's formula gives results somewhat lower than those found by M. Barbier. Curve No. 8 corresponds to a train on the Canadian Pacific Railway, weighing 152 tons, and composed of five cars. Curve No. 9 shows the resistance of a train on the Pennsylvania Railroad, weighing 162 tons, and composed of five cars. Curve No. 10 is that of a train on the Russian Nicolaievski Railway, running from St. Petersburg to Moscow. This train weighs (cars only) about 390 tons, and the number of cars was thirteen.

RESISTANCE OF COMPLETE TRAIN, INCLUDING LOCOMOTIVE, TENDER AND CARS

Finally, in Fig. 5, I have plotted some curves showing resistances of complete train, including locomotive, tender and cars. In plotting these curves the maximum and minimum resistances of the locomotive and tender are taken from the maximum and minimum values as given in curves No. 3β and 3S in Fig. 2, as found from M. Privat's experiments. For the resistance of cars General Petroff's formula is used. The two values are then combined by the following formula:

$$R_m = \frac{R_{loc} \times L + R_t \times Q}{L + Q}$$

in which
R_m = resistance of total train in kg. per ton
R_{loc} = resistance of locomotive and tender in kg. per ton
R_t = resistance of train (cars only) in kg. per ton
L = weight of locomotive and tender in tons
Q = weight of train (cars only) in tons.

Thus, in Fig. 5 curves Nos. 1 and 2 correspond to the case of the train used in the experiments made by M. Barbier, in which L = 93 tons, Q = 206 tons, n = 7; in the upper curve the formula for the maximum resistance of the locomotive is used, and in the lower one the minimum. The two curves No. 1′ and No. 2′, lying quite close to curves Nos. 1 and 2, correspond to the case of a train on which experiments were made on the Austrian Ferdinand Northern Railway. Here L = 96 tons, Q = 203 tons, n = 5. Curves Nos. 3 and 4 correspond with a train on the Pennsylvania Railroad; L = 82 tons, Q = 162 tons, n = 5. Curves Nos. 5 and 6 correspond with a train on Russian Nicolaievski Railway. L = 91 tons, Q = 390 tons, n = 13.

As will be seen, within the limit of speed from 60 km. up to 120 km., all these curves are practically straight lines. Finally, curves S and V represent, respectively, the resistances of trains as found by Mr. Sinclair, and quite recently by Mr. Vauclain, of the Baldwin Locomotive Works. Mr. Sinclair's formula, expressed in kg., tons metric and km., is R = 1 + 0.075 v. That of Mr. Vauclain, expressed in kg., tons metric, and km., is R = 1.5 + 0.052 v. These last two formulæ give for resistance of trains (locomotive and tender included) straight lines too, with limits from 50—60 km. up to 120 km. (*)

Having all these curves before us, it seems interesting to see how they agree with data found directly from experiments.

(1) On the Russian Nicolaievski Railway it was found

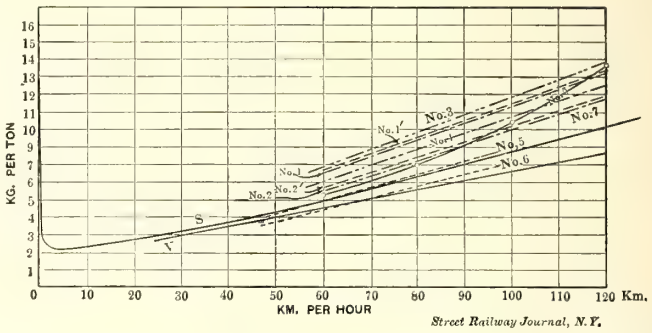


FIG. 5.—GROUP OF CURVES FOR RESISTANCE OF COMPLETE TRAINS.

Nos. 1 and 2.—Max. and min. curves from tests on French Northern Ry., L = 93, Q = 206, n = 7.
Nos. 1 and 2.—Max. and min. curves from tests on Austrian Ferdinand Northern Ry., L = 96, Q = 203, n = 5
Nos. 3 and 4.—Max. and min. curves from tests on Pennsylvania R. R., L = 82, Q = 162 n = 5.
Nos. 5 and 6.—Max. and min. curves from tests on Russian Railway.
No. S.—Curves plotted from Mr. Sinclair's formula.
No. V.— " " " Mr. Vauclain's "
No. O.— " " " Mr. Barbier's "

that new high-speed locomotives, weighing, with tender, 91 tons, were capable of hauling continuously trains of 390 tons at a uniform speed of 80 km. on the level, and of 48 km. on a 0.8 per cent grade. From curve No. 5 we learn that the locomotive was obliged to develop about 915 i.h.p. in the first case, and 860 i.h.p. in the second. These data do not differ materially. As the locomotive was designed for high speeds it was naturally able to develop more power when running at 80 km. than at 48 km.

(2) On the Austrian Ferdinand Northern Railway a locomotive weighing, with tender, 96 tons, when running with a train of 203 tons on a grade of 0.26 per cent at a uniform speed of 80 km. developed about 1027 i.h.p. From curves Nos. 1′ and 2′ we obtain, respectively, maximum power, 1000 i.h.p., and minimum power, 890 i.h.p.

(3) On the Pennsylvania Railroad a locomotive weighing, with tender, 82.5 tons, when running with a train of 162 tons on a level at a uniform speed of 104 km., developed about 1120 i.h.p. From curves Nos. 3 and 4 we obtain respectively, maximum power, 1080 i.h.p., and minimum power, 945 i.h.p.

The writer has at his disposal too small a quantity of similar data to carry this investigation further, but it would be of interest if persons who have made tests of this kind should try and combine, in the manner shown above, the

* A final reason for a lower coefficient of resistance at high speeds can be found in a reduced coefficient of track resistance due to a better alignment of the cars on the track. This can be deduced analagously from some experiments conducted by M. Barbier on the French Northern Railway on the resistance of trains on grades. If the track resistance were the same on level tracks and grades, it would be natural to assume an increase of 1 kg. per ton for every 0.1 per cent of ascending grade and a decrease of 1 kg. per ton for the same per cent of descending grade. The tests made showed, however, that the increase when ascending was only 0.9 kg., instead of 1.0 kg., and the reduction on the descending grade was 0.9 kg., instead of 1.0 kg. This difference in the case of the ascending grade is attributed to the greater tension of the train, by which the axles are kept more closely at right angles with the rails. As a result, there is less flange wear, and the track friction is reduced to a minimum. Conversely, the increase in resistance on down grade is due to a relaxation of the tension, permitting the cars to get out of alignment, increasing the wheel and track resistance.

curves for resistance of locomotive and tender, as found from M. Privat's experiments, and those of General Petroff for the resistance of trains (cars only), finding thus a curve for the resistance of a complete train, including locomotive, tender and cars in different cases, and obtaining the i.h.p. of the locomotive as developed from the formula

$$W = \frac{R_m \times (L+Q) \times v}{75}$$

R_m = resistance in kg. per ton of complete train
L = weight of locomotive and tender in tons
Q = weight of cars in tons
v = speed in meters per second
W = work in i.h.p.

It would be interesting to learn how these values accord with the values of the i.h.p. as obtained directly by indicator diagrams.

While a little outside of the subject of discussion, the writer suggests that the portion of the air resistance which is made up through the creation of a partial vacuum and consequent eddy currents at the rear of the train, a factor which constitutes a certain amount of the total air resistance, could be lessened in a measure, which might be considerable, by placing at the end of the train a car formed somewhat like the inverted stern of a boat, as shown in Fig. 6. It is a well-known fact that the resistance of a

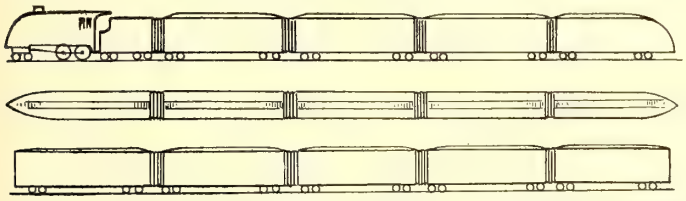


FIG. 6.—PROPOSED FORMS OF ELECTRIC AND STEAM TRAIN FOR REDUCING AIR RESISTANCE.

ship moving at high speeds depends very much upon the form of the stern, even more than upon the form of the bow. If the stern of the vessel is not sufficiently acute, there is a tendency to create a vacuum, and considerable power is lost in eddy currents, and when the train is moving rapidly it is natural to suppose that there is a corresponding depression behind the last car. The writer has no data as to the amount of power that is lost in this way, but it is possible that experiments in that direction will prove interesting and valuable. For high speeds, then, he would suggest trains of vestibuled cars with, in case of an electric train, a pointed motor car and rear car, and with a steam train, a complete protective shield on the locomotive to form a cutting surface.

The Expenses of Mechanical Traction in Paris

The annual report of the Compagnie Générale des Omnibus, the largest street railway company in Paris, has just been published, and from advance proofs the STREET RAILWAY JOURNAL is able to show some of the results secured in operating costs by the different systems of mechanical power employed. The company has four types of mechanical motors, viz.: Serpollet locomotives, Rowan locomotives, compressed air locomotives and compressed air motor cars. The locomotives draw two or three trail cars and the motor cars one trail car. The car mileage made by the different systems last year was as follows: Serpollet motors, 902,968; compressed air motor cars, 640,375; compressed air locomotives, 546,198; Rowan locomotives, 117,685. To these should be added the mileage made on one line (Louvre-St. Cloud) of 354,297, made up of a mixed service of Rowan and compressed air locomotives.

The cost of operation of all the mechanical systems is given below in francs per car km., cents per car mile and gross expenses in francs. The cost of the operation of compressed air motor cars drawing one trail car amounted in 1898 to 0.4815 francs per car km. (15.07 cents per car mile), and for compressed air locomotives capable of drawing several trail cars, 0.5358 per car km. (16.76 cents per car mile). The company is probably the largest tramway company in Europe, and is one of the largest in the world. It operates both tramcars and omnibuses, and in its tramway department alone the operating expenses (including taxes) amounted in 1898 to about $3,400,000, and, including the omnibus service, the operating expenses of the company were over $8,000,000.

Following the table of expenses for mechanical power are given those for horses, so that a comparison of the operating conditions in Paris may be drawn. In this table a franc is considered equal to 19.45 cents, and a kilometer equal to 0.621 miles. The fractional differences account for the difference of one figure in the last decimal place in some cases.

EXPENSES OF MECHANICAL POWER CARS—COMPAGNIE GENERALE DES OMNIBUS, 1898.

	Fr.	Fr. Per Car Km.	Cents Per Car Mile.
General Expenses.			
Taxes	328,477	.0794	2 59
Interest on funded debt	357,893	.0865	2.82
Other general expenses	459,618	.1113	2.64
Total general expenses	1,145,988	.2772	9.05
Passenger Expenses.			
Wages of superintendents and inspectors	15,381	.0037	0.12
Wages of starters	147,801	.0358	1.17
Wages of conductors	299,820	.0725	2.37
Wages of detectives	9,787	.0024	0 08
Rent, heating, lighting, etc., of stations	48,320	.0118	0.38
Total passenger expenses	521,719	1.262	4 13
Rolling Stock and Track.			
Maintenance of cars	195,346	.0472	1.54
Maintenance of registers	3,398	.0008	0.02
Heating of cars	9,370	.0023	0.08
Lighting of cars	50,610	0122	0.40
Cleaning and lubrication of cars	46,654	.0113	0.37
Maintenance of track	423,067	.1023	3.34
Total rolling stock and track	728,447	.1761	5.76
Mechanical Power.			
Labor at stations and repair shops	148,949	.0360	1.17
Wages of motormen	355,619	.0860	2.80
Maintenance of locomotives and motor cars	816,412	.1975	6.39
Maintenance of stationary engines and lubrication	175,395	.0424	1.29
Fuel	645,950	.0562	5.11
Water	27,655	.0067	0.22
Establishment of Orleans-Odeon line	32,724	.0079	0.26
Total for mechanical power	2,202,706	.5327	17.39
Total, all expenses	4,598,862	1.1122	36.32
Sinking fund	683,322	.1652	5 40
Grand total	5,282,185	1.2774	41.73

During the same period the expenses for horse cars were:

	Fr.	Fr Per Car Km.	Cents Per Car Mile.
General expenses	3,037,462	.2355	7.37
Passenger expenses	1,684,136	.1305	4.08
Rolling stock and track	2,382,182	.1846	5.88
Animal power	6,376,545	.4943	15.47
Total	13,480,325	1.0449	32 70
Sinking fund	1,515,688	0.1174	3.67
Grand total	14,996,013	1.1623	35.35

During the same period the expenses for omnibuses were:

	Fr.	Fr. Per Car Km.	Cents Per Car Mile.
General expenses	5,380,891	0.2302	7.20
Passenger expenses	3,122,859	0.1336	4.18
Rolling stock	1,516,433	0.0649	2.03
Animal power	13,266,404	0.5676	17.77
Total	23,286,588	0.9963	31.18
Sinking fund	2,252,489	0.0964	3.02
Grand total	25,539,077	1.0926	34.20

Mr. Sprague on Rapid Transit in New York

The following letter has recently been written by Mr. Frank J. Sprague, to Chairman Orr, of the New York Rapid Transit Commission:

Sprague Electric Company,
New York, April 26, 1899.

Dear Sir—I have read with interest the letter of March 29, 1899, addressed to you by President Stuyvesant Fish, of the Illinois Central Railroad.

Coming from the chief officer of a railroad which has accomplished so much in the way of steam rapid suburban service, its conclusions should, and naturally will, receive serious consideration.

With many of the facts stated and with some of the views promulgated, especially those suggesting guaranteed high schedules, I am in hearty accord, but there are two statements which I will quote *in extenso*, which are in error, or are capable of two readings. These are:

Paragraph I. "The motive power used by the Illinois Central consists of steam locomotive engines, most of which were built many years ago. If the tunnel company is to be tied down to electricity as a power it cannot, in the present state of the science, be required to make the speed of our trains. We believe, however, that before long it may become possible to move trains by electricity on our schedules, and we have been carefully watching developments in that direction for many years."

Paragraph IV. "As yet electricity has not been applied in such a way as to give a service equal in speed to that furnished by the Illinois Central in Chicago by using steam. After the most careful, painstaking and patient investigation, we have been forced to adhere to the use of steam, although anxious on many accounts to substitute electricity. . . . While I believe that electricity can be hereafter so used as to develop schedules about equal to those which we now have in use in Chicago, there is as yet nothing to show that better can ever be done through the use of electricity. Our investigations teach us that with each added unit of speed the cost increases more rapidly where electricity is used than where steam is used."

It is impossible to understand the reason for the conclusions given by Mr. Fish, and I must take exception to them, not only from engineering reasons, but from the record of accomplished facts.

Under any given conditions schedule speed is solely a question of the amount of available power per ton and the proportion of it which can be effectually used. The higher the schedule, the shorter the station intervals and the longer the station stops, the greater will be the amount of power required for moving any given tonnage, and the greater the power thus required, the higher the ratio of weight moved which must be on the driving wheels.

On the local suburban service of the Illinois Central Railroad a five-car train weighing, with its passengers, 105 tons, is driven by a locomotive of 80 tons weight, which can develop from 900 to 1000 effective brake h.p., making the total weight moved 185 tons, 46 of which, that is, 25 per cent, are on the drivers. Or, to epitomize, there is provided a maximum of about 5 h.p. per ton, with 25 per cent of weight moved on the drivers.

Leaving, for the moment, out of all consideration *how* it is to be done, if greater power is applied to a train and a higher percentage portion of the weight on the drivers is utilized during the period of acceleration, higher schedules immediately become possible.

Taking the street railway systems of the country as a precedent, from 80 per cent to 100 per cent, not 25 per cent, of the weight is on the drivers. Adhering to the single car as a unit, and putting all the available power in the motors connected to each of its axles which space permits, it is readily possible to put on motor equipments which will develop not less than 20 h.p. to 22 h.p. per ton moved, and to use 100 per cent of the weight on the drivers. The possibilities of this unit, that is, using the entire weight of a car for traction, and all the power which can be put within the space provided, *is the limit, and absolutely the only limit*, of the possibilities of speed to be attained by an electric car, and it must necessarily exceed that possible to a steam locomotive alone.

Lengthen now this unit, put joints in; that is, aggregate cars into a train, preserve the same ratio of weight on the drivers and the same h.p. per ton, then it matters not what the length of the unit; in other words, no matter what the size of the train, identically the same schedules can be made with a train as with a single car.

In the table of Illinois suburban trains, the local schedules are stated as 18.51 and 18.76 miles an hour, with stations averaging 2900 ft. apart.

On Dec. 23, 1897, a proposition was made to the Illinois Central Railroad by the Sprague Company, which required the use of the entire weight of cars and a very high power equipment, and guaranteed a schedule of 24½ miles an hour on the same runs, but it was not accepted at the time, and I think wisely, in view of the developments which were being undertaken on another road, namely, the South Side Elevated of Chicago, and the opportunity which these would afford for study and natural improvement. This latter road has been in operation for nearly a year. It started with an original equipment of 120 cars, each of which was equipped with two 50-h.p. (hour rating) motors on one truck, or a maximum of about 6 h.p. to 6½ h.p. per ton with average loads, and utilizing from 60 to 62 per cent of the total weight on the drivers, the general equipment being what is known as the Sprague "multiple unit" system, in which each equipped car is a self-contained transportation unit, but so controlled that aggregations in any number or sequence can be made, and the whole controlled from a single point. For weeks, every day, morning and night, with the exception of Sundays, 119 out of 120 equipped cars, pulling 28 or 29 trail cars, thus overloading the general equipment one-third, has run on as hard service as has ever been undertaken on any elevated railroad, and the success of the system from every standpoint has been unparalleled in so novel a departure. This equipment has been followed by thirty more completely equipped cars.

It may be that Mr. Fish referred to this system in speaking of the possibilities of the future, and the limitations spoken of were as to schedule speeds actually accomplished, rather than to methods demonstrated. On the South Side road no attempt was made to equal the schedule of the Illinois Central Railroad. The contract requirement was 15 miles an hour, with existing station intervals, and 16½ miles have been frequently made, but if a higher schedule had been desired all that was necessary to be provided was more power. The general method of application and control is settled for a finality.

It is true that as the schedule increases, the power increases in a more rapid ratio, and equally true whether the power is steam or electricity, but cars equipped and controlled on the system referred to here are already in operation, and taken singly or aggregated into train units, will outrun any possible steam combination which now exists on the local suburban service of the Illinois Central, or any other road, and this fact can be easily demonstrated in this city with existing equipments, so far as permitted by local conditions.

As I have stated, much in the letter meets my hearty assent, but the inferential conclusion that a four-track elevated railroad, however good an engineering proposition in itself, is advisable, because steam can be used on it, whereas electricity only can be used on an underground, is untenable.

A number of years have passed since I publicly offered, at my own expense, to run express trains at 40 miles an hour on an elevated structure in this city with electricity as a motive power, and I am ready to guarantee, in competition with any other known method of train operation, whether for local or express service, practical schedules higher than have ever yet been attempted, and higher than is possible by any combination, steam, air, or electric, which localizes the power in one or two units, and pulls dead cars between or behind them.

It may be pointed out that the actual limit of schedule speed possible on a level railroad, with stations averaged at 2900 ft., as on the Illinois suburban, and with a maximum of 300 lbs. to the ton adhesion, is very nearly 30 miles per hour, as against 18.51 and 18.76 given in Mr. Fish's reference, and these increased schedules are absolutely only possible with electric motor application, and where the motors are distributed throughout the train, every pair of wheels being used as drivers. Of course, this is in fact the aggregation of the car units, such as fill our city streets, except somewhat larger in size, with the addition of a suitable secondary control, which simutaneously governs all cars.

In this connection permit me to call attention to a letter, under date of April 1, 1898, to Mr. John H. Starin, the then chairman of your contract committee, copy of which I inclose herewith. Very respectfully,

FRANK J. SPRAGUE,
Second Vice-president and Technical Director.

LETTER TO MR. STARIN

John H. Starin, Esq.,
Chairman Contract Committee, Rapid Transit Commission,
22 William Street, New York.

APRIL 1, 1898.

Dear Sir—In all the published accounts on the subject of the negotiations between the commission and the Manhattan Elevated Company, as well as with any one else, one of the most important essentials seems to be entirely ignored. Routes, structures, rights of way and penalties are all considered, but the one thing which would do more to relieve congestion does not seem to be insisted upon, and that is the question of motive power.

The time has past when there could be any question as to the advisability of abandoning steam and adopting electricity, and by this agent, and this alone, can the essentials of cleanliness, reduction of noise, smoothness of operation, and, what is most important of all, increase of schedule speed, be obtained.

The elevated railroads now make on way trains a schedule speed of not exceeding 12 miles an hour, including stops, when running with loaded trains. It is possible to increase this to 18 or about 18½ miles, although that is the absolute maximum with station stops as they now exist; but 16½ miles is within the range of practical, reasonable demand.

It would seem, therefore, perfectly proper that the following conditions should be introduced in the granting of any franchise, of any kind whatsoever, and to whatsoever company:

1. That there shall be a change from steam to electricity.
2. That there shall be a schedule speed, including stops at each station, of not less than 16½ miles, whatever the length of train.
3. That there shall be a schedule speed, including stops at limited stations, of express trains of not less than 30 miles an hour.

The above conditions can be met, and it is only reasonable to expect that these increased speeds should be supplied by the railway company if they receive additional privileges.

Very truly yours,
(Signed) FRANK J. SPRAGUE.

The City Council of Bergen (Norway) has refused the proposition to buy and operate the local street railway system.

The Destruction of Old Transfers and Tickets

After transfers and tickets have been used the chief object of the railway company is to so destroy them that they can never be employed again. The usual practice is to have the tickets burned under the oversight of some responsible officer of the company, but this is not the only method employed. The STREET RAILWAY JOURNAL recently made an investigation of the methods in use by a number of companies in this country, and obtained the following particulars as to the practice of a number of companies in destroying tickets.

On the Brooklyn Heights Railroad Company the tickets are chopped in a machine designed for that purpose, and when thus mutilated are sold as waste paper. The company tried burning the tickets under the boilers of one of its power stations, but was obliged to transport the tickets to the power station, which was a considerable distance from the office, and after a short experience found that this was not the safest way of disposing of them.

The Boston Elevated Railway Company has for several years used a ticket cutting machine, located in the office of the auditor of the company and operated by a 1-h.p. motor. The machine was originally built to run by hand, but was altered in such a way that electric power could be used. With this machine the company is able to destroy about three barrels of tickets in two hours. The refuse is sold for a small amount.

The Twin City Rapid Transit Company, of Minneapolis, Minn., has for some time burned all of its canceled tickets under one of the large boilers connected with the general office of the company. This method, however, is not regarded with very great satisfaction, and the company may install a machine similar to that used in Boston and mentioned above.

The North Jersey Street Railway Company, of Jersey City, N. J., disposes of its tickets and transfers by burning them at one of its power stations. The tickets and transfers are in the custody of the cashier, who personally supervises the disposal of them from the time they leave the office until they are consumed in the furnace. Owing to the large number of lines operated, the company has a great many tickets and transfers, and finds that this is the best way to dispose of them.

The Milwaukee Electric Railway & Light Company writes that the practice of that company is to tie the tickets up daily in large paper sacks and then to burn them, a clerk from the accounting department supervising the operation.

The Metropolitan Street Railway Company, of New York, adopts a similar method, except that the tickets are first chopped into very small pieces before being burned.

The New Orleans Traction Company also employs the method of burning its old tickets. The plan has been found very satisfactory.

The Third Avenue Railroad Company, of New York, adopts a similar method, the tickets being deposited in wooden boxes before being taken to the boiler room.

The Union Traction Company, of Philadelphia, Pa., also destroys its tickets by throwing them into the furnace of a boiler room adjacent to the receiver's office. The tickets, however, are first placed in a manila paper bag 33½ ins. long and 11 ins. wide. The operation is conducted in the presence of the receiver, who witnesses their complete destruction.

The United Traction Company, of Pittsburgh, Pa., employs the same method, but keeps the tickets for a short time, usually a few weeks, before burning them in the power-house furnace.

On the Market Street Railway, in San Francisco, the tickets are returned to the accounting office, where they are inspected and checked, and are then deposited in a chute, which conveys them to a locked receptacle in the basement. This receptacle is opened daily after office hours and the tickets, transfers, etc., are emptied into a box truck, wheeled to the engine room and shoveled into the furnace. This is done under official supervision, although there is little opportunity of reusing the tickets, as the transfers are not only stamped with the date, month and year, but are also canceled at the time of being received for fare.

A Steam vs. Electric Rate War in Missouri

Fred H. Fitch, formerly of the Chicago City Railway Company, but more recently interested in the Southwest Missouri Electric Railway, and who is now again located in Chicago, was in New York last month, and gave some interesting particulars of a rate war which occurred when he was connected with the Southwest Missouri Electric Railway. This railway, which is described elsewhere in this issue, connects the important towns of Carthage, Carterville, Webb City and Joplin, Mo., and Galena, Kan.

Previous to 1893 all travel between these centers of population was taken care of by the steam railways, the charge being 3 cents per mile, and trains were run at very infrequent and irregular intervals. The district demanded more frequent and cheaper service, and in 1893 the electric road made its appearance, and by 1896 communication from Carthage through to Galena was had every half hour for eighteen hours during the day, at a cost of about 1 cent per mile. The district felt the healthful effect of it; the people and the press praised the men who had made it possible, and the road prospered.

The St. Louis & San Francisco Railroad Company, familiarly known as the "Frisco," in June, 1897, put on in competition with the electric road an interurban service, running trains consisting of an engine, combination baggage and smoker, and a coach, every hour over one portion of its road, and every two hours over another portion. The steam fares were reduced to meet those of the electric road, and the running time was about two-thirds that required by the electric cars. In order to discount the advantage which the electric road had in running through the streets, the steam railroad managers inaugurated a free hack service between the business portions of the towns and their depots.

In June, 1898, the electric railway company succeeded in obtaining a franchise into the city of Galena, and the "Frisco" managers immediately notified the electric railway company that unless it disavowed all intention of extending its road under the grant obtained that they would cut the rate to 5 cents between any two adjacent towns, and make 10 cents the maximum rate anywhere along the line. This threat was put into execution in June, and meant a cut from 40 and 25 cents to 10 cents, and from 10 cents to 5 cents.

But the "Frisco" did not stop here. For a while, on Sundays and holidays, this new rate was cut in two, and a rate of 10 cents only was charged for the round trip from Carthage to Galena and return, and correspondingly low rates along the line. This made a ride of 60 miles for 10 cents, or 1/6 of a cent per mile. Here is what the lucky populace could do on these occasions: enter a hack at a hotel in Carthage and be taken to the depot; be transported to Galena, 30 miles; enter another hack, and go to a hotel or to the business center; having spent the day in Galena, be driven to the depot, take a train for Carthage, and there take a hack to their homes, all for the great sum of 10 cents.

Mr. Fitch quoted from W. F. Merrill, second vice-president of the Erie Railroad, who said before the New York Railroad Club that it costs the Erie 27 cents per mile to run a train similar to those run by the "Frisco," "and," he added, "while Mr. Merrill didn't say as much, I don't believe the 27 cents included any expense for operating free hacks." Meanwhile, the receipts of the "Frisco" were from 12 cents to 15 cents per train-mile, and they operated 600 miles per day.

On Jan. 8 last an agreement was reached and the rates were restored, although not to the original amounts, for one lesson learned from the rate war was that cheap fares make business, and that an error can be made in making rates too high.

The "Frisco" still maintains its interurban train service, but the electric road is doing a splendid business, greater than ever before, and, having safely and victoriously passed through the bitterest fight that it can probably be the misfortune, or fortune, perhaps, of an interurban electric road to encounter, it no longer looks upon the "Frisco" as a bugaboo.

Southwestern Gas, Electric and Street Railway Association

In consequence of a smallpox epidemic at Laredo, the annual convention of the Southwestern Gas, Electric and Street Railway Association, which was to have occurred on April 19, 20 and 21 at Austin, has been postponed until May 17, 18 and 19. Advantage will be taken of the postponement to elaborate the plans for the meeting, and also for the electrical exhibition to be held in connection with the convention. The exhibition will be held in a well-arranged building, 80 ft. x 120 ft., which is situated near the railroad tracks, and is easily accessible from all parts of the city. The meeting and exhibition promises to be one of the most successful of its kind ever held. The following is a list of the papers which will be presented and discussed at the convention:

"The Item of Depreciation," by W. E. Hamilton, Shreveport, La.

"Meters," by W. E. Holmes, Austin, Tex.

"Transformers," by Harry L. Monroe, Dallas, Tex.

"The Amount and Extent of Legitimate Investment in Electric Lighting Plants of Certain Capacities," by F. Fries, San Antonio, Tex.

"Summer Amusements for Street Railway Companies," by W. H. Steuart, Waco, Tex.

"Art and Science of Selling Gas," by Thomas D. Miller, Dallas, Tex

"A Model Plant Under Model Management; What Both Would Be Like," by J. F. Strickland, Waxahachie, Tex.

"Alternators," by E. Dysterud, Monterey, Mexico.

"The Attitude of a Corporation to the Public," by W. R. Weiss, San Antonio, Tex.

"Means of Encouraging the Diversified Use of Electric Current," by C. L. Wakefield, Dallas, Tex.

Mexican Paper—"Electric Lighting and Application of Electricity to Various Purposes in Mexico," by a Mexican delegate.

"Arc Lamps," by Max Levy, Galveston, Tex.

"Fare Boxes vs. Conductors," by F. E. Scovill, Austin, Tex.

"Transfers," to be assigned.

"Gas for Fuel," to be assigned.

Some Recent Street Railway Parks

LAKESIDE PARK, MO.

The Southwest Missouri Electric Railway Company, with headquarters at Webb City, Mo., operates about 34 miles of track, extending from Carthage, Mo., to Galena, Kan., and passing through a number of towns and villages in its course. Along the line are situated two or three beautiful pleasure resorts, which are well patronized by the population of nearby towns, particularly of Joplin and Webb City. The most extensive of these parks is known as Lakeside, and is situated 7½ miles from Carthage, 3 miles from Webb City, 9 miles from Joplin, and 15 miles from Galena.

It is truly one of nature's parks, being located on the banks of a pretty stream of water, and containing a large and beautiful lake. The park has an abundance of forest trees, making a most delightful shade. As the lake is large and deep, one of the principal attractions is, of course, the boating, a large number of pretty boats of all descriptions being kept in readiness at all times for visitors. Bathing is another of the principal features of this resort. A floating bath house, especially for ladies and their escorts, equipped with all the modern accommodations, such as bathing suits and other necessities, is provided, in addition to a gentlemen's bath house, which is equipped with springboards, swinging ropes, etc. To amuse and entertain the children and young people a large number of swings have been distributed throughout the park.

One of the best appreciated features of Lakeside is the abundance of pure, cold water, there being two 160-ft. wells, that are never-failing, and the quality of the water is equal to the spring water at many of the popular watering resorts.

The grand pavilion, which is shown herewith, is a handsome and costly structure, with a stage and new scenery, and a seating capacity of 1000. It is built without sides, but is provided with curtains around its entire length, so that in case of rain it can be closed in a moment, making it a large and commodious hall. In this pavilion, and also throughout the park, are large tables and seats for picnic parties, etc. At one end of the pavilion are comfortable dressing rooms for ladies and gentlemen, and nothing is lacking in the way of accommodations to visitors. Not less pleasing than the charming scenery and delightful attractions at the park is the enjoyable trip from either direction. The country through which the road passes is one of the finest in the West, and the road itself is one of the best constructed and equipped properties in the United States.

HIAWATHA PARK, OHIO

The owners of Hiawatha Park are busily engaged getting the place into shape for the opening exercises, which will occur on Decoration Day. This resort is on the line of the Mt. Vernon Electric Railway Company, of Mt. Vernon, Ohio, and is conspicuous for its pleasing scenery and for the diversity and attractiveness of the amusements that are provided. Three years ago P. B. Chase, president and general manager of the Mt. Vernon Electric Railway Company, took charge of the old county fair grounds, which had not been used for years, and which consisted of a rough, unkept plot of ground with dilapidated buildings and fences. As a result of his planning and energy, this place has been transformed into a beautiful park, and when the changes now under way are fully carried out, this spot will be an ideal pleasure resort.

The fountain is being rebuilt and enlarged, the material used being moss-covered stone. The flower vases have been replaced with large rustic ones of the same material as the fountain, and these will contain growing plants. The floral work about the park will this year be finer and much more extensive than in other years, and will be on an altogether different plan. Formerly large floral plots have been one of the features of the park, but these will be discontinued, and in their place will appear large rustic vases, which will be filled with flowers, the effect being modeled somewhat after that produced at Lincoln Park, Chicago.



VIEWS IN LAKESIDE PARK, MO.

Probably the greatest change in any one of the many attractive features will be made in the grotto, which has always been a favorite place with visitors. In the interior flowing water will drip from crevices in the roof and sides upon plants, ferns and flowers. In front of the grotto stone columns, 3½ ft. square, will be erected, with an old-fashioned arch of moss-covered stone, rustic in appearance. Leading from the columns to the front of a semicircular design will be two stone walls, on the extreme ends of which will be located large vases of flowers. In the stone columns will be cut windows, giving all the appearance of the entrance to an old castle.

One of the principal drawing cards of Lake Hiawatha has been the zoo gardens, and these will be maintained during the coming season on a somewhat extended plan. Additions of rare and interesting birds and animals are to be made.

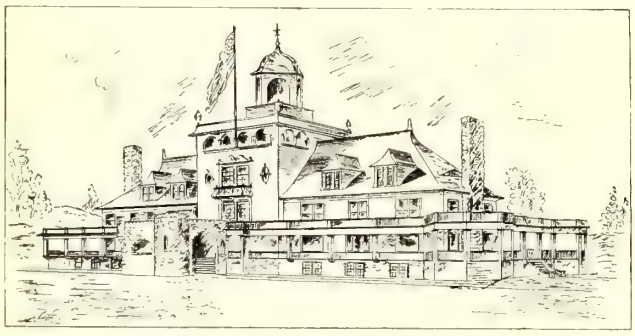
In addition to the large number of rustic seats on the grounds, about forty swinging seats have this season been placed in shady nooks, where they will be most appreciated. The boathouse will be enlarged, and a toboggan

slide into the lake will be maintained. For the auditorium a large orchestra has been engaged. This orchestra will also furnish music to picnic parties for dances at the park or in the city at reasonable rates. The railway company is a member of the Interstate Vaudeville Association, and the best attractions will be given at this resort. Matinees will be given on excursion days, and performances every evening. The prices for seats are 5 and 10 cents, according to location. A large number of cottages have been built on the grounds, and these will be rented for the summer.

MERRYMEETING PARK, MAINE

Merrymeeting Park is situated near Brunswick, Maine, on the lines of the street railway company, and considerable time and money have been spent in developing it, and it is now one of the most attractive resorts in New England.

The most prominent feature of this park is the casino, which is shown herewith. This building is two and a half stories high, exclusive of the tower. The basement con-



CASINO, MERRYMEETING PARK

tains a kitchen and storerooms, and also accommodations for a large number of bicycles. The first story is divided into a general waiting room, office and a large ball room, with a moveable stage. Here plays and entertainments are given when stormy weather prevents the use of the open-air theater.

The second story is devoted to dining rooms, ladies' parlors, smoking rooms, and a large public dining room. The tower will be used for observation purposes, and also as a roof garden. The building is heated by steam, and brilliantly lighted throughout with electricity. During the summer evenings a special feature will be made of the illumination of the building.

Merrymeeting Park has a frontage of one-quarter of a mile on the Bath road, and extends for nearly one-half a mile along the Androscoggin River. The park has been laid out and the casino built under the direction of Frank M. Blaisdell, of Boston.

One of the improvements made in the property that is particularly worthy of note is the substitution of a pretty pond for a piece of ground that was formerly an impenetrable alder swamp. This was accomplished by building a dam across a small stream that runs through the park.

In the center of the pond a large pavilion has been placed, which will be used for dancing during the warm summer nights, this arrangement being a particularly agreeable feature. Next winter it is intended to utilize this pond for skating, and arrangements will be made for clearing it of snow and flooding it when the surface of the ice becomes too rough. The grounds have been cleared of a large amount of undergrowth and fallen deadwood, and paths have been laid out in all directions, giving the visitor his choice of a dozen pleasant strolls. Rustic seats and chairs are placed at frequent intervals.

A rustic outdoor theater has been erected in a natural depression in the ground, the seats rising in tiers above the stage. Here the usual out-of-door vaudeville and dramatic amusements will be given. At each side of the stage is a spring of cool water, and attendants serve this water to the spectators during the progress of the plays. This feature is very much appreciated by the public.

The owners of the park have in contemplation numerous other improvements and attractions at this resort, and, during the spring and early summer, lawns, flower beds and shrubbery will be placed in the vicinity of the casino; little ponds will take the place of swampy ravines, summer houses, shelters and observatories will be erected at prominent spots, a large athletic field will be made in the meadow near the river, deer, caribou, moose and elk will be placed in the woods, and swans, ducks and other aquatic birds on the pond and river.

PARK AT ALLENTOWN, PA.

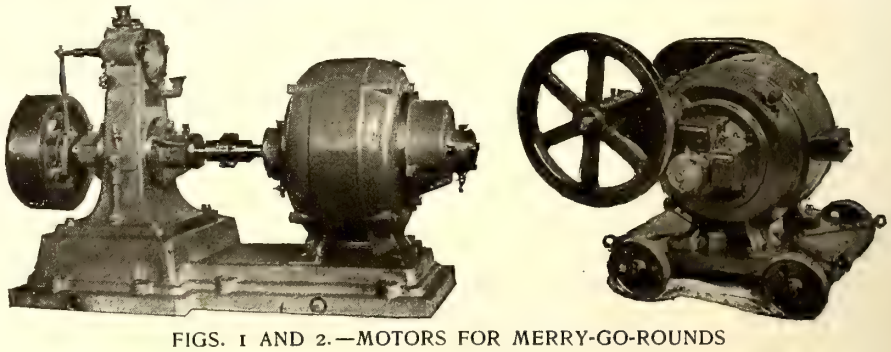
The park of the Allentown & Lehigh Valley Traction Company will open shortly with a large number of improvements and additions. The principal attractions at this place are an open-air theater, where performances are given daily, and a small "zoo." This company has found that a cage of lively monkeys provides one of the most pleasing and amusing attractions that can be found. Crowds will stand and watch the antics of a dozen monkeys for nearly a half-hour, when they would pass by the ordinary park attractions without notice. The company also owns an elephant, which has proven a center of attraction, especially to the children.

ROSS PARK, BINGHAMTON

Ross Park, located at Binghamton, N. Y., opens this year with greater promises than ever before for a successful season. This resort has been laid out on broader lines than the usual run of pleasure resorts, and it is known and patronized by people for miles around. Men have been busy for some time getting the grounds into shape, cleaning up the winter's rubbish and making a number of slight improvements. The company is considering the advisability of building a much larger open-air theater and amusement pavilion, as the present one is not large enough to accommodate the visitors on pleasant days.

Park Attractions

Practically all street railway managers unite in the opinion that there is no better paying attraction for street railway parks than



FIGS. 1 AND 2.—MOTORS FOR MERRY-GO-ROUNDS

merry-go-rounds. The Armitage-Herschell Company, of North Tonawanda, N. Y., is one of the largest manufacturers of machines of this kind in the country, and through many years of experience in the designing and building of merry-go-rounds, has created a very extensive domestic and foreign export trade.

The standard machine built by this concern consists of a steel track, upon which run wheels supporting the machine proper, consisting of sweeps, platforms and lattice work, this in turn supporting four chariots, each capable of seating four passengers, together with the twelve pairs of horses, each of which has an animated and

exhilarating galloping motion. Sixteen chairs are also provided, making the seating capacity of the machine fifty-six persons.

All of the parts of these machines are made in large quantities, by workmen skilled in their particular duties, and upon the interchangeable system. All of the parts are ingeniously fitted and interlocked, so that the whole machine may be assembled in a very short time, and when the various pieces are in place with their bolts turned up, the whole frame work becomes rigid as one piece, thus greatly lengthening the life of the machine by limiting all wear from racking strains.

The rotation of the gallery is obtained by means of a steel cable passing about a groove on the circumference of the machine. This cable is driven by a stationary engine, or where electric power is available by means of an electric motor, either of which is built by this company in the same plant as the gallery, thus assuring that each will be adapted for the other. This method of driving is covered broadly by patents which cover as well the use of the eccentric for giving the horses their galloping motion. The machines can be operated successfully by two men where a permanent stand can be obtained, although it is advisable to have three men when the machine is to be moved from place to place. When, however, the electric motor can be used, one man can operate the gallery successfully, as the electric controller is placed directly upon the machine, so that one man may act as both fare collector and operator, having perfect and absolute control of the motion of the gallery. The motor used for this purpose is shown in Figs. 1 and 2.

As a modification of the standard machine, and to meet a demand for a novelty, a somewhat similar machine is built in which there are three horses abreast instead of two, the number of chariots remaining the same. This increases the capacity of the machine by twelve riders, and increases the earning capacity to the same extent, and is very popular in locations where the capacity of the standard machine is inadequate to the demands for seating capacity.

In addition to the above machines and in order to supply a machine adapted for permanent locations where a large attendance is assured, the "Mountain-Valley" shown in Fig. 3 has been



FIG. 3.—MOUNTAIN VALLEY MERRY-GO-ROUND

evolved and perfected. Upon an undulating track having a rise and fall of 6 ft., are propelled eight gorgeous chariots, each with a seating capacity of twelve passengers. Each chariot is resplendent with massive carving and gorgeous decorations, being studded with beveled mirrors and richly upholstered. The chariots are attached to the portable frame by brass rods and move about a center of magnificent pictures and superb decorations. Over the whole is a canvas top surrounded by a carved valance, resplendent medallion pictures, hand-carved scrolls and beveled mirrors, and supported by heavy brass columns.

With the standard and three-horse abreast machine is furnished an elegant organ about 60 ins. high, 40 ins. long and 25 ins. deep, with trumpets, piccolos and flageolets of very rich and powerful tones, having inside violin and basses, contra basses, and stopped diapason, with two barrels playing eight tunes each of the latest popular airs, also a novelty in the way of a negro image represented as turning the organ which automatically turns its head and bows to the audience as the gallery revolves. The organ furnished with the "Mountain-Valley" is considerably larger and finer than this.

VAUDEVILLE ATTRACTIONS

J. W. Gorman, of Boston, the well-known manager of amusement attractions for parks, states that an increased interest is being felt in the subject of street railway parks this season. Mr. Gorman formed a circuit last year among a large number of street railway parks in the East, and thus gave each one a change of bill every week or oftener, if desired, through the season, with satisfaction to the railway companies. Mr. Gorman has given the subject of entertainments attention for many years, and during this time has made a specialty of out-of-door attractions. After a study of local conditions the only information which he needs from a railway company is how much it is willing to spend on park attractions, and he will then supply the best entertainment for the conditions and prices named. Devoting, as Mr. Gorman does, his entire attention to this one specialty, he is well posted on everything that is needed, and will supply specifications for park theaters or other fittings necessary.

Official Tests of Brakes in New York

The Board of Railroad Commissioners of the State of New York has issued the following notice:

NOTICE TO OWNERS OF BRAKES FOR STREET SURFACE CARS

ALBANY, March 29, 1899.

The board of railroad commissioners of the State of New York will make a test of braking systems for street surface cars, on cars to be furnished for that purpose by the Metropolitan Street Railway Company of New York City. The tests will be made of such braking systems offered as appear to the commission to be practicable. Applications to have braking system tested, and for permits to equip cars for this purpose, must be made on the accompanying blanks. All applications must be accompanied by a drawing, tracing, blue print or photograph showing the system complete; also a full description of the same, setting forth the details of construction, application to car and method of operation.

The cars to be furnished will be eight-wheel cars, with "Brill" maximum traction trucks fitted with G. E. 1000 motors, with non-suspension; driving wheels 30 ins., tread wheels 20 ins. in diameter; length of car-body over all 28 ft; outside measurements of wheel base 17 ft. 6 ins. The railway company will furnish space in its car-house and pit-room for the purpose of fitting up cars, but will not furnish any supplies, labor or machine shop facilities. The general master mechanic of the Metropolitan Street Railway Company will designate the cars to be equipped and the car-house at which the work shall be done.

These tests will be made in any manner the board of railroad commissioners may determine. While the tests are being made only one representative of the applicant will be allowed on the platform on which the brake is operated.

All tests of braking systems for stopping a car will be from a signal on a basis of $\frac{WS^2}{D} = E$.

E = Efficiency of braking system.

W = Weight of car.

D = Distance between point at which signal is given to point of stop.

S = Rate of speed at time of giving signal.

The merits of braking system will be determined on the following points:

First—Emergency stop at —— miles per hour.

Second—Stop at —— miles per hour, without skidding wheels.

Third—Service at —— miles per hour.

Fourth—Ease of manipulation.

Fifth—Reliability of system.

Sixth—Operation of the system by the ordinary motorman.

Seventh—Simplicity of system.

Eighth—Liability of brakes operating when they should not

Ninth—Safety devices in case of failure of any part of braking system.

Distinctive emergency brakes will be tested on their merits and their non-interference with the ordinary brake.

Application for permits to compete and to equip cars should be addressed to C. R. Barnes, electrical expert, railroad commission of the State of New York, Albany, N. Y., and will be received until May 2, 1899.

JOHN S. KENYON.
Secretary State Railroad Commission.

There appear to be three main conditions involved in the "best material" for brake shoes, viz.: that it should be economical in wear itself, economical as regards wear on wheels, and should have a good coefficient of friction. Different men will vary in opinion as to the relative importance of these three conditions.—From paper read at the Atlanta, Ga., Convention, 1894.

LEGAL NOTES AND COMMENTS*

The Question of Practice in Negligence Cases

It is our purpose generally to treat questions in these columns aside from questions of practice, but a recent decision in our New York courts, under the Code of Civil Procedure (which has been substantially adopted now in many other States), is of so practical a character that we believe the loss departments, both in this jurisdiction and outside of it, will be interested.

Ordinarily, when the plaintiff's case is weak and the presiding justice believes that the complaint should be dismissed or the jury directed to bring a verdict for the defendant, he makes that ruling without submitting the case to the jury.

If, in the opinion of the appellate tribunal, he has made a mistake, then all the labor, expense and trouble of a new trial results, even though the jury upon the first trial was convinced, as the judge was, that there was no case for the plaintiff, and therefore would have rendered a verdict settling the controversy on the questions of fact forever.

Time was, when this was not the practice, and when a judge allowed a case to go to the jury, in many instances, with a settled intention in his own mind to set the verdict aside should it be in favor of the plaintiff, and grant a new trial on the ground that the evidence did not warrant the verdict. Thus, if the jury found a verdict in favor of the defendant, there was no new trial, even though the judge might have erred in his opinion that the case never should have been submitted to a jury and that the defendant was entitled to a direction of a verdict.

But when the appellate courts decided that it was the judge's *duty* to dismiss the complaint, or direct a verdict at the close of the evidence, and before submitting the case to the jury, *in every case* where he would be compelled to set aside a verdict in favor of the plaintiff, and to grant a new trial, this was necessarily abandoned by the judges, especially as it necessitated their going on record as having committed error in not dismissing the complaint or directing a verdict in the first instance.

The recent case which is the occasion of this article is that of Sullivan vs. the Metropolitan Street Railway Company, decided in the February term (37 App. Div., 491). There, at the close of the evidence, a motion was made for the direction of a verdict, and instead of deciding the motion *instanter,* the court, *pending the decision of the motion,* submitted to the jury four questions of fact, which were raised by the pleadings, in accordance with the provisions of section 1187 of the Code of Civil Procedure. The first three questions relate respectively to the absence of contributory negligence of the plaintiff, the presence of negligence of the defendant, and the amount of the plaintiff's damages. The fourth question was a special question as to whether the car was at a standstill when the plaintiff attempted to get upon it. The jury returned answers to the question which entitled the plaintiff to a judgment in a substantial amount; but the judge ignored their findings, and, granting the motion which he had taken under advisement, directed a general verdict for the defendant.

When this matter came before the Appellate Division, objection was made to the practice pursued by the court, but the court was upheld in that regard and the practice was approved, and the Appellate Division held that this practice would, ordinarily, allow them to direct judgment to be entered in accordance with the findings of the jury in favor of the plaintiff for the amount found, and so the necessity of a new trial would be avoided. In the particular case under consideration a new trial had to be ordered on another ground, because material evidence offered by the defendant company was rejected, to its prejudice. This evidence not having been before the jury, the defendant was entitled to a new trial.

It will be noted that this practice accomplishes at least three results, which cannot be obtained by the dismissal of the complaint or a direction of a verdict in favor of the defendant at the close of the evidence and before the case goes to the jury.

First, it gives both sides a chance to have the facts passed upon by a jury; and if in favor of the defendant the litigation is ended, unless there be valid exceptions.

Second, it gives the appellate tribunal a chance to direct a judgment in favor of the plaintiff, if it is found that the court erred in directing a general verdict for the defendant.

Third, in case the jury disagrees, the judge retains the power to direct a verdict or to dismiss the complaint upon the motion, which he has held in advisement, while the jury has been deliberating.

This last is a *desideratum,* since, in an ordinary case where a jury disagrees, both sides seem remediless under the present practice; for no motion will be entertained for a reconsideration of the ruling that may have been made upon the trial for the direction of a verdict or a dismissal of the complaint. A new trial, with all its expense and delay, must be accepted by both sides as the inevitable result of the mistrial.

The submission of special questions to the jury also simplifies the work of the Appellate Court, and may enable them to affirm a judgment when, under the usual practice, they would be compelled to order a new trial.

There are other advantages which, together with what we have already stated, ought to make the practice followed in the Sullivan case popular with the courts in lessening their labors, as well as with the bar. To the street railway company it would appear to be advantageous, in that it decreases the expense of litigation, and will oftentimes save them from a second trial and its accompanying inconvenience. H.

* Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

ILLINOIS.—Street Improvement—Assessments—Liability of Street Railroads—Ordinance.

An ordinance in consideration of the acceptance of which the rights of a street railroad company were extended, providing that it shall, "as respects the filling, grading, paving and otherwise improving and repairing the streets * * * on which it has constructed its railways, * * * fill, grade, pave and keep in good repair" a certain number of feet in width of the streets, in accordance with such ordinances as the city council may pass respecting the same, and the same shall be done by the company "with like material, in like manner and at the same time as required as to the rest of said street," is a valid contract, exempting the company from assessment for improvements of such streets.—(West Chicago St. Ry. Co. vs. City of Chicago, 53 N. E. Rep., 112.)

LOUISIANA.—Taxation—Street Railroad Franchises—The law requiring franchises to operate street railways to be taxed according to their value makes the earning capacity of the corporation a basis for ascertaining the value at which the franchise shall be assessed, but does not exclude reference to other elements that bear directly on the question of that value.—(Const. art. 203; Act 1890, No. 106, secs. 1, 28. St. Charles St. Ry. Co. vs. Board of Assessors et al., 25 So. Rep., 90.)

NEW YORK.—Ordinances—Street Car Fenders—A provision, in an ordinance requiring safety fenders to be attached to the front platform of electric street cars, that they shall not be more than 3 ins. from the tracks, is unreasonable, in view of the liability of the height of the car above the tracks to vary according to the loads, the grades, and the curves.—(City of Brooklyn vs. Nassau Elec. R. Co., 56 N. Y. Suppl., 609.)

NEW YORK.—Joint Use of Tracks—Leased Lines—A street railway company, having a right to operate its line in a certain avenue, agreed with another company that the two should con-

struct a double track on such avenue, to be used jointly by them; each to operate as many cars over the track as it might deem proper. Held, that the latter company could not restrain the former from operating the cars of a leased line over the double track.—(Coney Island & G. Ry. Co. vs. Coney Island and B. R. Co. et al., 56 N. Y. Suppl., 508.)

NEW YORK.—Lease—What Constitutes.

1. A contract for the passage of cars over a street railroad, of which the owner otherwise holds control, is not a lease, within Laws 1890, chap. 565, sec. 78, authorizing contracts for the use of railroads, but providing that, if such a contract is a lease for more than one year, it shall not be binding, unless stockholders consent.

2. Same—Use of Road—Right of Interference—Failure to pay compensation under a contract for the use of a street railroad does not authorize intereference with the use.

3. Same—That the terminus of the right of way has been slightly changed in the actual operation of a part of a street railroad, under a contract for its use, does not impair the right to enjoin interference with the use contracted for.

4. Same—Rights of Co-Tenants—One co-tenant of a street railroad, bound not to let, sublet, assign, or convey any interest therein without the other's consent, could not convey a perpetual right to operate the cars of a third road over the common tracks, on the consent inferable from their operation for several years without complaint from the other.

5. Same—Rights of Purchase—A company which has acquired the interests of co-tenants of a street railroad may object to the exercise of an easement to which only one interest is subject.

6. Same—Estoppel—Failure of a co-tenant of a street railroad to complain at once of the use thereof by a third road, which has acquired the right from the other co-tenant only, does not give rise to any estoppel in favor of the use.

7. Same—Corporate Stock—Foreclosure—Interest of Purchaser—One who acquires stock of a street railroad company by foreclosure of a mortgage takes it free from an agreement by the former owner, a street railroad company, for a right of way for the company whose stock it purchased over a line it occupied in common with another, and to procure from its co-tenant such right of way, though such agreement was the consideration of the purchase by such former owner.—(Chapman et al. vs. Syracuse Rapid Transit Ry. Co., 56 N. Y. Suppl., 250.)

OREGON.—Receivers—Liens—Priority.

1. Since a heater, furnished to an electric railroad company after a test showing that it would save a certain sum per month in fuel, was not necessary to keep the company in operation, the seller has no preferred claim for payment out of the receipts of the company after it goes into the hands of a receiver.

2. The fact that a heater furnished to an electric railway company before its insolvency has already earned a sum equal to the agreed consideration, by effecting a saving in fuel, does not give the seller a preferred claim for payment out of the receipts of the company.—(McCormack vs. Salem Consol. St. Ry. Co., 56 Pac. Rep., 518.)

RHODE ISLAND.—Franchise—Fare—Municipal Contracts—Right to Enforce—Test Cases.

1. Where a town granted a franchise to a street railroad company, the contract stipulating that the fare between any two points on its lines should not exceed five cents, the grantee waived its right to charge more as successor of another company whose charter allowed it to charge ten cents, under which charter the grantee had established a fare of five cents for a continuous ride.

2. Where a town grants a street railway franchise, the contract limiting the rate of fare between any two points, an individual who has been ejected from a car for refusing to pay more than that rate may avail himself of the contract, in trespass for assault and battery.

3. Under Pub. Laws 1891, chap. 975 (Act May 29, 1891), authorizing towns to make contracts granting franchises to corporations operating street railways, section 4 of which provides that the charge for service shall not exceed the price charged by the corporation at the time of granting the franchise, a contract which limits the rate of fare to less than that then charged by the corporation is not beyond the town's authority.

4. Where a party boards a street car, tenders a certain fare, and, on refusing to pay more, is ejected, an action by him is not a moot case, which the court will refuse to entertain, though the party's sole motive was to make a test case.—(Adams vs. Union R. Co., 42 Atl. Rep., 515.)

UTAH.—Self-Executing Statutes—Franchise Is Contract—Waiver of Breach—Status of Privileges Granted—Franchise—Breach of Condition—Waiver—Strangers to Contract Without Right—Forfeiture of Franchise—Procedure—Articles of Incorporation—When May Be Amended.

1. The various legislative acts under which the defendant street railroad company was incorporated, containing provisions that, unless certain acts were performed within a certain time, the "act of incorporation shall be void," and being later amended by adding the words "as to all parts of its chartered lines not then constructed," it is contended that such provisions are self-executing, and that, having failed to comply with the terms of the acts, defendant's rights have been forfeited. Held, that such contention is inconsistent with plaintiffs' allegation that defendant is a corporation, and of no avail.

2. A franchise is a contract between the State, or other body granting the franchise, and the party accepting and acting upon it. It is governed by the general rules applicable to contracts, and either party may waive any breach of the conditions of a franchise; and anything which would constitute a waiver of a breach of a contract constitutes a waiver of a breach of the conditions of a franchise.

3. The waiver of a breach, which, if insisted upon, would forfeit the franchise, or some special right under it, leaves the party in default free to enjoy the privileges granted until the State moves in the matter, and a forfeiture has been judicially declared.

4. The defendant company having been in operation for a period of about twenty-seven years, and no proceedings having been instituted by either State or city to forfeit any of the rights granted by the franchises to the defendant company, and additional franchises having been repeatedly granted, all defaults on the part of the defendant company up to the date of the last franchise (March 18, 1894) have been waived; and the plaintiffs, being strangers to the contract, have no rights in the premises.

5. The act authorizing the city to grant a franchise to defendant company imposed no restriction, except as to the time for which the franchise should be granted. No rights can be forfeited, therefore, except for the causes and in the mode prescribed in the franchise, and Rev. St., sec. 438, is not applicable.

6. There being no statutory time limit within which articles of incorporation may be amended, an amendment may be made more than ten years after filing the original articles; and, in the case at bar, the amendment having been made in 1889, seventeen years after filing the original articles, Rev. St., sec. 438, could have no application, except to the amended articles, and, as to such, there was no default when this action was commenced.—(Dern et al. vs. Salt Lake City R. Co., et al., 56 Pac. Rep.)

VIRGINIA.—Contract to Build Railroad—Liability to Sub-Contractor—Extras—A railroad company which has let a contract for the construction and equipment of its road is not liable to a sub-contractor for extra work done by him in constructing it under his contract with the principal contractor.—(Richmond Ry. & Elec. Co. vs. Harris, 32 S. E. Rep., 458.)

UNITED STATES COURTS.

WASHINGTON. — Jurisdiction — Citizenship — Circuit Court of Appeals—Decision—Conclusiveness—Supreme Court—Right of Appeal—Where jurisdiction of the Circuit Court originally depended on diversity of citizenship, Act Aug. 13, 1888, making the decree of the Circuit Court of Appeals final in such cases, applies, and prevents an appeal to the Supreme Court, though another ground of jurisdiction, under which such appeal might be taken, is developed in the course of the proceedings.—(Third Street & Suburban Ry. Co. vs. Lewis, 19 Supr. Ct. Rep., 451.)

LIABILITY FOR NEGLIGENCE.

DELAWARE.—Collision at Crossing—Negligence—Evidence—Opinions.

1. It is competent for a motorman of an electric car injured by collision with a wagon, claimed to have been negligently driven in front of the car, to show that the car which was run on schedule time, was on time when the accident occurred.

2. Question asked one suing for personal injuries whether he feels that he will ever again be able to do a good day's work, or recover from his injuries, is improper.

3. A motorman of an electric car, suing for injury from collision with a wagon who has given evidence that he was careful in handling the car at the time of the accident, and that the apparatus was then in good condition, cannot, before any attempt of defendant to show that he was an incompetent or careless man, give evidence that he was habitually careful to see that his car was in order.

4. A witness who has stated that when he saw the driver of a wagon whip up his horses, and the proximity of the car, there was bound to be a collision, cannot state why he says that.

5. A motorman suing for personal injuries received from collision of his car with a wagon cannot show the result of a hearing had by the motorman before a magistrate on a charge of reckless driving.

6. Plaintiff may ask his witness, who has testified that he saw a

car, and that, in his judgment, it was going about 5 miles an hour, whether he was safe in saying that he thought it did not exceed 5 miles an hour.

7. The owner of a team sued for injury to a motorman whose car collided with the team cannot state whether he has observed how long it will take a team to go from the side of the street to the car line, with the horses at a walk, any observations being immaterial, as the speed at which horses walk varies.

8. Where at foot of a hill, down which an electric car had come, there was a collision between it and a wagon, one not called as an expert cannot testify to a test made of a car going down a hill as steep as that in question, and of the space within which the experiment showed a car could be stopped.

9. The right of a person in charge of a street car and of a person driving a team to the use of the street at a crossing must be exercised with due regard to the right of the other, and in a reasonable and careful manner, so as not unreasonably to abridge or interfere with the right of the other.—(Price vs. Charles Warner Co., 42 Atl. Rep., 699.)

INDIANA.—Negligence—Driving Across Tracks—A plaintiff, driving at night in the direction of an approaching street car, which he can plainly see, is negligent in undertaking to cross the track when the car is so close that it strikes his horse before it is off the track.—(Citizens' St. Ry. Co. vs. Helvil, 53 N. E. Rep., 191.)

INDIANA.—Injuries to Passenger—Special Verdict—A complaint alleged that plaintiff notified the conductor to stop the car, and it could easily have been done; and, as the car approached the crossing, its speed was slackened; that plaintiff, being a passenger, was standing on the rear platform, and, as the car slowed down, the conductor, with his hands, "passed" plaintiff in front of him, to allow plaintiff to step off, which he did, taking hold of the railing and stepping down on the step, to be ready to step off when the car stopped; and, while he was so stepping down and off, the motorman suddenly turned on the electricity, so that plaintiff was thrown from the car. There was a general verdict for plaintiff. The special answers found that the car was running from 4 to 5 miles an hour, and there was no change in the amount of electricity used; that there was no evidence that the motorman turned the lever turning on and off the current; there was no finding that the speed was or was not increased; that plaintiff was getting ready to get off as soon as the car stopped; that he was not stepping from the platform to the step when he fell; and that he was trying to get off a moving car to avoid being carried past his destination. Held, that the special answers, being inconsistent with each other, could not control the general verdict.—(Citizens' St. R. Co. vs. Hoop, 53 N. E. Rep., 244.)

LOUISIANA.—Injury at Crossing—Contributory Negligence.

1. The authorities are numerous and uniform to the effect that a person whose business or pleasure occasions him to use the streets of a city which are traversed by electric cars, and particularly at street crossings, is guilty of negligence if he fails to employ proper precautions for his safety.

2. He is bound to look and listed for the approach of cars, and to exercise ordinary care and caution to avoid possible danger of a collision; and, should he see an approaching car in close proximity, it would be his plain duty to halt until same could pass by, rather than run the risk of an accident by attempting to cross the track in front of it.

3. Failing to take such necessary precautions for his safety, the injured party is guilty of that negligence which deprives him of the right to reimbursement for injury received.—(Dieck vs. New Orleans City & Lake R. Co., 25 So. Rep., 71.)

LOUISIANA.—Injury to Person on Track—Evidence.

1. One who heedlessly attempts to cross ahead of a car properly manned, if injured, has no one to blame but himself.

2. The motorman was not at fault, and none of the negligence charged by plaintiff was shown.

3. He exercised reasonable care to avoid the injury. He paid proper attention, saw the danger, and gave notice or warning, and did all he could to stop his car.

4. There was nothing out of repair about the car or the track, nor anything lacking to increase the danger in which plaintiff, the testimony shows, placed himself.—(Webster vs. New Orleans City & Lake R. Co., 25 So. Rep., 77.)

LOUISIANA.—Injury to Person on Track—Contributory Negligence.

1. A boy, eleven years of age, standing at night on the off side of the down-town track of defendant company's street railway, waiting for a car on the up-town track (which was furthest from him) to pass, and, that car having passed, without looking up the track nearest him, to see whether or not it was safe to cross, steps on the track, 12 or 15 ft. in front of an approaching down-town car, trips and falls, is run over, and his foot crushed. Held, a case of want of care on his part, barring recovery of damages; it being shown that, notwithstanding effort on part of motoneer to arrest car, it could not be done in that distance.

2. The motoneer had a right to suppose the boy was waiting for his car to pass, and to expect he would remain where he was out of danger until it had passed.—(O'Rourke et ux. vs. New Orleans City & L. R. Co., 25 So. Rep., 323.)

MASSACHUSETTS.—Personal Injury—Frightening Horse—Negligence—A horse drawing a buggy in which plaintiff was seated was driven in a public street near defendant's electric car, which made a loud noise and threw sparks from its wheels. When the motorman rang the gong, the horse took fright, and plaintiff was injured. It did not appear that the noise and sparks were due to any defect in construction, or negligence in operating the car, and the horse did not appear to be frightened until the gong sounded. Held, no evidence of defendant's negligence.—(Henderson vs. Greenfield & T. F. St. Ry. Co., 52 N. E. Rep., 1080.)

MASSACHUSETTS.—Place of Accident—Rebuttal—Where plaintiff's evidence is that she was run over at a particular place, defendant's evidence that the accident happened at a different place does not make a fresh case, which plaintiff is entitled to meet; so that admission or exclusion of evidence on rebuttal corroborative of plaintiff's statement is discretionary.—(Lansky vs. West End St. Ry. Co., 53 N. E. Rep., 129.)

MASSACHUSETTS.—Injury to Employee—Negligence of Superintendent—Defective Appliances—Evidence—Assumption of Risk—Contributory Negligence.

1. A car shifter, whose only duties were to get cars ready for conductors and motormen, starting the turntable at a car house, was not a foreman, nor engaged in an act of superintendency, in so turning the table, within St. 1887, chap. 270, authorizing recovery by one injured by negligence of a superintendent.

2. Where plaintiff was injured by alleged defective appliances, evidence of a change in such appliances after the accident is inadmissible.

3. Where a servant knew of the danger of the work in which he was engaged, he cannot recover having assumed the risk.

4. Where a conductor of a street car had an experience of three or four years with transfer car tables, he was guilty of contributory negligence, where he was injured by an obvious danger in the use of such table, though he had not observed it.—(Whelton vs. West End St. Ry. Co., 52 N. E. Rep., 1072.)

MASSACHUSETTS.—Negligence—Evidence—Witnesses—Instruction—Service on Corporation.

1. A request to rule, in an action against a street railway company for injury to a passenger, that on all the evidence defendant had proved there was no negligence on its part, and had thus overcome the effect of the evidence of the mere running off the track by the car, and to direct a verdict for defendant, is properly refused, there being evidence that the car had run off the track an hour before the accident, and that, immediately before it again ran off, causing plaintiff's injury, it was running at the rate of 15 miles an hour, down a grade, and around a curve.

2. In the absence of any other adequate explanation, negligence of a street car company may be inferred from the going off the track of a car, injuring a passenger, there being evidence that it had gone off the track an hour before, and that immediately before it again ran off, causing plaintiff's injury, it was running at the rate of 15 miles an hour, down a grade, and around a curve.

3. What inference shall be drawn from failure to call a witness equally within the reach of the parties is for the jury to say under all the circumstances.

4. Error cannot be predicated of an instruction, on a second trial, as to witnesses who testified at both trials, that the only purpose and effect of showing their testimony at the former trial is to affect the weight of their present testimony, the instruction evidently referring to witnesses as such, and defendant's exception thereto giving no intimation that it was understood to refer to plaintiff as a party whose previous testimony might be evidence against him in the nature of an admission.

5. Motion to dismiss for want of proper service on defendant corporation is properly denied, service on it by serving its assistant treasurer being returned, and no plea in abatement being filed, and it being impossible to know, as matter of law, that he was not an officer having charge of defendant's business, within Pub. St., chap. 161, sec. 36, authoring service on such an officer.—(Harriman vs. Reading & L. St. Ry. Co., 53 N. E. Rep., 156.)

MASSACHUSETTS.—Master and Servant—Negligence—Jury—The rear truck of a street car was derailed at a switch, and swung around so that there was just room for a car to pass on the other track. The motorman was trying to right the car with a piece of iron under the derailed wheels, and his superior ordered him to remove the iron, and use a crowbar. As he stooped to pull out the iron, the superior ordered a car on the other track to "come ahead," and, as the motorman raised himself, he was caught

between the two cars. He heard the order given, but did not know to what car it referred, and the motorman on the other car did not know he was there. Held, that there was sufficient evidence of the superior's negligence on which to go to the jury.—(O'Brien vs. West End St. Ry. Co., 53 N. E. Rep., 149.)

MICHIGAN.—Damages for Personal Injuries—Pleading and Proof—Evidence—Instructions.

1. In an action for personal injuries, the fact that plaintiff's intended marriage had to be postponed on account of the injuries cannot be proved under a general allegation of mental suffering, since it was not a necessary consequence of the injury.

2. It is a violation of this rule to admit evidence of such fact, though the court charges that it "is not, independently, an element of damage, but an element" to be considered as bearing on plaintiff's mental suffering.

3. Manifestations and declarations of present pain may be proved, in an action for personal injuries, to show plaintiff's condition, though they were made long after the accident.

4. One who receives bodily injuries through the negligence of another may, under a general allegation of mental suffering, recover for the shame and mortification of being obliged to use a crutch and a cane.

5. Under a declaration alleging injury to the hip, hip joint, pelvis, and thigh, a resulting trouble to the sciatic nerve may be shown.—(Beath vs. Rapid Ry. Co., 78 N. W. Rep., 537.)

NEW YORK.—1. Evidence—Ejection from Cars—Res Gestæ. In an action for damages for ejection from a street car because plaintiff's transfer check had expired, evidence of statements by a third person to defendant's conductor, that he had seen plaintiff get off one car an onto the next one, is inadmissible as part of the res gestæ.

2. Same—Hearsay.

It is also inadmissible because it is hearsay.

3. Trial—Objections to Evidence—Waiver.

A party does not waive objections to the admission of evidence by endeavoring to rebut it.—(Woods vs. Buffalo Ry. Co., 54 N. Y. Suppl., 735.)

NEW JERSEY.—Death by Wrongful Act—Right of Action—Pleading—Amendment.

1. A father, as such, cannot maintain an action to recover for the loss of services upon the death of his son, caused by the negligence of another. The action to recover pecuniary damages resulting to him by the death of his son is only maintainable, under the death act (1 Gen. St. p. 1188), by the personal representative of the deceased son.

2. After an action has been commenced by the father as such, and declaration has been filed, to which a demurrer has been presented, an amendment to the summons and declaration, substituting the personal representative of the deceased party as plaintiff in the action, under the death act, will not be allowed, because it would be the institution of a new action between different parties, and raising new questions, and would be vexatious, especially if it appear that the statutory period in which the new action could have been brought has expired. By such an amendment the defendant would be deprived of a plea which it could have if the action was commenced in the name of the personal representative of the deceased.—(Fitzhenry vs. Consolidated Traction Co., 42 Atl. Rep., 416.)

NEW YORK.—Injuries to Persons in Street—Negligence.

1. A street car on a populous street ran over a four-year-old boy, who started to cross the street when the car was 100 or 125 ft. away. The car was going down a steep grade at about twenty miles an hour. The usual rate of speed of a car was eight or ten miles an hour, and, traveling at such rate, it could be stopped within 20 ft. As the boy began to cross the street, a person in an adjoining house and passengers in the car screamed, and the motorman looked at the house, then at the passengers, and then began to stop the car, which was 40 ft. away from the boy, but its speed was such that he was unable to bring it to a standstill until the boy had been run over. Held, that the question of the motorman's negligence was for the jury.

2. Same.—It was the duty of a motorman to keep the car under such control as to be able to bring it to a standstill in time to avoid injury to persons on the street.—(Fullerton vs. Metropolitan Street Railway Co., 55 N. Y. Suppl., 1068.)

NEW YORK.—Directed Verdict—Judgment on Appeal—New Trial.

1. Code Civ. Proc., sec. 1187, authorizes the court to submit issues to the jury pending a motion to direct a verdict, and thereafter direct such verdict as either party is entitled to, and on appeal requires judgment to be entered in favor of the proper party. Held, that where there were erroneous rulings on the trial, duly excepted to, the Appellate Division would not render judgment on appeal, but would order a new trial, as authorized by section 1317.

2. Same.—Where the court properly submitted the question of negligence and contributory negligence to the jury, and directed it to assess plaintiff's damages, and such issues were found in plaintiff's favor, it was error to direct a verdict for defendant.

3. Witnesses—Impeachment—Evidence.—A policeman made a memorandum of an accident he had seen, which he gave to the desk sergeant, who entered its substance in a blotter. In an action based on the accident, the policeman testified that, after being subpœnaed, he asked the sergeant to read the entry to him, and that it was correct. Held, error to refuse to allow witness to read the entry, and state whether it had been correctly read to him, where it differed materially from his testimony; and this, though the original memorandum was not produced.

4. Same.—In an action based on an accident, a police desk sergeant testified that just before the trial the policeman who had reported it asked him to read his report to him. Held, error to refuse to allow witness to state whether he read the report to the officer correctly; the latter's testimony concerning the accident differing materially from his report, and he having also testified that the sergeant read the report correctly.—(Sullivan vs. Metropolitan St. Ry. Co., 56 N. Y. Suppl., 88.)

NEW YORK.—Infants—Loss of Wages—Right to Damages.

1. An infant cannot recover damages for the loss of wages unless he has been emancipated.

2.—Same—Allegation of Emancipation.—An allegation in a petition by an infant for the appointment of a guardian ad litem, that deponent "is unable to perform any work, and has been seriously injured and damaged," is not an allegation of emancipation, evidence of which entitles the infant to damages for loss of wages.

3.—Evidence—Pleadings.—The allegations in a pleading are not admissible as evidence in favor of the pleader.

4.—Judgments—Conclusiveness—Parties in Different Capacities.—A judgment in favor of an infant for damages for loss of wages in an action by his father as guardian ad litem is not conclusive against the individual right of the father to recover for the loss of the same services.

5.—Appeal—Remittitur.—Where a judgment in favor of an infant contains an improper element of damages, consisting of loss of wages, and the amount of such item clearly appears, he will be allowed to enter a remittitur.—(Lieberman vs. Third Ave. R. Co., 55 N. Y. Suppl., 677.)

NEW YORK.—Collision—Negligence—Presumptions.

1. A passenger in a street car, suing for injuries caused by a collision between it and the car of another railroad company, must prove that such other company was negligent, as its negligence will not be presumed merely from the happening of the collision.

2. Same—Appeal—Instructions—Error Cured.—Error in charging that the happening of a collision between defendant's street car and the car of another, in which plaintiff was a passenger, makes it incumbent on defendant to prove that it was not negligent, is not cured by the granting of a request to charge that the mere fact that defendant's car struck the blow does not prove negligence on its part.—(Falke vs. Second Ave. R. Co. et al., 55 N. Y. Suppl., 984.)

PENNSYLVANIA.—Boarding Car — Negligence.—While a street car which had reached the end of its run was being prepared for the return trip, a person mounted the running board before the barrier preventing him from entering on that side had been removed, and was struck by a car on the other track. Held, that the company was not negligent in failing to provide against such an act.—(Malpass vs. Hestonville M. & F. Pass. Ry. Co. et al., 42 Atl. Rep., 291.)

PENNSYLVANIA.—Collisions — Contributory Negligence.—One who drives at a trot upon an electric railway crossing, without slowing up and looking for a car after obstructions preventing a view from the house line are passed, cannot recover for injuries caused by a car, though it was negligently operated.—(Darwood vs. Union Traction Co., 42 Atl. Rep., 290.)

PENNSYLVANIA.—Negligence—Personal Injury—Instructions.—Where the accident on which an action for a severe injury is founded was apparently trivial, and did not indicate that serious results would follow, and no notice thereof was given to defendant until the action was brought, a year and a half later, it is a case calling for full instructions as to the duty of plaintiff to make out affirmatively every element essential to recovery.—(Cooley vs. Philadelphia Traction Co. et al., 42 Atl. Rep., 288.)

PENNSYLVANIA.—Accident to Conductor—Master's Duty to Instruct—A street car company is not bound to instruct a conductor of nine years' experience, when taking out for the first time an open summer car, with a running board on the side, whereby it was extended nearer cars on the other track, of the danger of being struck by such cars while on such board.—(Fletcher vs. Philadelphia Traction Co., 42 Atl. Rep., 527.)

PENNSYLVANIA.—Accident to Child—Question for the Jury—The question of negligence is for the jury where a child of six years old, who had been playing on a lot abutting the street, known to the motorman to be a usual playground for children, immediately before the accident ran from a point 40 ft. from the curb line to and upon the street, and came in contact with the car as soon as he reached the track, the distance from the curb to the track being 5 ft., and there being evidence that the car was running at an unusual and excessive rate of speed, by gravity down grade, without the gong being sounded, or other warning being given; that, if the electric current had been used, the car could have been stopped inside of 10 ft.; and that the boy was struck by the front of the car.—(Walbridge vs. Schuylkill Elec. Ry. Co., 42 Atl. Rep., 689.)

PENNSYLVANIA.—Collision—Car and Runaway Team—Negligence—There is no evidence of negligence of the motorman of the street car, with which plaintiff's runaway horse, which he was driving, collided, where it only appears that plaintiff, when 60 ft. or 80 ft. from the crossing, shouted to the motorman to stop his car, and that the latter, who had started to cross, without coming to a full stop at the crossing, proceeded to cross the street, either not hearing plaintiff, or electing to do otherwise than he said.—(Phillips vs. Peoples' Pass. Ry. Co., 42 Atl. Rep., 686.)

MISSOURI.—Ordinance—Creation of Civil Liability—Pleading—Verdict.

1. The violation of a municipal ordinance, regulating the running of street cars, resulting in an injury to a passenger, cannot be made the basis of a civil liability by a mere allegation that such ordinance was in force and binding on defendant, since it must be alleged and proven that defendant agreed to be bound by the ordinance.

2. Where a complainant combines a good cause of action with an invalid one, and the court instructs that he can recover on either, the verdict must be set aside, since it cannot be distinguished whether the verdict rests on that for which there was no legal foundation, or otherwise.—(Byington vs. St. Louis R. Co., 49 So. W. Rep., 876.)

MISSOURI.—Cable Cars—Negligence of Gripman—Jerks—Imputed Negligence—New Trials.

1. A complaint setting forth as the negligence the act of the gripman of a street car in negligently operating the grip iron so as to cause the car to jerk with such force that it broke plaintiff's hold, and threw him on the street with great force, limits plaintiff to proof of the specific negligence averred.

2. Evidence that plaintiff was thrown from a cable car by a jerk of the car caused by some action of the gripman, without showing what the gripman did, or how he caused the jerk, or that he caused it at all, is not prima facie sufficient to submit to the jury the question of the gripman's negligence.

3. The fact that a cable car gave a sudden jerk, throwing plaintiff from the running board, is, per se, insufficient to make the company liable.

4. It appearing that jerks in the running of cable cars are unavoidable, because of the slack in the rope, negligence will not be imputed to the company merely because of such a jerk.

5. A verdict rendered for the right party, though under erroneous instructions, should not be disturbed by the trial court.—(Bartley vs. Metropolitan St. Ry. Co., 49 S. W. Rep., 840.)

NEW JERSEY.—Damages for Personal Injuries—Where the plaintiff claims that a nervous condition has resulted from an accident for which the defendant is responsible, the defendant may show the existence of a fact, other than the accident, from which it may reasonably be inferred the nervous condition has sprung.—(Mullin et al. vs. Consolidated Traction Co., 42 Atl. Rep., 764.)

NEW JERSEY.—Electricity—Live Wire—Injury—Question for Jury—Evidence—Physicians—The plaintiff picked up a wire that was lying in a public highway, and was injured by an electric current. He brought suit against the telephone company, whose wire it was, and against the trolley company, whose current, it was contended, did the harm. Held:

1. That the question whether the lineman of the telephone company had been reasonably diligent in discovering the fallen wire, and in preventing probable injury, was properly left to the jury. Also, that:

2. Whether the failure of the trolley company to use guard wires was negligence by which the plaintiff was injured was for the jury.

3. Testimony that a witness had certain uses of his hand, after an accident somewhat similar to the plaintiff's was properly excluded.

4. If the plaintiff used reasonable care in the selection of a reputable physician to cure his injury, he cannot be kept out of damages because with a better physician he would have had better results.—(New York & N. J. Teleph. Co. et al. vs. Bennett, 42 Atl. Rep., 759.)

NEW JERSEY.—Injury to Passenger—Presumption of Negligence—In a suit brought against a street railroad company by a passenger for injuries caused by the derailment of the car, proof of the happening of the accident is sufficient to charge the company with negligence, and to place upon it the burden of showing that the injuries were not received through any fault on its part.—(Bergen County Traction Co. vs. Demarest et al., 42 Atl. Rep., 729.)

NEW YORK.—Injuries to Passengers—Exemplary Damages—Evidence—Before a passenger in a street car could take her seat she was thrown on the floor and injured by the sudden starting of the car, or the speed at which it was run around a curve. The officers of the company did not direct the starting of the car in such manner, nor did the conductor and motorman intend to injure the passenger. Held, insufficient to justify an award of exemplary damages.—(Wigton vs. Metropolitan St. Ry. Co., 56 N. Y. Suppl., 647.)

NEW YORK.—Instruction—A requested instruction, "If you believe that the occurrence did not happen as plaintiff described it, then your verdict must be for the defendant," is too broad, requiring a verdict for defendant if some essential detail was incorrectly stated by plaintiff.—(Bendit vs. Third Ave. R. Co., 56 N. Y. Suppl., 789.)

NEW YORK.—Bicyclists — Collisions — Contributory Negligence—An expert bicyclist, familiar with the streets and the dangerous situation into which he was riding, was following a downtown car, and when it stopped he turned out and passed it, crossing to the opposite track, and was struck by an uptown car, which, when he turned out, was only 25 ft. away. Held, that freedom from contributory negligence was not shown.—(Cardonner vs. Metropolitan St. Ry. Co., 56 N. Y. Suppl., 500.)

NEW YORK.—Injury to Person on Track—Where a woman, in full possession of her faculties, with an unobstructed view of a street railroad track for several blocks, glances up and down the street from the sidewalk, and then walks slowly upon the track, with an approaching car fully in view, and is run over, she is guilty of contributory negligence.—(Hickman vs. Nassau Elec. R. Co., 56 N. Y. Suppl., 751.)

PENNSYLVANIA.—Injury to Bicyclist—Negligence—A boy on a bicycle turned a corner, and in passing around a wagon, which stood between the curb and the defendant's tracks, struck a car which was approaching on a track so close to the wagon that there was no room for the bicycle to pass between. The motorman had his head turned, looking for people approaching from the opposite direction, but the bicyclist could not have been seen until he rode past the end of the wagon, when the car was so close that it would have been impossible to stop it in time. Held, that the motorman was not negligent.—(Gould vs. Union Traction Co., 42 Atl. Rep., 478.)

UNITED STATES COURTS—(WISCONSIN).

Collision with Bicycle—Negligence—Plaintiff, who was deaf, was riding a bicycle, and crossed one of the two parallel tracks of an electric street railroad, not more than 50 ft. in front of an approaching car, and, turning, continued in the same direction the car was moving, riding in the space between the two lines, which was 4 ft. wide. Not exceeding twenty seconds later his arm was struck by the passing car, and he was thrown from his bicycle and injured. The motorman on the car turned off the current when he saw plaintiff start across the track, but turned it on again when plaintiff had crossed, though he continued to sound his gong until the accident occurred. He had no knowledge of plaintiff's deafness. Held, that, giving plaintiff the benefit of the broadest construction of the qualification of the rule as to contributory negligence, which would permit him to recover notwithstanding his own gross negligence, if defendant might, by the exercise of reasonable care and prudence, have avoided the consequences of such negligence, there was nothing in the evidence to charge the defendant with liability, as the motorman was justified in supposing that, after having crossed in safety, plaintiff would keep at a safe distance from the track until the car passed.—(Nein vs. La Crosse City Ry. Co., 92 Fed. Rep., 85.)

NEWS OF THE MONTH

The original design for the tickets to be used by the Indianapolis Street Railway Company when the new four-cent fare arrangements go into effect, was not acceptable to the city authorities because it bore the words "Not good if detached." The company thereupon yielded the point and all tickets will be so worded as to be good when detached and tendered by any person to a conductor, and will entitle the possessor to transportation and a transfer to any line and to all other privileges the same as if a cash fare had been paid.

The April issue of the "Technology Review," the new magazine devoted to the interests of the Massachusetts Institute of Technology, contains articles on "Applied Science and the University," by James P. Munroe; "Institute Men in the Spanish War," several papers upon the institute facilities and athletic and other interests, and 1 any notes of much interest to graduates and undergraduates.

After a long discussion with the city officials, the Indianapolis Street Railway Company has finally been granted a new franchise, its old one having expired. The new franchise is for thirty-four years, and under it the company is to pay the city $1,160,000 in cash in instalments, and is to sell six tickets for a quarter, and twenty-five tickets for one dollar, all tickets to have transfer privileges. The company is also compelled to bear the cost of paving between the tracks and for 18 ins. on either side.

It is stated that about 318 cars, including regular bridge cars and trolley cars, pass over the Brooklyn Bridge every hour.

The New York, New Haven & Hartford Railroad Company has decided to extend immediately the third rail electric system on its Plymouth division from Nantasket Junction to Cohasset, a distance of about 3½ miles.

The power station of the Huntington Railroad, of Huntington, L. I., is one of the first street railway plants to be operated by gas engines. This road is 3 miles long, operating one car in winter and three cars in summer. As there is a steep grade on the line, the load is, of course, an extremely variable one. The power-house equipment consists of two Westinghouse, three-cylinder vertical gas engines, each of 50 nominal h.p., taking their gas supply from the adjacent works of the local gas company. Each engine is belted to a 27½-kw. Westinghouse four-pole, 550-volt generator. A storage battery of 265 cells is used to equalize the load. It is stated about 46 cu. ft. per car mile of gas is used. The car mileage is about 200 miles per day.

The International Traction Company, recently formed to purchase and consolidate the Buffalo and Niagara Falls street railway properties and others in Western New York, has organized, with W. Caryl Ely, of Niagara Falls, as president; Daniel S. Lamont, President Cleveland's former Secretary of War, as vice-president, and Bi rt Van Horn as general manager. The new company has assumed control, and is now operating, the Buffalo and Niagara Falls street railway properties, the Buffalo & Niagara Falls Electric Railway, the Buffalo & Lockport Electric Railway Company, and others.

The Board of County Commissioners at Indianapolis has reduced the proposed charges set out in their schedules by the several interurban electric railways leading out of that city and across the county to one and two-fifths cents per mile.

By an order recently promulgated by the War Department, provision is made for the extension of the legal effect of any present or future United States patents to Cuba, Porto Rico, the Philippine Islands, and any other territory subject to military government by the forces of the United States. The order also applies to trade marks. By observing certain formalities the necessary record can be effected.

The convention of the Amalgamated Association of Street Railway employees will be held in Louisville some time in May, 1899.

The Sandusky, Milan & Norwalk Electric Railway Company, of Sandusky, Ohio, has restored the wages of conductors and motormen to 15 cents per hour from 12½ cents, the rate at which the men worked during the winter.

A bill authorizing the sale of property left in street surface railroad cars, and the disposition of the proceeds for the benefit of any of the employees and societies existing among the employees of the corporation has recently passed the New York State Assembly.

The Mahoning Valley Street Railway Company, of Youngstown, Ohio, has made an increase in wages in all departments. Motormen and conductors will now receive 14, 15, 16 and 17 cents per hour, according to class.

The Third Avenue Railroad Company has built a temporary track through 125th Street, and will operate this line with horses until the new electric conduit construction is completed. It has been found necessary to take out all the old cable construction on this line, including the yokes.

The Cincinnati Street Railway Company, of Cincinnati, Ohio, is planning to greatly enlarge its shops, so as to enable it to build all its own cars.

Several new cars, including a mail car, are being built in the shops of the Rochester Railway Company, of Rochester, N. Y.

It is stated that the experiment of giving vaudeville shows on special cars while en route will be tried in Brooklyn, N. Y. The car will be extra long, and at one end will have a small stage. At the other end will be a diminutive smoking apartment. The fare on this car will be 25 cents.

The Milwaukee Electric Railway & Light Company claims that it is losing thousands of dollars a year through the illegitimate use of transfers by the public, and a bill has been introduced in the Wisconsin Legislature providing that persons convicted of selling or giving away their transfers shall be fined from $5 to $10.

All of the city and suburban lines of Wheeling, W. Va., were tied up for several days recently owing to a strike of the conductors and motormen. The men demanded nine hours a day, at 20 cents an hour, and a recognition of the union. Much rioting and disorder attended the strike.

It is proposed to hold a World's Fair in the city of St. Louis in 1903, celebrating the centennial of the Louisiana purchase, and it is intended to make this exposition second to none in history. The project involves the organization of a stock company with a capital of $5,000,000, and with a par value of $10 per share. A popular subscription is invited, the first payment to be 5 per cent, and no subsequent calls for payment to be made exceeding *in toto* 20 per cent of the amount subscribed. All subscriptions are contingent on the securing of at least $5,000,000 in all, and except for the first payment of 5 per cent, no further calls on subscribers will be made until the aggregate subscriptions amount to $5,000,000. The city of St. Louis proposes to help the enterprise by increasing its bonded indebtedness $5,000,000, and the National Government will be asked for a loan of $5,000,000, and the State of Missouri for a loan of $2,500,000. It is believed that with the $17,500,000 thus secured an exposition will be obtained rivaling that of Chicago, where the total expenditure, before the opening of the gates, amounted to $18,600,000.

An interesting decision has recently been handed down by the Supreme Court against the Nassau Electric Railroad Company, of Brooklyn, affirming that street railway companies are liable for accidents caused by falling trolley wires, even though it has not been proven that the company was negligent.

Foreign Visitors in America

During the month of April several British engineers have visited the United States on tours of inspection of electric railway work. Among them was Prof. A. B. W. Kennedy, one of the most prominent of British electrical engineers, who is consulting engineer for the London County Council with special reference as to whether or not the underground electric conduit system is practicable for the conditions found in London. Prof. Kennedy in pursuance of this investigation visited New York, Hartford, Boston, Schenectady, Buffalo, Niagara Falls, Chicago, Pittsburgh, Washington, Baltimore and Philadelphia, on a flying trip extending over but two weeks, and at its conclusion expressed himself as very much interested in what he had seen. Accompanying Prof. Kennedy was E. W. Monkhouse, an electrical engineer of London, who desired to make a careful investigation of electric

railway practice in this country in behalf of other clients. On April 13, Dr. Edward Hopkinson, managing director of Mather & Platt, Ltd., and Bertram Hopkinson, nephew of the late Dr. John Hopkinson, arrived in New York, and are now making similar investigations in various cities of the United States with a view to acquiring a general understanding of the best American practice in electric railroading. They expect to return in May.

New Manufacturers of Electric Railway Apparatus in England

Dick, Kerr & Company, the widely known railway contractors and manufacturers of England, are at the head of a syndicate which is about to form a company with a capital of £200,000 to carry on the manufacture of dynamos, motors and controllers (for electric railway purposes only) for the British home and foreign trade. The members of this syndicate are Dick, Kerr & Company, Ltd.; John Kerr, George Flett, Claude T. Cayley, Benjamin Sykes, T. S. Turnbull, Richard Prestwich, John Prestwich, George Readman, W. J. Kirk and Sidney H. Short. All except Mr. Short's are well known names in British business and financial circles, and Mr. Short has an international reputation as an electrical engineer and designer of electric railway apparatus through his connection with the Brush Electric Company, the Short Electric Railway Company, and the Walker Company, and through the many papers which he has contributed to scientific bodies on electrical engineering matters. The name of the new company is not yet determined upon, nor its officers selected, but Mr. Short will be in charge, as technical director, of the design of the machinery to be built by the new company.

It will be remembered that not long ago the Electric Tramway & Carriage Company, of Preston, Eng., was organized by another syndicate headed by Dick, Kerr & Company, and a large factory was constructed in Preston. Opposite this factory, a tract of 11 acres of ground has been secured as a site for the new railway motor and generator works, and the foundations are now under way for buildings which will cover about 4½ acres of this plot. The main machine shop will be 900 ft. x 120 ft., and in connection with this will be a foundry 400 ft. x 80 ft., together with pattern shops, offices, store rooms and other buildings usual with a plant of this kind. Electric power will be used throughout the works for running all machinery, and the capacity of the shops is expected to be 1200 equipments per annum of motors, and 30,000 kw. of generators. The buildings will have a steel framework with brick facings, and it is expected that the works will be in full operation by Jan. 1, 1900.

Mr. Short has engaged S. B. Fortenbaugh to go with him across the water as technical assistant, and it is the purpose of the syndicate to engage in America the principal superintendents needed for the new operations. On April 13, Messrs. Flett, Cayley, Turnbull and Short arrived in New York, via S. S. Teutonic, in order to make these engagements and to purchase the machinery and possibly the structural material for the new works. Contracts for at least $120,000 worth of machine tools will be placed in America, and orders have already been given to E. W. Bliss & Company for the presses, and to the Kemp-Smith Company for milling machines, and the remaining orders will be placed before May 6, when the entire party sails from New York for Liverpool. Orders for the engines were placed in England with the Musgraves, of Bolton.

The well known energy and indefatigable determination of Dick, Kerr & Company in pursuit of electric railway business in Europe have won them hosts of friends, and there is no question about their ability to fill their new electric railway works to overflowing with orders. One of the interesting features of the entire transaction, and one characteristic of British quickness to take advantage of opportunities for investment is found in the fact that the entire capital for the construction of the works, £200,000, was subscribed in about thirty minutes, and no subscription of less than £10,000 was accepted, while the desire to obtain larger amounts than could be alotted was urgent.

One of the unpleasant features about this new enterprise is that Mr. Short's friends in America will lose him for several years at least, as in pursuance of his contracts with the new company he will have to take up his residence in England. He returns with Mrs. Short to England on May 6, as stated above, and will shortly be followed by the remainder of his family. He has leased for several years a beautiful house and estate in Weybridge, one of the most charming of London's suburbs, and has been fortunate in securing one equipped with all the modern improvements, including a system of heating by hot water, a rare thing to find in England.

Municipal Ownership in Detroit

In March last, H. S. Pingree, Governor of Michigan, affixed his signature to the so-called "McLeod" bill, thus creating it a law. This bill gives the city of Detroit the power to acquire and operate all the street railway lines in that city and gives the conditions under which they are to be so acquired. As is quite generally known, municipal ownership is one of the pet theories of Governor Pingree, and he has been endeavoring for a number of years to put his opinions into actual practice. To this end about a year ago he opened negotiations with T. L. Johnson and R. T. Wilson, the holders of a majority of the stock of the Detroit street railway properties looking to the transference of the roads to the city at a price to be decided by a commission. The new bill is the result of these negotiations.

There are twelve sections in the bill and its provisions are briefly as follows: The Common Council of the city of Detroit is authorized to appoint three persons who shall constitute a board of commissioners to be known as the Detroit Street Railway Commission. One of these commissioners shall be appointed for a term of two years, one for a term of four years and one for a term of six years. At the expiration of each respective term, the Mayor shall appoint the succeeding commissioner for the term of six years. The bill expressly provides that no alderman shall be appointed on the commission. Before entering upon the duties of their office, the commissioners are severally required to execute a bond to the city of Detroit in the sum of $250,000 to secure the faithful performance of their duties. This commission, with the consent of the Common Council, is empowered to construct, operate and maintain, lines of street railway, to carry passengers and freight and to use the earnings of the road to that end. The commissioners are also empowered, if in their opinion it is deemed necessary, to issue bonds in the name of the city for such amount as may seem proper, the sum to bear interest not exceeding 4½ per cent per annum, and to be payable thirty years from date in gold. The bonds will not, however, be a charge against the city or the property of its taxpayers, but the commission will pledge for the payment of the bonds all assets and property connected with or relating to the line of the street railway constructed by said commission, and as additional security the commission is authorized to grant to a trustee a franchise to maintain and operate said line of railway for a term not to exceed fifty years and on such conditions as said commission shall deem proper. The rate of fare over a single line shall not exceed five cents for a single fare, and six tickets must be sold for twenty-five cents. In addition to this, the workingmen's tickets (at eight for twenty-five cents), already provided for by a street railway ordinance, will be maintained.

The franchise to be granted to the trustee shall be of no force except in the event of the default of the commission or said city in the payment of the bonds. In the event of such default the franchise is to be transferred to a corporation to be organized by the holders of the bonds and all rights, powers and benefits guaranteed by the franchise shall inure to the benefit of the holders of the bonds.

The bill expressly provides that the commissioners may purchase the present street railway lines in the city and may issue bonds to the necessary amount to pay for the same. These bonds are to bear interest at a rate not exceeding 4½ per cent per annum and to be made payable not more than thirty years from date. These bonds also will not be a direct charge upon the property of the taxpayers, but will be secured by the net earnings and tangible assets and property of the street railway lines purchased, and, in addition, by a franchise granted under similar conditions as mentioned above.

The three commissioners appointed are Governor Pingree, Carl E. Schmidt and E. G. Stevenson.

The price to be paid for the present street railway lines has not yet been fully settled. The companies are bonded for $11,000,000. It is estimated, however, that the system can be duplicated for about $5,000,000 at present prices. It is thought that the city will pay about $12,000,000 for the properties.

Late in April it was announced that a technical flaw had been discovered in the McLeod bill, and that the law would be declared null and void. It is claimed that the engrossed bill does not contain a clause which was in the original; namely, "Providing that nothing in the act shall affect the granting of franchises by the City Council." Governor Pingree thinks that this omission will not invalidate the law, but it is stated the street railway companies will make the alleged discrepancy a strong point in the proceedings they are about to bring in the courts to test the act.

Messrs. Issigonis and Piltacos, of Smyrna, have been granted a franchise for the construction of a railway in that city.

Some of the Larger Transportation Problems in Cities*

BY EDWARD E. HIGGINS

The managers of a large city railway system are constantly called upon to deal with problems of great difficulty and complexity. They have a double responsibility—a responsibility to the public and a responsibility to the investors of whose interests they are trustees. They are charged with the management of thousands of employees whose attitude toward the enterprise, whether of content or discontent, is of vital importance to its success. They must pass upon inventions and improvements in the science of municipal transportation, determining where costs and true economy join hands; they must adopt operating methods adequate to the development of the system and of the city which it serves; they must care for the comfort and pleasure of the public, and they must so unify all of these varied and sometimes conflicting duties as to develop an organization and management successful as a whole and not unduly weak in any part.

Grave misunderstandings often arise between street railway companies and the public. The people often believe the companies to be grasping, sordid, careless of their duties as public carriers, and desirous only of making the largest possible return to stockholders. The companies, on the other hand, daily harrassed by complaints about inconveniences suffered, small or large, often come to regard the public as unreasonable in its demands, forgetting that that public is not in a position to see all the difficulties and perplexities which beset the management at every turn, and which make it often impossible either to grant such demands or to explain why they cannot be granted. The street railway business as a whole is so complicated and so much a matter of detail that no one department of it can be well understood without some knowledge of the others, and fragmentary or partial explanations of the reasons for specific decisions, however sound in their relationship to the general plan of management, might not always or often appear so to non-technical critics.

I shall attempt in the following discussion to give such an explanation of the entire scheme of modern street railroading on its broad lines and of the principal problems which the manager has to solve as will lead to a clearer understanding by those who are not of "the faith" of what the public has a right to expect from the street railway companies, which are its servants and which are, as a rule, honestly trying to fulfill all the obligations which can reasonably be imposed upon them.

ESSENTIAL DIFFERENCES BETWEEN CITIES

In the first place, it cannot be too clearly made evident how different are the transportation conditions in each city from those of any or all other cities. Nothing can be more fallacious, or lead to greater injustice, than to say that because such and such concessions are granted by the companies to the people of a certain city, therefore, similar ones can and should be made in another city. The most common error of all, perhaps, is to assume that the conditions found in a small city obtain in a large one or vice versa. Population and population density have an enormous influence on street railway earnings, profits and possibilities of generosity. A second even more common error is to hold that as much ought to be expected from an old company which has passed through one or more experimental stages of street railroading and has had to throw away enormous investments for antiquated motive powers and to purchase their substitutes at high initial prices, as from a new company just entering the field, with all the accumulated experience of many years to draw upon, and with the benefit of the low prices for material and supplies of the present day. Behind these more obvious injustices come others less easy to understand without some technical exposition. How, for example, can a manager satisfactorily explain to the public the reason why the people of his city patronize their street railway system to the extent of only $3 per capita per annum, while in another city of the same population, the earnings are over $5 per capita? When the generosity of the richer system is cited as a precedent for the poorer to follow, it is a delicate matter to show that the latter's public is largely composed of the working classes to whom the daily five or ten-cent fare forms a material burden, or a difficult one to make clear that the plans on which the two cities are laid out are radically different, the one calling for greater patronage of street car lines than the other, without necessarily involving greater expense to the operating company. A knowledge of these differences in city plans and lines of development is so essential to the understanding of the theory of street railroading that a brief explanation of their effect upon earnings is desirable.

The world's great cities are, with scarcely an exception, built upon or around some form of water front—sea, lake or river. Upon some section of this water front is always found the "congested district" devoted to commercial and business purposes. The manufacturing districts of a city may or may not be on this water front, according to the location of the railroad termini and branches, the presence or absence of rivers tributory to the main water front, and other governing conditions. All, or nearly all cities are laid out and developed on one of four distinctive plans; first, the peninsula plan, such as that of New York city (Manhattan Borough) and San Francisco; second, the valley plan, with a river or rivers running through the center, such as Pittsburgh; third, the radiating plan, with territory on one side only of water front, such as Chicago, Boston, Brooklyn and many other cities, and fourth, the radiating plan with territory on both sides of the water front, of which examples are found in Metropolitan New York (including Eastern New Jersey), Paris, London and many other cities, large and small.

The peninsula and valley plans usually call for comparatively small street railway track mileage, and great traffic density is found on that mileage, together with large gross earnings per capita served, per mile of track and per car mile. For example, the complete transportation system of New York city proper (Boroughs of Manhattan and the Bronx) earns about $13 per capita gross, and that of San Francisco nearly $14. The radiating plans mean greater street railway mileage for the population served, and usually a much less density of traffic and less gross receipts per capita. The Chicago surface and elevated lines, for example, earn less than $10 per capita, and the surface lines of St. Louis hardly $8 per capita.

It can be easily seen how different, for example, is the transfer problem in a peninsula and valley city from that of a radiating city. In the former there may be a few through lines of heavy traffic with many cross-town feeder lines. Transfers in such a city might mean no additional expense to a company and little or no complications. In the radiating city, on the contrary, a transfer system might mean a ride of great length, while the plan of the system might be such that dishonesty in the use of transfers would be easily possible.

Again, a city plan very favorable to economical operation might make a four-cent fare possible in a given city, while in another city, even of the same population, such a fare would mean bankruptcy. A city system of large track mileage running many cars might have immense maintenance accounts to deduct from earnings, whereas a more fortunate one in another city would have a great traffic density on small mileage. All that a comparison of practice between the street railway systems of two cities can do, therefore, is to put the burden of proof upon the system which is apparently less generous with the public of showing why the more generous practice cannot be followed, and the company's argument should be received with attention and respect; for, after all, nothing is more certain than that the best reasonable service of the public will bring about the largest earning power to a street railway company, and none is more quick to recognize this fact than the average street railway manager.

THE FUNCTION OF ELEVATED AND UNDERGROUND RAILWAYS IN CITY TRANSPORTATION SYSTEMS

The question of adding to existing facilities or solving difficult congested district problems by the building of elevated or underground railways is facing the managers of several of the principal cities of the world, and it is a serious one indeed. The enormous cost of tunneling, and the hardly smaller combined investment required for building an elevated structure and paying damage claims to abutting property owners, leads, and will lead to a postponement of the issues as long as possible. The great tunnels of Paris are an immense burden upon French taxpayers, while private capital cannot hope to make a success of tunnel enterprises except in countries where rates of interest are extremely low, and even then the public must usually be called upon to help by special concessions or subsidies of one kind or another. The London Metropolitan underground system is a failure financially, partly because of its immense cost and partly because it was not properly laid out to obtain the greatest density of traffic. It is hoped that the new Central London Underground will be more successful, being comparatively short and built under one of the heaviest traffic routes of that great city. Private capital has so far shown very little enthusiasm for an underground railway in New York city, where, if anywhere in America, such a railroad should prove profitable.

The elevated railway system of Manhattan Island has been in the past exceedingly profitable, chiefly because it is built in a "peninsula city" *par excellence*, where an immense tide of travel sweeps south in the morning and north at night along few and narrow lines, but the fact that through all these years until the present time, the New York elevated lines have had as competitors only

* Lecture delivered before the Franklin Institute of Philadelphia, Pa., March 28, 1899.

comparatively slow-moving horse cars, has been almost equally potent in affecting profits, since short distance as well as long distance travelers have been obliged to use the elevated when time is an object. Elevated railroading in the two "radiating cities" of Brooklyn and Chicago has been distinctly unprofitable. In cities of this class it is difficult or impossible to find the density of traffic necessary for the payment of operating expenses and interest upon the heavy capital outlay required. This is particularly true where the surface cars are run at frequent intervals and at high speeds, for the latter will inevitably obtain the short distance, or more profitable class of traffic, leaving the long distance, or unprofitable class only to the elevated lines. Moreover, in cities of the radiating class, the population is usually spread out over so large an area as to make it impossible for any one line to obtain a large proportion of the traffic. The adoption of electricity on the elevated lines of Chicago has favorably affected gross and net earnings, and with the scaling down of capitalization which has recently been accomplished, there is a possibility that a reasonable return on the new capitalization can be made if new competitive conditions do not arise; a similar result is hoped for in Brooklyn. It is by no means improbable, however, that the only permanent solution to the problem of running surface, elevated and underground railways in the same city is to have them under one control and management, so that the surface lines can serve as feeders to the elevated or underground lines, an express service only to be given on the latter, and a fare charged for the combined service somewhat greater than the single five-cent fare.

In the congested districts of our principal cities, elevated or underground lines, either, or both, will find a true and valuable field. The business sections of Chicago and Boston furnish problems of the most serious and complicated character, which are only partially solved at present, and are likely to grow graver in geometrical ratio as the years go on, and as the territory tributary to the business centers increases in area and population. It is probable that the only permanent solution to congested district problems in cities lies in subway or tunnel lines and loops in these districts. These will take from the surface of the streets the enormous crowds of people which at morning and evening hours of the day pour into and out of the tall buildings which have become so necessary an evil in the modern city business districts. Boston's new subway is a decided, though not as yet a complete, success in relieving congestion and saving time throughout a large portion of the twenty-four hours. The new Boston elevated lines at present under construction will be of great assistance in this congested district, passing as they do from its limits on the north and west (the latter projected) to those on the south, and the managers of the great city railway property in Boston have done wisely in confining these elevated lines to the congested district and not carrying them to a greater distance away from the business center. In Chicago, the loop terminal of all the elevated lines, recently put into operation, has been a great convenience to the people, and has added largely to the traffic, but it is a question if it has not even so soon nearly reached its train capacity, particularly on days of its heaviest traffic, for on a recent holiday, no less than 65 per cent of the trackage on one of the loop lines of the structure was covered by trains, i. e., they were less than a train length apart on an average.

THE PROBLEM OF MOTIVE POWER

No decisions which street railway managers have been called upon to make during the past ten years have caused them such anxious solicitude, and have meant so much to the public and to stockholders, as those connected with motive power. Ten years ago horse traction was almost universal, with the cable in use or building on the heavy traffic routes of a few cities, and electricity just coming into sight. To-day electricity reigns triumphant, having displaced both horses and cable on nearly all the mileage of American cities. A synopsis of the reasons for this wonderful revolution in transportation methods which has completely changed the complexion of our cities and added new life and vigor to their daily routine, will be of present as well as retrospective interest, inasmuch as the primacy of electricity, and particularly of overhead wire electric traction, is still occasionally disputed.

All motive powers may be divided into two classes, those which make a car a more or less independent unit on the streets, and those which make it constantly dependent on some central source of power. To the first class belong the horse car, the storage battery electric car, the compressed air car, and various forms of gas, stored steam, petroleum and other motor cars. To the latter belong the cable system and the electric overhead wire and conduit systems.

Independence in the car unit is a highly desirable thing. With it comes minimum disturbance of the pavement or obstruction in the streets with minimum investment for installation; and with it comes also an avoidance of the danger that the central source of power may give out and stop the entire system or any large section of it for a considerable period. There is no question that a really successful independent unit system would be heartily welcomed by street railway managers, certainly as an auxiliary, and would find a large field immediately ready for occupancy.

But there are serious obstacles to success. It is probably impossible to devise a power generating and using system which will go within the narrow space limits available in a modern popular car, and which shall be capable of exerting as a maximum a power four or five times the average amount required for the propulsion of the car. Such a system can be placed in a dummy car and some room left for passengers as well, but when one or more trail cars are to be drawn, difficulties of traction come up immediately. At all times there is the impossibility of generating power in small amounts with anything like the economy with which it can be generated in large. If power be generated in quantities at some central station and stored in some one of several forms for transfer to and use on a car, that car is quite as surely dependent on the central station as it would be were the power transmitted by wires or cable, and is likely to give even more trouble through the exhaustion of the stored power and the consequent stoppage of the car on the line. Still another difficulty is found with so-called independent car operation (except where electric motors are used as in the storage battery system), and that is the impossibility of producing a rotary motion without the use of an initial reciprocating motion, with all the latter's well known disadvantages in the matter of wear of parts and reduction of tractive effort on grades, curves and in starting. Finally, such disagreeable concomitants as odor, noise, or danger of explosion must be excluded if the independent motor is to be an entire success.

Modern street railroading requires constantly increasing average speeds over city streets without increasing danger of accident. With the short runs between streets and the many stops necessary for taking on and letting off passengers, high average speeds can be obtained only by means of high rates of acceleration in starting, and correspondingly high braking effort in stopping. In other words, maximum speed must be reached as quickly as possible and kept up as long as possible before brakes are applied.

Now, the one propelling agency adapted for this peculiar class of work, so far developed in the entire transportation field, is the electric motor, with its constant rotary effort, or torque, and with its almost infinite capacity for automatically absorbing and transforming electric power into a rotary effort. A little 25-h.p. car motor can be overloaded 100 per cent or more if the occasion requires, and will take power until its wires actually melt in the process. There is no such reserve power in any form of reciprocating motion engine—no such constant torque and no such ease of control. Compressed air, stored steam, gas, petroleum and other motors all have their possibilities of development, mechanically and commercially, and when proven successful in practice on any considerable scale, there will be certain portions of the general transportation field open to them, but it is equally true that the electric motor has intrinsic advantages such that it will never be displaced in street railway service, while it is certain also that it will reach into larger transportation work now performed exclusively by steam locomotives.

Before proceeding further with electric motors, a word should be said about the cable system. It would appear at first sight that here also is found a system which would fulfill the requirement of maximum acceleration and braking possibilities, and consequent high schedule speeds. Maximum acceleration can certainly be obtained with the cable, as has frequently been demonstrated by a surly or incompetent gripman, to the great discomfort of passengers, but no cable line can compete with a parallel electric line in point of schedule speed for the reason that the maximum speed is limited to the speed of the cable, and the latter must be kept down to a point such that slippage through the grip is not continuous. In other words, there is little probability that cable cars, once behind their schedules, can catch up to them unless by rare good fortune in not being required to stop for passengers, while with the electric cars there is always the possibility of flying through the streets in the suburban or less congested streets so as to make up time lost elsewhere. As a matter of fact, the cable is disappearing from American street railroads, partly because it is not popular, as it is found that the people always prefer parallel electric lines because of the greater smoothness in running, and partly because of the greater economy in operation, demonstrated again and again in our leading cities where both motive powers have been used. The cable system is a complicated one with its immensely costly and cumbersome construction, which requires constant care and attention, and it is true, moreover, that a cable line cannot be sectionalized to the extent than an electric line can be done, to the end of minimizing the stoppage of traffic.

Granting, therefore, that the electric motor is the city trans-

portation agency of the present and the future, there remain to be considered the relative advantages of the overhead system, the conduit system and the storage battery system. In spite of numerous attempts to put the latter system upon a commercial basis, it has not yet been demonstrated to the satisfaction of street railway managers that it can be used with economy on a large scale, or that good acceleration and grade climbing work can be done where storage batteries alone are dependent upon for reserve and contingency requirements. The equipment of the Chicago and Englewood Street Railway with storage batteries is about the only ambitious experiment on a scale that is now being tried in this country, but abroad batteries are used quite largely and successfully in what is called the "mixed system," in which the overhead trolley system is used for suburban and outlying lines, and storage batteries for the business centers. The great difficulties in the way of storage battery work for transportation purposes lie in the great weight of the batteries to be transported, the deterioration of the plates, particularly when called upon for the widely varying power requirements of a street car, and the somewhat sluggish action of the cars in acceleration. It is by no means unreasonable to hope, however, that improvements will come in this line such that commercially successful storage battery cars may be made possible.

The central station method of operating street railway systems, particularly by electricity, has many intrinsic advantages. In the first place, power can be generated at such stations in large quantity and at extremely small expense. It is probable that in the largest street railway power station in the world now building in New York, the cost of power will be reduced to three-quarters of a cent per car mile, or less than 8 per cent of the total operating expenses of the system, this cost including all losses of generation, conversion, transmission and reconversion. The inherent advantages and possibilities of electric transmission for power purposes are such that it is difficult to conceive of a more perfect adaptation of means to the desired end. When, however, the matter of transmission is taken up in detail, three methods present themselves for selection, the overhead wire system, the open slot conduit system and the surface contact, or "Button system."

The overhead wire system is the one in almost universal use, and the wisdom of its adoption has been completely justified in a large majority of cases. It is inexpensive to install as compared with the other two systems; it is, when well put up, probably more economical than either, and troubles can be easily located and quickly remedied. Its chief disadvantage from the public point of view is the so-called unsightliness of poles and wires. In the early days of electric traction, there was certainly grave cause for complaint about this feature, but since then the improvements have been so radical that it has no longer great force, while the danger of falling wires and of obstruction to firemen in the discharge of their duty has also been done away with to a very large extent, so that there are to-day as few accidents of any kind from the operation of trolley cars in our principal cities as could possibly be expected in view of the immense number of passengers carried, and the congested conditions of the streets.

The surface contact, or "button system," is not in use on any large scale in this country, but a large installation has just been made in Monaco, which is said to be working successfully. The chief trouble with this system lies in the employment of a great number of pieces of mechanism more or less complicated, and liable to failure, the number usually being 500, at least, per mile of single track. Theoretically, the system is an excellent one and has many points of advantage, but it has not come into common use as yet, and time only will tell whether or not the mechanism can be kept in good working order indefinitely without constant danger of "tie-ups" or delays.

The open slot conduit system is in use in America only in New York city and Washington. In New York it has cost probably ten times as much as an overhead system would have cost to accomplish the same results, and its operating expenses are probably about the same as, or perhaps slightly less than, those of the equivalent overhead trolley system.

The city of Glasgow, Scotland, in common with many other British and European cities, has before it to-day the problem of determining which of these three varieties of electric traction shall be adopted. Glasgow has had some experience with the overhead system, and knows that it is reliable, reasonable in first cost, and economical in operation. The favorable results obtained on the conduit lines of New York, Washington and a few European cities, have been studied in Great Britain and elsewhere with the greatest care and interest, and yet it has been determined in Glasgow and other places to use the overhead system in preference to the conduit. The fact is that it is only in cities where great traffic density obtains, and where the mileage to be equipped is comparatively small, that it is possible to pay interest upon the enormous investment requisite for the conduit system, and this is particularly true if this investment has to be piled up upon that for previous improvements, such as the equipment of horse lines with the overhead system. Moreover, the climatic conditions must be favorable in order that success with any form of conduit system may be assured, and the sewerage system must be perfect, for unless the conduit can be kept perfectly clean and free from snow or accumulations of water, serious electrical troubles will occur, which may tie up a railway in whole or in part. If the street railways in this country now operating on the overhead electric system were compelled to change to the conduit system over their entire lines or any large portion of them, financial ruin would undoubtedly be the consequence.

All these problems of motive power have had to be faced by managers in this country, and are now before the tramway managers of Europe. They are wise in their generation who have looked, and are looking forward to the future of their properties and of the cities in which they are located, and who recognize the importance of the part which local transportation plays in the onward march of a great and constantly growing city. The real interests of the people and of the private capital engaged in street railroading are, or should be, substantially the same. The ideal system for both is one which can be handled with the greatest certainty in operation, and which can be indefinitely extended into suburban territory in advance of population without too great cost and without the necessity of transfers, and which can be built at minimum expense for the advantages given. It cannot be for the public interest to load down street railway companies with constantly increasing burdens, such as the adoption of the most costly forms of motive power, if cheaper would answer the purpose, for by doing so they thus postpone still further the time when any reductions can be made in fares or a system of profit sharing with the city can be established.

THE PROBLEM OF CARS AND CAR SERVICE

Upon the character of the cars and the car service of a street railroad depends largely the gross revenue which will be derived from the public. One of the key notes to success in handling street railway property is to bring about to the greatest possible extent "short distance riding." The number of times that a car can load up and empty itself upon a trip governs the success of that car from a profit-earning standpoint. For this reason it is essential that cars be run frequently enough to make them a convenience to those who would walk were not the opportunity of riding offered on the instant. But on the other hand, the frequency is limited by the number of people who could by any possibility be induced to ride. In practice the manager has to experiment with car frequency until he strikes that which will bring about maximum earnings, and at this point it is not far from the truth to say that the public is well served.

The car service must also be rapid, for the short distance rider takes a car not only because it is right at hand, but also because he can save some minutes in getting to his destination.

The car must be comfortable and well lighted, by windows in the day and by lamps at night, for the further advantage and attraction of the traveling public. Never has there been such attention given to the comfort and convenience of the people as in these days of electric traction. When the investments are large, the business required to maintain that investment must also be large, and the margin between success and failure is so small that an inferior or unpopular service means a loss of business sufficient to turn the scale. In some of the Western cities, St. Louis in particular, where several companies are competing for business in the same territory, there have been developed many novel and attractive types of cars to the advantage of the public if not of the companies. The carrying of traffic is so delicately adjusted in cities like St. Louis that oftentimes the appearance of ten or fifteen new and beautiful cars on a given line has meant an increase in receipts on that line of hundreds of dollars a day, and a corresponding diminution on the lines parallelling it. These other lines, finding it necessary, of course, to get back their traffic, have been forced to order even better and more attractive cars. In the old horse railway days, 12-ft., 14-ft. and 16-ft. closed cars with longitudinal seats, and six or seven-bench open cars with cross seats were in almost universal use, though many railways denied themselves and the public the luxury of the open cars. To-day cars range in length from 20 ft. to 40 ft., and a 16-ft. car looks almost as small and as much out of place as the old 10-ft. and 12-ft. cars of the horse railway era. With these longer cars has come greater steadiness in riding, and trucks have been greatly improved to the end of bringing this about. The West, always in advance of the East in obtaining beauty and convenience in railroad passenger trains, is somewhat in advance of the East also in street railway cars, and in St. Louis, Milwaukee, Denver, San

Francisco and elsewhere, will be found some of the most beautiful travel attracting street cars in the world, with cross seats, center aisles, broad windows, window guards, electric signals and elegant fittings throughout.

Somewhat strangely, perhaps, the almost universal foreign custom of providing roof seats on tramway cars has not been popular in this country, the reason appearing to be that such cars are better adapted for slow speeds than for high, and for countries whose peoples do not place upon time the same value that Americans do, for there is no question that it would be impossible to keep up the present schedule speeds on American street railroads if the cars were obliged to take time to load and unload passengers to and from the roof seats, while the danger of accident to people not used to climbing up and down the stairs while cars are in rapid motion would be considerable.

The manager or employee who lays out the schedules of a street railway has in his hand when doing this work the operating profits of the enterprise. If he is too niggardly with car mileage, he saves a little in expenses, but may perhaps reduce gross income by a far greater sum than the savings. If, on the contrary, he is extravagant with car mileage, he may increase expenses far more than income. The mean is indeed a golden one, and worth a never-ending series of experiments to determine the maximum traffic and profit possible to be derived from any given line. In more than one instance, a languishing or unprofitable enterprise has been turned into a vigorous and profitable one by the mere application of common sense principles to the car service.

THE PROBLEM OF TRACK AND ROADBED

The introduction of longer and heavier cars, a much more frequent service and a self-propelling power which needs to obtain a grip on the rails, has enormously increased the difficulties of the track problem for street railway companies, and on all sides are being heard complaints that joints are wearing out, rails are showing excessive wear in spots, leading to unevenness of track, and that the repairs and depreciation of roadbed for electric traction have been underestimated. The most heavily worked track and special work of the larger cities will stand hardly three years of service, and the life of electric track varies from this period to ten or twelve years as a maximum, according to our present experience. When it is stated that it costs from $10,000 to $25,000 a mile to replace track, it can easily be seen how serious is this problem, and how great a burden upon the finances of a company is the track repair and depreciation account. In the few places where street railway profits seem excessive, therefore, such burdens as these, which are yet, in all their seriousness, of the immediate future rather than of the present, should be remembered.

THE PROBLEM OF FARES

In this country a uniform five-cent fare is almost universal; in other countries a variable fare, based on distance traveled, is equally universal. There is something more than a mere financial policy involved in the discussion of the fare problem. Broadly speaking, a uniform fare means depopulation of the tenement house districts and settlement of the suburbs—means a clean, happy life in purer air and better surroundings—means individual homes and plenty of room for the children. A graded fare means enormous density of population in the heart of the city, scanty suburban settlements, pale faces, sickly children and a miserable home life for the masses. These words are not too strong, nor is the influence of street railway fares upon these living conditions exaggerated. The difference between the street railway track mileage and investment in our principal cities and those of equal size abroad is something amazing. Compare, for example, Brooklyn, Glasgow and Boston, three cities of about the same size. Brooklyn, with a population of about 900,000, within five-cent fare limits, has over 500 miles of track; Boston, with 700,000 population, has 325 miles of track; while Glasgow, with 800,000 population, has but 77 miles of track. The total street railway investment in Brooklyn is nearly $100,000,000, in Boston is over $25,000,000, and in Glasgow less than $4,000,000. The 800,000 people of Glasgow are distributed over but 23 sq. miles of territory, and the population in the city is therefore about 35,000 per sq. mile; Brooklyn's 900,000 inhabitants live in a 45-mile area, and have a population density of but 25,000 per sq. mile, while Boston's 700,000 inhabitants are happy in 122 sq. miles of area, with a population density of but 5700 per sq. mile. Is not the uniform fare principle justified by these figures alone?

For five cents a citizen of Brooklyn may travel more than 10 miles. A citizen of any of our great cities can travel 10, 15, or even 20 miles. In doing so he inflicts a loss upon the company, and if there were a large proportion of the total number of passengers carried who traveled so far, or even 5 or 10-mile distances, our city railway properties would be continually unprofitable and probably insolvent. It is in the short-distance riding that the losses are made up, and it must, therefore, in frankness be admitted that the short distance rider pays part of the fare of him who rides the longer distance. This is an apparent injustice, which cannot, however, be remedied unless the whole principle and policy of American street railroading be radically changed, and the effect of the change would be undoubtedly disastrous from a sociological point of view, tending to check the expansion of cities into the suburbs and increase the congestion of life in the centers.

Is the present five-cent fare too high, and can it be reduced without consequent disasters to street railway companies? Both these questions can be most emphatically answered in the negative. The street railway companies of to-day are giving to their patrons a maximum ride two or three times greater than that given for the same price ten years ago, and an average ride at least 50 per cent greater; they are giving them a speed in transit from 50 to 100 per cent greater, and are providing them with cars cleaner, finer, better lighted, and in all respects superior to the old regime. Is a mere change of motive power from horses to electricity a magical thing that can multiply wealth as by a philosopher's stone and make all things possible? No. The street railway companies of the country are by no means unduly prosperous to-day. In fact, too many of them are struggling under far heavier burdens than ever ought to have been put upon them by the people. In Philadelphia, for example, the right to change the motive power from horses to electricity has been granted on condition that the street railway company shall lay down new pavement and permanently maintain this pavement on over 400 miles of street within the city limits—a condition more onerous perhaps than that ever before laid upon a quasi public industry, and one which will make the payment of excessive dividends or a reduction of fares impossible for many years to come, if not forever. Take twenty of the great street railway properties of the country, none earning less than $1,000,000 gross per annum. Their aggregate capitalization in bonds and stock outstanding is nearly $500,000,000; their aggregate gross receipts are about $67,000,000; their apparent operating expenses (including taxes) are about $42,000,000, or 63 per cent of the gross receipts, and the percentage of apparent earnings from operation amount to barely 5 per cent on the total capitalization.

"But these properties are overcapitalized," it will be said.

Admitted.

Suppose I assume, too, for the sake of the argument, that the overcapitalization is 100 per cent—that the real accumulated cash investment in all these particular properties is not $500,000,000, but $250,000,000. This certainly would seem to be an assumption sufficiently sweeping to suit any critics, and is far larger than the fact.

As a result we have apparent net earnings equivalent to a return upon investment of 10 instead of 5 per cent. Is this larger figure too great for risks so serious as those which have to be taken by investors in street railway properties?

But this is not all. These twenty properties are not now in reality earning 5 per cent on their $500,000,000 of their capital liabilities, or 10 per cent on half this amount. They are knowingly or unknowingly deceiving themselves in the matter of maintenance, and some day there will be a reckoning in consequence. In other words, their percentage of operating expenses to gross receipts is much more than 63 per cent, and perhaps hardly less than 75 per cent, and they are probably earning on an average but 4 per cent or less on their capitalization.

THE PROBLEM OF TRANSFERS

To most people, no doubt, the transfer problem appears a very simple one. Surely it would seem that no more just and reasonable demand could be made on a street railway management than that a passenger should be allowed to ride from any point within a city to any other for a single fare, particularly if the entire system is owned by one company, and if the city is a small one. It is on deeper investigation only that the real difficulties appear. Broadly speaking, it may be said quite certainly that hardly a street railway manager in the country would object to the simple proposition outlined above if that were all there were to the problem. It is not of serious importance to him whether a passenger complete his ride on the original car or on a connecting one. The trouble is found in limiting the use of transfers to their entirely legitimate purpose without running against sheer dishonesty on the part of the public, and on that of the company's own employees. The entire transfer problem is one of preventing this dishonesty and of nothing else. To prevent conductors from replacing cash fares with transfers is possible only by the most careful comparison of returns and records in connection with a more or less complete detective force, and the cost of this combined service is often very large. But a more serious trouble than this by far is found in the "swapping" of transfers by, for example, clerks in the same offices living in different parts of the city, or by

their improper use in other ways for return or continuation trips, and in the actual giving away or selling of transfers taken for that purpose at the close of the honest trip. There are not a few cities in which the routes are so peculiarly laid out as to make it practically impossible to put into effect a transfer system which cannot be thus tampered with to a most serious extent, while in all cities there is a more or less large percentage loss from illegitimate use. The fact that in nearly all cities of America the street railroad companies have conceded some form of transfer accommodation and are standing the consequent loss in receipts and in operating expenses, should be credited to them as a partial offset for some of the things which they have been obliged to refuse the public.

THE AVOIDANCE OF ACCIDENTS

In the operation of many cars through crowded streets of cities, it is inevitable that there should be accidents, trivial and serious, from the running down of a peddler's cart to the killing and maiming of a carload of passengers. The fact that the trivial accidents are so few and the serious ones so extremely rare in proportion to the number of passengers carried and to the number of obstructions, human and otherwise, in the streets, points to the remarkable care which is uniformly exercised by the employees of our great companies working under carefully established rules. During the year ending Sept. 30, 1897, the street railway cars of the entire State of Massachusetts ran 61,577,917 miles, and carried 308,684,224 passengers. The number of accidents of all kinds was so extremely small that the cars traveled on an average over 48,000 miles before injuring a passenger, and about 83,000 miles before injuring any one in the streets or highways through which they passed. The number of fatal injuries was only one for each 200,000 miles traveled. The number of fatal injuries to passengers was but one for each 30,000,000 carried. This is a marvelous record considering the character of the "rights of way" which street railways possess, and indicates the most careful attention to safety in travel.

Accidents may be minimized in number, first, by reducing speeds of cars indefinitely; second, by increasing braking power; third, by the introduction of some form of fender or protective device; fourth, by the selection of employees who will exercise care in the handling of cars, and fifth, by the education of the public itself to treat the cars with respect at all times. Speeds will increase rather than decrease, for the constant effort is and will be, in America at least, to save time at the expense of concurrent disadvantages such as even that of injuries to passengers and wayfarers, and if the proportions do not rise to extraordinary figures, the public will not suffer the carelessness or misfortune of the very few to interfere with the advantage of the immensely greater number. The remedy must be sought, therefore, in the other directions named, and will, as a matter of fact, be found in the combination of all. The public, whether on foot or in vehicles, is daily learning to keep out of the way of street cars, and the lesson of the true economy of good employees has been well learned by street railway companies. No entirely satisfactory braking system of general application has yet been found, but the power of mechanical brakes has been enormously increased since the advent of electricity, while air and electric brakes for the higher speeds of interurban work have been developed, not perhaps to the highest point possible to reach in future, but to one of present commercial and effective value. Fenders are yet a necessity, though a troublesome one, and it is hard to see how their use can be avoided even with the best braking appliances.

THE MANAGEMENT OF EMPLOYEES

It is within the power of the street railway manager to exert an influence for good or for evil—towards better things or worse—in the lives of hundreds or thousands of employees. He can arrange their hours so as to keep them constantly on the move between home and work, or so as to give them long free periods of time within desirable hours. He can harass them with a multitude of rules, or deal with them as reasonable beings with comparatively few rules. He can make them loyal and enthusiastic in the service of the company, or disloyal and indifferent to its interests. Upon his treatment of employees depends the success of his administration more than upon any other of its features.

The new street railroading of to-day has brought into service a much more intelligent grade of employees than was found in old horse car days. Then it was only necessary that a driver should be able to handle horses with reasonable care and to maintain the schedules through the streets. The conductor was watched with the most jealous care to prevent dishonesty. Uniforms were rarely seen, and the morale of the men was undeniably poor.

To-day, the entire force of employees, particularly in the transportation department, is composed of trained men, neatly uniformed and with quick and intelligent minds. They are, and must be smart, "snappy" and businesslike in the conduct of their work. The conductors and motormen must know many things about their cars, which were never required from the horse car force, since blockades must be prevented and the road kept in operation at all hazards. As a consequence, the present employees can be made to feel proud of their work and their opportunities. The organization is more complicated, the chances for promotion are better, and the conditions are in all respects improved. The most successful managers of to-day have put their systems far beyond the danger of strikes by making friends with their men, and putting certain influences into play among them, which enormously increase their *esprit de corps*.

The most important of these influences perhaps is that of increase of pay with length of service. In the old days, the wages of a conductor or driver were no greater to the man of twenty years service than to the six months fledgling. All were treated alike, the theory being that the *work* was the essential thing, not the *man*. As a consequence, disaffection was easy to create in a body of employees. The long service employee felt, indistinctly perhaps, but none the less certainly, the injustice of putting him on a level with the new man, and felt, too, that there was nothing for him to look forward to in the future. All men were equal in the labor meetings, and a knot of the disaffected could sway the entire body of employees.

It is easy to understand the restraining influence brought about by the adoption of a graduated wage scale in a body of employees of this character. Suppose, for example, that this scale runs from $1.75 to $2.25 per day, the minimum being received for the first year's service, and a five-cent per day increase being granted for each subsequent year, so that only after ten years' service will the $2.25 rate be obtained. We have, therefore, in such a force, ten different bodies of men, each growing better and better satisfied, and more and more conservative as the years go by. Each takes a pride and pleasure in every increase of pay, looks forward to still better things, and considers the entire wage scheme reasonable and just. The chances for disaffection are confined to the newer men and the influence of all the others is a restraining one, not only because of their self-interest, but also because of their longer experience with the company's methods and the consequent value of their advice. In the remote contingency of a threatened strike, the employees cannot go before the public with as strong a case as they could were the average wage rate $1.75 or $2; for example, since the company can show that it is really paying the higer wages demanded for experience and ability, and it is the new and untried men who are making the trouble.

Another influence of much the same general character is the adoption of the "service stripe" plan of recognizing length of service. The man who carries on his sleeve one, two, three or four stripes, signifying an equal number of years of service, or one or more gold stripes, signifying five years each, feels the responsibility of his position, and feels a self respect which shows immediately in his care of the traveling public, and which in turn commands respect from that public. He is identified with that company, its interests are his and will be guarded. The officers of the company themselves should have, and do have, as a matter of fact, great respect for the older employees, and the entire force, from the president down, is welded together more and more closely as the proportion of the long service men increases.

Still another good influence among the men is that of promotion to positions of higher responsibility, and the sooner street railway companies realize this and put the principle into practice, the better will be the results they obtain, and the more nearly will they approach the stability and strength which the railroad industry has gained by the security in tenure of office and chance of promotion which has been for many years granted to railroad employees.

The principle of competition in the conduct of the street railway business has not as yet been introduced to nearly the extent that its value warrants. In the maintenance department, for example, piece work as against time work could probably be adopted with considerable advantage. A man will always work harder and more intelligently and adopt better labor-saving methods if the fruits of his work are to be given him in greater remuneration, and while careful inspection of such work is, of course necessary, the conditions under which street railway repairs are carried out are such as to make such inspection feasible and efficient. The experiment has been tried in one or two cases with excellent results.

Another place where the competitive idea can be introduced is in the management of the power used by cars. It is well known that motormen, as a rule, waste power enormously by the improper handling of controllers. In many cases this is done carelessly without much thought of results. In others it comes from a disposition to play with the immense force at the command of

the motorman by the mere movement of his hand. The results of this misuse of the controller are seen not only in the power cost, but also in increased depreciation of motors through constant use of excessive currents. Now the very simple plan of placing in each car a wattmeter to measure the power which is used by that car, and of taking regular readings of this wattmeter at the end of each run, has accomplished in one or more instances, and would accomplish in practically all, remarkable results in the saving of power and of depreciation, for the moment that a motorman is called to account for using more power in going over a route than another motorman uses, that moment he begins to be more careful. In one case recently made public, a saving of 33 per cent in the cost of power was effected by this simple method.

The street railway employees' associations, with their corresponding club-rooms, gymnasiums, baths, libraries and monthly and annual entertainments, together with the provisions for death benefits, etc., tend to bring the management and the men into closer union, and are always to be encouraged as valuable adjuncts to the regular work. The library feature, which has been lately introduced on at least one large system, brings the home influence into play in behalf of a management, tending, however slightly, to cause the women of the family to exercise a restraining influence over the men in times of threatened strikes.

Broadly speaking, the modern street railway management, as distinguished from the older forms, brings men into closer communion with the official staff and creates in them a self respect and manliness of character which is the best possible security against trouble. Those managers who have adopted these broad gage methods and have been genuinely solicitous for the well being of their men, have been successful to a remarkable degree in securing the personal loyalty of the latter, and in strengthening their own position and that of their company in the community.

THE ADVANTAGE OF COMBINATION

The public gains, or ought to gain, with combination of municipal service enterprises. No principle in practical sociology is better established, perhaps, than that which grants to public service industries in municipalities the right to be regarded as "natural monopolies." It can never be to the permanent advantage of the people to have two lines of street railway serving the same territory on the same or parallel streets, while it is a distinct disadvantage to have separate companies serving different sections of the city. A transfer system between independent companies is an impossibility on any fair basis, while the almost universal result of a consolidation of several different companies in a single city is the immediate granting of transfer rights, and an immense saving to the people. This one advantage alone is a sufficient *raison d'etre* for consolidation, but in addition to this there are others. The entire transportation of a city can be operated by a single company on broader lines and to the far better service of the people than can be done by two companies. Economies can be introduced and more liberal expenditures in other directions made possible, through routes can be established along the lines of customary travel, and in many other ways the people will be benefited.

The economies effected in the street railway administration are numerous. Instead of several power stations, one or two of the best ones only may be kept in service and the cost of generating and distributing the current may be minimized. A better service may be given with a smaller number of cars than before, the official salary list may be reduced, the principle of division of labor may be introduced into shops, repair force, etc., and the day when fares may be made lower to the people will be brought distinctly nearer.

There is also much to be said in favor of the consolidation of street railway and electric light and power interests. The great difficulty with electric lighting stations to-day—a difficulty which is keeping up the price of light and power to materially higher figures than ought to be possible of attainment—is the fact that the stations can be loaded up to their capacity for but a few hours out of the twenty-four. This puts the working forces to a disadvantage, leaving them comparatively idle for many hours, and reduces the economy of the engine or leaves a part of the plant idle, which thereby earns no interest upon its cost. If the market for power can be increased and the loads distributed fairly evenly over the day, the cost per unit of power delivered will be far less than at present, and the price can be correspondingly reduced. The consolidation of all electric power using interests will tend to bring about this result, and is therefore to be favored on the grounds of public as well as of private gain.

THE PROBLEM OF MAKING A FAIR BARGAIN WITH THE CITY

I have purposely left this most important problem till the last because it is only through a more or less clear understanding of the nature of the other problems hereinbefore discussed that the true character and difficulties of this one can best be understood. There are, and will unfortunately continue to be, a great many false theories and ill-advised schemes put forward to solve the problem of how to best handle municipal service enterprises and to relieve the tension now existing between municipalities and private companies. The truth is that there is no one method of universal application. It is as foolish to assert that municipal ownership of everything in sight will bring the millennium immediately as it is to hold that municipal ownership has no place whatever in the management of public service enterprises. There is a sharp distinction between that class of services which a city has to itself use in whole or in part, such as, for example, sewerage, water supply, gas and electric light, etc., and that class which it does not use, such as transportation. An attempt to control the former class may be defended on the ground of wise economy in city expenditures. An attempt to control that latter has for its basic purpose an idea either of obtaining revenue by indirect taxation or of giving a service to the people at actual cost.

Under all circumstances and with all kinds of enterprises, it is true that municipal corporations, in which responsibility for results is so greatly subdivided, cannot, theoretically, and do not, historically, conduct business enterprises with economy or efficiency, while even more important than the question of mere money saving or waste comes the undeniable fact that the trustees of municipal funds cannot possibly manage these funds on broad lines, or with the calm confidence in the future justification of present expenditure that private capital would have. The taxpayers would not suffer the imposition of present burdens for the benefit of posterity, at least without a storm of criticism which would render the positions of the trustees difficult or untenable.

The transportation enterprise, particularly, is one where investment must be made without regard for present profit if the growth of the city on right lines is to be kept up. For this reason and entirely independent of the mere question of possible revenue to be derived by a city from the operation of its street railway system, I believe firmly that it would be utterly unwise to place the control of a city's transportation agency in other than private hands. I believe that in practically all cases the true solution of the problem of relations between a city and its street railway system is found in granting to the latter private ownership and operation, complete monopoly, perpetual franchises and a system of perpetual profit sharing with the municipality, joined to a remission of charges to the public if, and whenever profits come to be sufficient for that purpose.

By a policy of this kind it is possible:

1—To avoid pledging the city's credit for making the necessary original investment.

2—To place upon private capital the burden of all losses realized or contingent.

3—To obtain for the city an equitable share of all profits actually realized.

4—To avoid the creation by the city of a complex bureaucratic organization with its attendant political dangers.

5—To secure for the benefit of the municipality, its people and the private capital invested the undeniable benefits of private management as affecting profits, perfection of service and direct responsibility.

6—To secure for the municipality, the people and the private capital invested, the true pro rata shares of each in the additional profits coming with municipal development in the future.

When all the safeguards possible to devise shall be thrown around a municipal contract of this character, it will be found that the street railway problem in that particular city is solved for all time, and in a fair and equitable manner. Thenceforward the municipal government and the street railway corporations will work *together* to build up and develop on its broadest lines the municipality of whose interests they are, at once, guardians and servants.

Electric Traction and Its Application to Suburban and Metropolitan Railways *

BY PHILIP DAWSON

There are practically three methods of handling electrically the traffic on a railway, namely:

1. By locomotives or motor cars hauling a train of trailer cars.
2. By independent motor cars.
3. By a set of independent motor cars formed into a train and handled from the front car or from a so-called controller car. Each car, however, can be separated from the train, and it then becomes an independent motor car.

* Abstract of paper read before the Society of Arts, London, March 21, 1899.

As regards the supply of the necessary current for the motors, there are three distinct methods:

Firstly. By accumulators or storage batteries which may be carried either on the motor car or locomotive, or on a tender.

Secondly. By having a car containing a stationary engine, dynamo and boiler, which supplies the necessary current to the motors on the cars comprising the train of which it is part, and as proposed by W. Heilmann.

Thirdly. By continuous or multiphase current supplied directly from a generating station or from a sub-station which, in its turn, gets its supply of energy from the main station, the current being distributed either in the form of direct or polyphase to conductors running along the lines, and from which the power is supplied, through sliding contacts on the cars to the motors.

The two former methods, as far as this paper is concerned, will not be discussed, as sufficient data are not available to justify their being considered.

The system of transmission of energy to the motors by means of conductors laid along the track, will therefore alone be considered.

This method allows of several variations as far as the generation and distribution of power is concerned, amongst which the chief may be set down as follows:

(*a*) One continuous current generating station supplying current direct to contact rail. Where drop in pressure owing to distance becomes excessive, a negative "booster" may be used—it serves, so to speak, to pump back the current to the station, and is self-regulating, not taking at any period more power than is actually required to pump the current back. Should there be one or two lines too long to enable them to be worked this way, polyphase high tension generators should supply the power to one or more sub-stations along the line, as may be found necessary, in which rotary converters are located, which transform the current back into continuous. The polyphase generators to be driven by continuous current motors in the generating station. As an example of such a station, the new Dublin tramway power house may be taken.

(*b*) One central station generating continuous current with sub-stations in which accumulators are located along the road, and which are charged by means of a booster and special cables. As an example of this system, the Leeds tramways may be taken.

(*c*) A series of stations, as described under (*a*) and (*b*), situated at various distances and connected together one with the other. As an example of this, the tramways and light railways in and round Boston, Mass., may be taken, owned by the Boston Elevated Railway Company, which has absorbed the well-known West End Company.

Data of Boston Elevated Railway.

Track miles operated	305
Number of cars	2,648
Car miles run during 1898	29,787,000
Passengers carried during 1898	172,764,300
Number of power stations	5
Total capacity of power stations in kilowatts	16,100
Total rated indicated horse power of engines	24,000

(*d*) A power station generating polyphase currents, which, by means of static step-up transformers, are transmitted at tensions which run from 2500 to 40,000 volts to sub-stations where static step-down transformers reduce them to pressures of 300 to 350 volts, the current at this pressure enters rotary transformers, which deliver direct current at 500 to 550 volts to the line. As an example of this latter system, the Central London Railway, which is now under construction, may be mentioned.

(*e*) A three-wire system with continuous current, the rails or return forming the neutral wire. This has been tried and found wanting, and the engineers of the Central London Railway most carefully investigated its possibility and decided in favor of polyphase transmission and rotary converters, and rightly so.

From careful calculations and the investigation of what has been done both in Europe and America, there is no getting behind the fact that for any power station which will exceed 4000 kw. in capacity, the polyphase system is nearly certain to prove commercially the only admissable one. This statement is upheld by such an authority as H. F. Parshall, M. I. C. E. It is evident that in the particular cases at present under consideration (suburban and metropolitan communication), more than 4000 kw. will be under consideration, and therefore nothing, as far as the power station and transmission is concerned, but polyphase currents will be considered.

There are two distinct varieties of service to be catered for. One that on a system like the Metropolitan and District, where the stops are frequent and the runs short. The other the case of long distance lines with few stops. In the present paper it is only proposed to consider the first variety. In this case the use of polyphase motors need not be considered, as for work entailing frequent stopping and starting they have not up to date proved satisfactory.

A short examination of the importance of rapid acceleration on lines having stopping places at short intervals is interesting. Practical experience with electrically-driven motor cars, or locomotives on the experimental track of the General Electric Company, at Schenectady, has proved that it is perfectly feasible to attain a speed of 30 miles an hour ten seconds after starting from a standstill. Assuming a level track, and that during sixty-five seconds the current is cut off, and the train allowed to coast, that the brakes are then put on, the train will be brought to a standstill fifteen seconds later, and the total time from start to stop will be ninety seconds. Under these conditions it will be found that the average speed will have been 23.16 miles an hour, and that the total distance run will be about .55 of a mile. Assuming that instead of attaining the 30 miles an hour in ten seconds, it took thirty seconds, and that this full speed of 30 miles an hour was kept up for forty seconds longer, and the brakes then put on, the train would be brought to a standstill in ninety seconds, and the average speed would work out as 21.66 miles an hour, or an average speed of about 10 per cent less than in the previous case, the consumption of power, however, being much greater.

It is evident that the most important point is to attain a high average speed, and to keep the maximum speed attained as low as possible, as by so doing less power is required in braking the train, and also less power is required to run the train. The time between the moment when the maximum speed is attained, and when the brakes are put on, should be at least from four to six times that required for stopping the train, so as to allow for errors in judgment on the part of the driver, and also to enable him to make up lost time. On the Manhattan Elevated Railway, in New York, the trains which are drawn by steam locomotives take twenty seconds to attain a speed of 14 miles an hour, or less than half the speed in double the time as compared with electric traction just mentioned.

A much larger current will be required to attain a rapid acceleration than to attain a slow one, but the current will be required during a much shorter time, and the total energy supplied will be less in the case of rapid than of slow acceleration. This fact must not be lost sight of when calculating the feeders for such a system, and the train service should be arranged in such a way that as few trains as possible start together. Furthermore, the more rapid the acceleration required the larger will the motors have to be, and therefore there will be a limit, above which it will not be advantageous to push the rapidity of acceleration. In new tunnel lines, such as are now being constructed all over London, it will be evident that it is an advantage to have the stations built with a down-grade for the trains to start, so as to help the motors and reduce the current required at starting, and that similarly it will be an advantage to have an up-grade when nearing a station, so as to reduce the amount of power required in braking. By properly choosing these gradients it is found that a total economy of from 40 to 50 per cent in the total power required by a train may be made. According to Mr. Potter's tests it was found that during acceleration an average power of 32 amps. per ton of weight of train was required.

From a comparison of the actual results obtained on the elevated electric railways of Chicago and on the Metropolitan & District line in London, we see that whereas the maximum speed of 25 miles an hour is obtained in ten seconds with electric traction, it takes thirty-three seconds to do it with steam locomotives—and that whilst the electrically propelled train could do the distance of 1880 ft. in sixty-six seconds, with steam it would take ninety-three seconds, or nearly half as much time again. If in the case of electric traction the power is cut off the moment the maximum speed of 25 miles an hour is obtained, and the train allowed to coast before the brakes are put on, the distance considered would be done in seventy-six seconds. The steam-driven train even then would take more than 25 per cent more time to do the same distance.

Having tried to show the advantages which electric traction possesses as regards the possibility of increasing the frequency of the trains without decreasing the factor of safety, namely, the distance between two trains, it may be advantageous to see how, from an economical standpoint of generating power, electricity is a cheaper method of operation than steam locomotion. An electrically-driven train only requires one man instead of two to drive it, and when the train is not running no power is consumed and no coal or water wasted. Steam locomotives, it is well known, use but very little less coal and water when they are standing still than when they are running, and are much less economical, consuming, as they do in America, from 5 lbs. to 6 lbs. of coal per i.h.p. On main line English roads it is stated that 3 lbs. to 4 lbs. are consumed, and taking an average power of 400 h.p. per locomotive,

and a train plus engine weighing 250 tons, at a speed of 40 miles an hour, we get at the most economical rate about 0.65 lb. of coal per ton mile, or compared to the electric power required by electric traction 13 lbs. of coal per Board of Trade unit required, which is enormous—under favorable conditions it would not take much over 3 lbs. of coal to give one Board of Trade unit at the switchboard. A properly designed electric station with large units would probably never consume more than 2 lbs. of coal per i.h.p.-hour, or 2.65 lbs. per kw.-hour at the switchboard, and engines of the size of 4000 to 6000 h.p. would be guaranteed to consume not more than 12 lbs. of steam per i.h.p.-hour. A large station would fully justify a comparatively large initial expense in coal handling and stoking machinery, and the location of the station could be chosen so as to be most advantageously situated as regards both coal and water, the coal without being handled being taken from either the ship's hold or the railway truck, conveyed automatically to the coal stores, and from thence automatically to the fires, the ashes being conveyed away automatically as well. In such a station but very few men would be required, and the cost of power could be reduced below one halfpenny per Board of Trade unit, including expenses of every kind.

Comparing again the coal consumption per train mile on large English main line railways, which varies from 35 lbs. to 58 lbs. of coal per train mile, we get a coal consumption of from 0.146 lbs. to 2.32 lbs. per ton mile, corresponding to 28.12 lbs. to 46.4 lbs. per Board of Trade unit, required to be generated at the power house. The following results actually obtained with slow speed Corliss type engines and standard American railway generators, may be of interest:

Total coal consumed, Brooklyn City Railway Company, per Board of Trade unit, 3 lbs.

Total cost, everything included, of Board of Trade unit at switchboard, 00.5195 cents (about one farthing).

Cost of coal per unit, 0.2307 cents, about 0.166 of a penny; Union Traction Company, Philadelphia.

Poorest coal, 3½ lbs. consumed, per Board of Trade unit at switchboard.

In another case cost of coal, 0.272 cents per Board of Trade unit at switchboard, about 0.186 pence.

Total cost of unit, all included, 0.591 cents, about 0.296 pence.

Coal consumption in another case with Corliss engine, average for one year, per i.h.p.-hour, 1.65 lbs. to 1.76 lbs.

What good slow speed Corliss engines, properly designed for railway work, compared to other engines mean are shown by the fact that by such a change in a large American station the coal consumption was reduced from an average of 8.3 lbs. to 4.9 lbs. of coal per car mile.

From a series of figures obtained from the various Chicago electric overhead lines, from 0.16 to 0.135 Board of Trade units are required at the switchboard to drive the trains, the average speed of the trains being 13½ miles an hour, and the maximum speed obtained varying from 28 miles to 35 miles an hour.

The coal and water consumption, per Board of Trade unit, must necessarily be very low, the losses in the step-up and step-down transformers and in the transmission and rotary converters would not be very great, and it would be perfectly feasible to attain an efficiency of 60 per cent at the motor terminals and of 50 per cent on the power applied to the car axles. Large engines and large generators and converters are designed so as to take an overload of 25 per cent for any period of time, and be capable of overloading 50 per cent for a short time without injury, and by a selection of proper units a very large economy could be attained.

It may be interesting to mention a few details regarding the two large power stations which are now being equipped in New York, and which will operate the two large tramway systems of that city, namely, the Metropolitan and the Third Avenue. The Metropolitan station is now under construction, and will contain eleven direct connected sets each of 3500 kw., room for extension being allowed, and a capacity having been foreseen of nearly double that amount. The following gives the particulars of the General Electric Company's dynamos which will be used.

The machine will have a frequency of twenty-five cycles per second, at 6600 volts. It will have forty poles, and will run a speed of 75 r.p.m. It will be of the stationary armature type, the core being built up of laminations 0.14 in. thick. Each lamination has two dove-tail projections which fit in corresponding slots in a heavy cast-iron spider. Spaces are left between the laminations at intervals through which currents of air are driven by the rotating field and circulating by intimate contact with core and windings. The armature winding consists of form-wound coils placed in slots in the core and retained by wooden wedges, the edges of which fit into recesses in the teeth. The field frame consists of a cast-steel ring supported upon a cast-iron spider, to this are bolted laminated core of sheet iron, the pole pieces of which project over and support the copper field windings. The field winding consists of copper strip wound on edge with paper insulation between turns. The insulation is such as to stand a test of 4000 volts alternating between the winding and the core. The exciting e.m.f is 125 volts. The collecting rings are of copper, and carbon brushes are used. The armature winding is tested to 12,000 volts alternating. The temperature rise of the machine after ten hours' run at full load is well under 40 deg. C. The efficiencies are as follows:

	Per Cent.		Per Cent.
1¼ load	.90	½ load	.92.5
Full load	.95.5	¼ load	.88
¾ load	.95	Inherent Regulation	9

The steam engines which drive these dynamos are cross compound Allis vertical engines 46 ins. high and 86 ins. low pressure cylinders, and 60 ins. stroke. They will develop 4500 i.h.p. at the rated economical load, and will be able to work continuously at 6000 h.p. if required, and for a short space of time they are to be able to work at 7000 h.p. The crank shaft is of solid steel, bored and forged, with a hole 16 ins. diameter the entire length, and it is 37 ins. in diameter where the wheel and armature are located. The diameter of the shaft in the bearings is 34 ins., and the length of the bearings 60 ins. The fly wheel will have cast-steel centers, and the rim will be built up of steel plates riveted together. The rim will weigh 225,000 lbs., and the engine itself, complete, about 600 tons, and it is believed that as good results as 12½ lbs. of steam per i.h.p. will be easily obtained. There will be several substations in which will be located step-down transformers of 300 kw. each, which will lower the voltage from 6600 volts to 350 volts. At this pressure the current will enter rotary converters of 900 kw. each, and will be delivered in the shape of a continuous current of 500 volts to the tramway system.

This company operates some 250 miles of tracks and carries approximately 250,000,000 passengers every year.

The Third Avenue Road is now engaged in equipping all existing horse and cable lines with electric traction, and for this purpose has just given out a contract for a power station which will eventually contain sixteen 3000-kw. generators. The generators will be very similar to those described above, and are being built by the Westinghouse Company, who are the sole contractors for the whole work. The engines will be marine type, vertical, and are being built by the Westinghouse Machine Company. Substations with rotary transformers will be used, as in the case of the Metropolitan system.

To give an idea of what may be done as regards power transmission the following few figures may be useful. The first attempts at this class of work were made during the Frankfort Exhibition of 1891, 300 h.p. being satisfactorily transmitted a distance of 106 miles with a pressure of 30,000 volts. Since that time electrical power transmission has largely increased, and the results obtained have been very satisfactory, 4000 h.p. at the present moment are regularly transmitted a distance of 85 miles to the city of Sacramento, Cal., at a pressure of 30,000 volts, where they are transformed into low pressure three-phase and continuous current for lighting, power, and traction purposes. At Telluride, Utah, 1000 h.p. are transmitted 55 miles at a pressure of 40,000 volts; 4500 h.p. are transmitted a distance of 40 miles to Salt Lake City at a pressure of 15,000 volts; 1400 h.p. are being transmitted 35 miles to Fresno, Cal., at a pressure of 11,000 volts; 2000 h.p. are being transmitted 30 miles to West Kootenay, British Columbia, at a pressure of 20,000 volts; 10,000 h.p. are being transmitted from Niagara to Buffalo, a distance of 22 miles, at a pressure of 10,000 volts. All the plants are working and giving satisfaction, and have nothing experimental about them, and there are hundreds more such.

In the designing and carrying out of a large system, there are three points which are frequently overlooked and which may cause a disastrous failure. These are good and adequate bonding; thoroughly good insulation, both mechanically and electrically, and trucks suited for the work for which they are intended.

As regards the bonding, the bonds used should be flexible, but, at the same time, should contain no solder or brazed joint, and they should be expanded against the side of holes drilled in the web or foot of the rail, and held in place by pins. Bonds of this description, when properly applied, can be absolutely relied upon, the contact resistance of the bond with the rail not being greater than the resistance of the solid bond.

With regard to the third-rail insulators, very good results are obtained by using insulating bolts screwed into base plates which are fixed to the sleepers, cast-iron chairs being fixed to the head of the bolts to hold the rails.

Parallel in the Development of the Locomotive and Electric Truck

BY JOHN A. BRILL

There is a remarkable and interesting parallel to be found in the successive steps by which locomotive and electric trucks have been developed. The striking resemblance is found in the treatment of the frame. The frame itself was the outgrowth of the requirements of constantly enlarging lines of service. The first illustration in this article (Fig. 1.) shows a locomotive designed by George Stephenson and built in the year 1836. An elaborate illustrated pamphlet was issued by the manufacturers showing the engine in detail. It was considered the finest machine of the kind which had been constructed up to that time. Our illustration is taken from "Cassier's Magazine," which recently published an article in which much of this remarkable pamphlet was reproduced. The engine was probably the most perfect machine of its type sixty-three years ago. It was put together, so far as its frame was concerned, in the simplest and by the most obvious mechanical method. Rivets were used everywhere to hold parts together and the frame was made up of materials ready at hand in the market. This frame, with its wood filling, was of flat bars and plate iron jaws to hold the boxes. These jaws were put on as independent pieces. A multiplicity of parts riveted together formed what seemed to be a solidly connected whole.

The fundamental principles of construction involved in the frame of an engine of this kind had not been discovered. The controlling idea in its construction was maximum power and convenience of manufacture. In fact, the old locomotive builders worked with the same limited conception of the problem that many of the modern builders of electric trucks entertain. They take, as in the olden times, what comes to hand in the market as most readily available for construction. The similarity of ideas which exists between this ancient frame and some of the electric truck frames of the present day is seen in Figs. 2 and 3. These show a modern built up frame as put in a truck and likewise the same frame by itself. The numerous rivets and the use of the bar iron are obvious. It is true that in the modern truck the wooden packing pieces are replaced with iron blocks, but in other respects there is little difference to be noted. The relationship of the modern truck to the ancient becomes very striking in Fig. 3, where the truck mechanism is absent and only the frame remains.

The very first American locomotive engines were quite similar in design. The model of the first locomotive turned out by Baldwin, now in the office of the Baldwin Locomotive Works, shows a frame of wood. Wooden frames plated with iron were common, if not the rule in the early days of locomotive building. As long as speeds were slow and the work light, these composite structures answered the purpose. How small the internal stresses were may be judged from the fact that the boilers of the Stephenson engine carried only a pressure of 50 lbs. per sq. in. The cylinders were 8 ins. in diameter, and the greatest strain exerted on the piston rod could not have reached 6000 lbs. even in starting. During operation the effective pressure fell off to a surprising degree, and the greatest pull exerted by the piston rod when running rarely reached 3000 lbs. This probably measures the greatest strain experienced in any part of the structure.

Higher speeds and heavier weights made the inherent defects of composite riveted frames very apparent. In less than six years experience American locomotive builders found that such frames were not the proper foundations upon which to mount an engine. In the year 1840, the Baldwin Works were using solid iron frames and it was at that time that M. W. Baldwin was granted a patent for making the jaws or pedestals in one piece with the frame itself which was of wrought iron. This practice has been followed by all American locomotive builders to the present day. The ad-

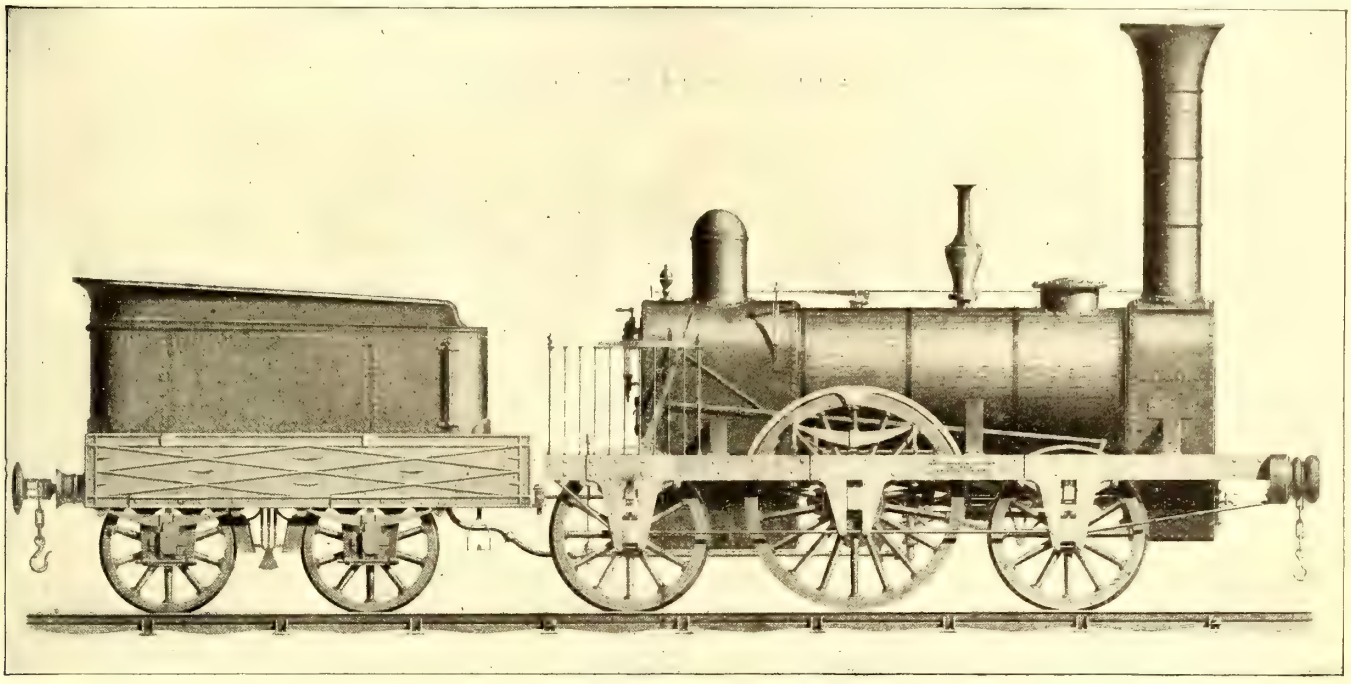


FIG. 1.—STEPHENSON LOCOMOTIVE BUILT IN 1836

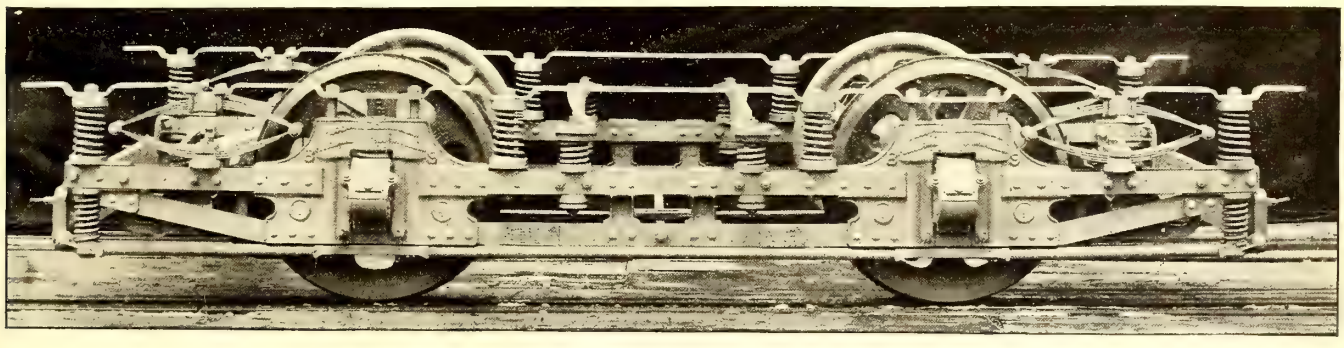


FIG. 2.—A MODERN ELECTRIC TRUCK WITH RIVETED FRAME

vantages of this form of frame were soon recognized and it was universally adopted in this country, only one locomotive builder adhering to the old plate frame for any length of time. His reason for so doing depended entirely upon manufacturing advantages having nothing to do with what was best and most mechanical for the purpose. As mechanical principles became better understood, it was seen that the solid frame was theoretically as well as practically right. The functions of the locomotive frame are simple and easily understood. It has to resist all the strains resulting from the operation of the machinery as well as those involved in the hauling of the train. It must sustain the load which strains it in a vertical direction, and, lastly, it must resist those forces which come into action when moving along the track. This includes the strains which are brought upon it when moving around curves and over irregular surfaces at the same time. In a word, it must be able to resist great strains which may be exerted upon it from all possible directions. Lastly, it must afford easy end for the attachment of the parts. The straight hollow cylinder for the least weight of material is the strongest of all geometrical forms for resisting strains from all directions. Difficulties of construction make them a form impracticable. The solid rectangular bar is the next choice since it has ample rigidity and its flat sides give facility for the easy and rigid attachment of the parts. A square hollow bar would, of course, be stronger for a given weight, but the difficulties of manufacture preclude its use. The American locomotive of the present day is essentially a rectangular bar of iron with the jaws forged into it. The points of the jaw are connected by tie bars, and the outer jaws usually have a diagonal bar connecting them with a prolongation of the main frame. The front section of the frame is usually a single bar of sufficient size and strength to resist all strain which may come upon it.

Fig. 4 is an outline sketch of the main portion of a frame made by the Brooks Locomotive Works for the latest type of six coupled, ten-wheeled passenger engines. Fig. 5 is an engraving of the engine itself. In the outline sketch the Brooks frame is shown from a point just behind the last or trailing axle jaw to a point just inside the cylinder seat. The great length and small scale necessary would make the details too minute to be seen had the whole frame been included in the engraving. It will be noticed that at the forward end a single bar is depended upon to do the work. These frames are neither of them a truss; their strength and stiffness are obtained from the substance and the quantity of metal which they contain. At the jaws where the strains are greatest, there is no attempt to truss or to maintain stiffness by means of braces. In Fig. 4 the inclination of the upper member between the first and second pair of driving wheels is merely an accommodation for the boiler. The bar at the forward end, which carries the cylinders, is a single piece of metal of immense size. This part of the frame could readily be formed into a truss if the truss form presented any advantages. As it does not, builders make it simply a massive bar.

The electric truck is a locomotive in its essential functions. It differs from the locomotive in having the additional duty of carrying a car body, and hence must be a carriage as well as a locomotive. The electric truck builders of to-day occupy a place relative to the art similar to the early locomotive builders. Like the early locomotive builders they are discarding the composite form after having, in their early efforts, given it an effective trial. Advanced



FIG. 3.—FRAME OF TRUCK SHOWN IN FIG. 2

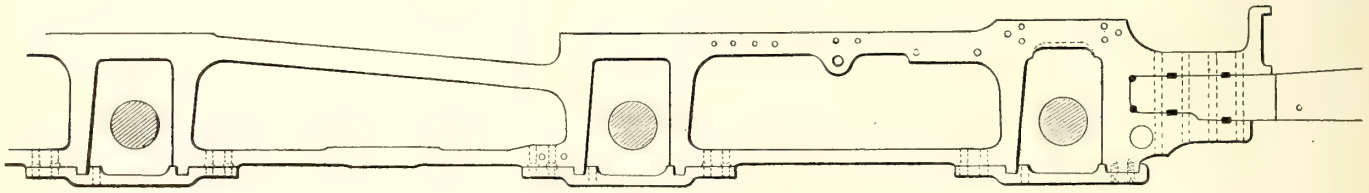


FIG. 4.—OUTLINE OF MODERN LOCOMOTIVE FRAME (BROOKS)

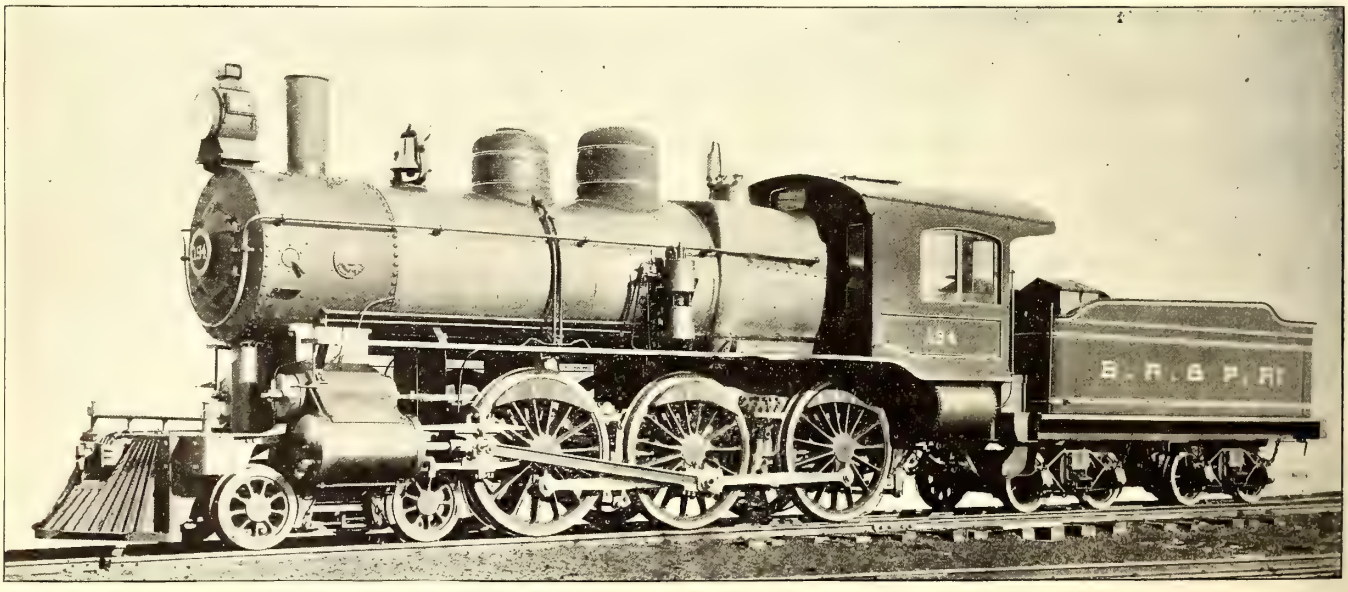


FIG. 5.—STANDARD BROOKS SIX-COUPLED TEN-WHEELED LOCOMOTIVE

electric truck builders have followed locomotive precedents in the introduction of a solid bar frame. A frame of this character by the Brill Company, of Philadelphia, is shown in Fig. 6, and the complete truck in Fig. 7. Like the locomotive frame, the metal is made sufficiently heavy to resist, without injury, all the strains that can come upon it. Comparing it with the locomotive frames, the similarity is at once apparent.

It is hardly surprising that the truss idea took such firm hold upon the builders who had thought of the subject in a superficial manner only. The truss is naturally the first thing that comes into the mind, because the load seems to be the most important factor in the problem.

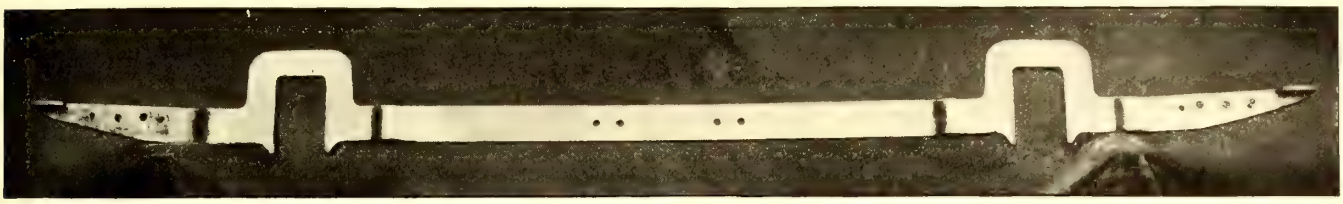


FIG. 6.—SOLID BAR FRAME

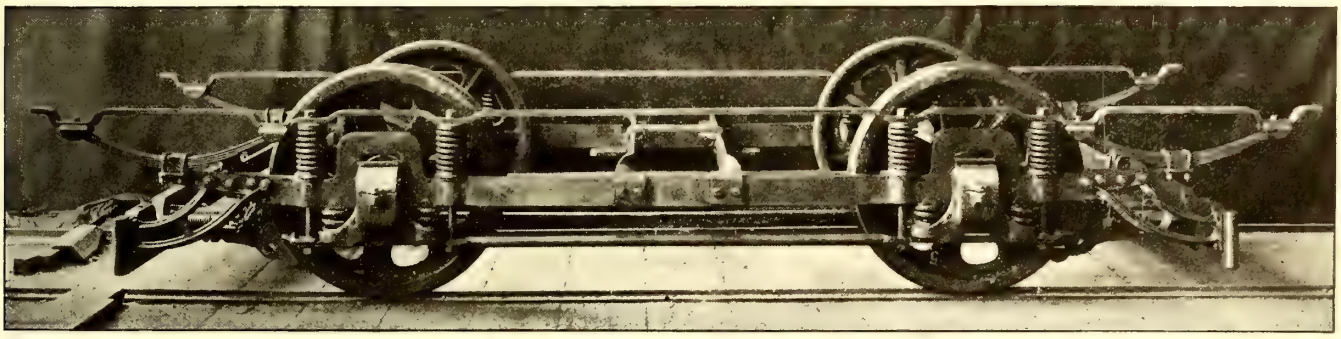


FIG. 7.—TRUCK WITH SOLID BAR FRAME

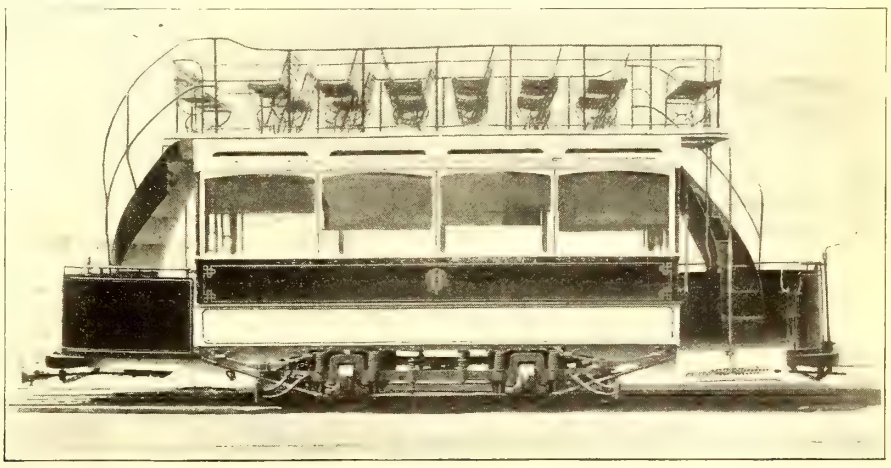
A little practical experience was required to show the fallacy of the idea, and it is surprising that it has retained its hold upon street railway men so long. It needs no study to prove a truss weak in all directions save one. It is a metal frame so disposed as to prevent the greatest resistance to a vertical load, with an entire disregard of strength in any other direction. In both locomotives and electric trucks the twisting and horizontal thrusts are often nearly, if not quite, as great as those exerted in a vertical plane by the load. There must be, therefore, horizontal as well as vertical strength. In addition to this, there is another element which is rarely given sufficient attention, the hammering and pounding of a locomotive or an electric truck upon the rails. This pounding destroys riveted connections with a speed which is quite surprising, and makes repairs frequent and expensive. This is undoubtedly one of the reasons for the early abandonment of riveted work in locomotive framing, and has also been an important factor in causing the composite frame to be regarded with disfavor in electric truck building.

Injunction in the Series Parallel Controller Case

The Thomson-Houston Electric Company and the General Electric Automobile Company on March 13, 1899, secured a preliminary injunction against the Detroit Citizens' Street Railway Company in the United States Circuit Court, Eastern District of Michigan, restraining the latter company from making, using or selling any combination of electric railway motors and motor circuits and resistance combined with controllers embodying the inventions or improvements recited in claims Nos. 20, 21, 22, 27, 28, 29 and 31, of Letters Patent No. 393,323. The principal claims of this patent were given in the STREET RAILWAY JOURNAL (American edition) for March, 1899.

Double Decked Car

The J. G. Brill Company, of Philadelphia, has recently built a number of double deck cars for the Hull Electric Company, of England, which represented the very latest features of their type. The length of the body is 16 ft., the length over all about 28 ft., the width at sills is 6 ft. and the greatest permissible width but 7 ft. The platforms are rather longer than usual, being 5 ft. 6 ins



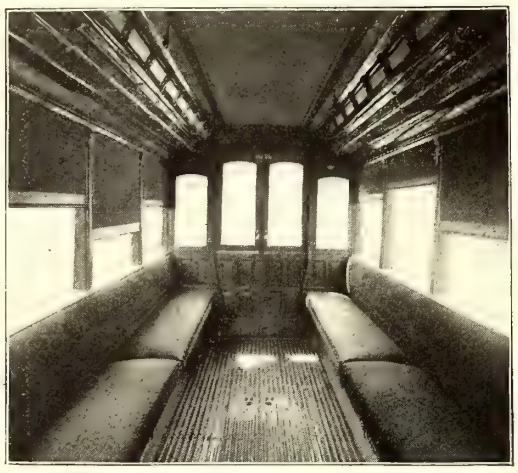
DOUBLE DECKED CAR—HULL

These cars differ from all those recently constructed in having fixed windows, and on this account the glass is of a large size and, of course, set without separate sash. The inside seats are longitudinal with spring backs and seats and are covered with carpet. Garden or "walkover" seats are used on the roof, with slat seats and backs. On the lower deck the car seats twenty-two persons. On the upper deck there are fourteen seats, accommodating twenty-nine persons, making a total seating capacity of fifty-one passengers. The cars are finished inside with three-ply maple ceilings and cherry over the windows. Spring blinds are used with the usual fittings.

Returning to the exterior view of the car, it will be noticed that the railing at the sides of the stairs is made much higher than usual to give greater protection to persons ascending or descending the stairways. At the sides of the upper deck, instead of having covering boards fitted to the rail, wire netting is used, giving the car a much lighter appearance than is usually found in English cars of this type. Galvanized gutters are fitted on each of the hoods. Red, green and white lights are arranged at the corners diagonally opposite the stairways. The trimmings are of bronze with bronze hand rail for the stairway. No. 90 Westinghouse

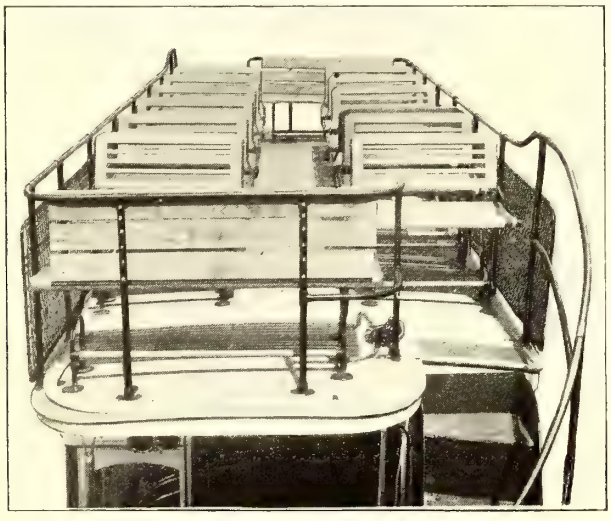
controllers are employed. By means of this the motors are turned into generators and form a brake by being short circuited through resistance. This brake is intended for emergency, but ultimately more resistance may be added and the use of the electric brake become more frequent.

The car is mounted on Brill No. 21 E truck. With the delivery



INTERIOR OF HULL CAR

of this order, there will be fifty-seven of this type of truck running in the city of Hull. There are two Westinghouse No. 46 motors for 500 volts and they are of the nose suspension style. The wheel



TOP SEATS OF HULL CAR

base is 6 ft., and the diameter of the wheels 30 ins. The Hull roads are of standard gage. One noticeable feature of this car is that of the unusual height which has been obtained in the center of the monitor deck, which is 6ft. 8 ins. from the floor. Angle iron bumpers are used with 6 ins. projection in front of the dasher. The cars are to be fitted with electric headlights. The platforms are dropped 6 ins. below the floor of the car, thus bringing the steps conveniently low.

A Handsome Catalogue

A handsome album of electric railway views has recently been issued by the Siemens & Halske Aktien Gesellschaft. It contains photo-engravings of many of the railway installations made by the company, as well as a complete list brought up to Jan. 1, 1899, giving detailed technical information of each road. These include both street railways in Budapesth, which are equipped partly by the trolley and partly by the underground conduit, and have employed the latter since 1889, the Franz-Joseph subway road in Budapesth, tramways in Switzerland, Italy, Russia, Holland, South America and China, mountain electric rock railways and mining roads. The cities in which the company has railway installations in operation or course of construction are in forty-six different States or countries.

Among the roads upon which construction is under way include the Berlin Elevated Railway, the complete tramway systems in Frankfort, A. M., and Vienna, the newly opened Stadtbahn in Vienna and the Wannseebahn in Berlin.

New Arc Electric Headlight

The accompanying engraving shows a new type of electric arc headlight, invented by H. Page Wellman, electrical engineer of the Ashland & Catlettsburg Street Railway Company, of Ashland, Ky., and in use on that line. The lamp is of the enclosed arc type, and is connected in series with about 500 ft. to 550 ft. of German silver resistance wire, No. 22, which reduces the voltage to that required by the lamp. The lamp is a hand-feed lamp, but has an automatic arc-starter, which automatically relights the lamp, after the current has been interrupted and again restored. The lamp will burn from two to three hours, when the carbons are easily fed together by the small knurled hand-wheel extending through the top. The carbons are so arranged that the arc is always in the exact focus of the parabolic reflector used.

It gives a very powerful light, which can be seen a half-mile



ARC ELECTRIC HEADLIGHT

away, and lights up the track so as to show clearly all objects in front of the car. The lamp consumes about 3 amps. of current, and is so arranged that it can be moved from one end of the car to the other. The connection is made by a plug located under the platform. The arc-enclosure is in the form of a transparent tube projected through the reflector, with the ends closed by caps, through which the carbon rods extend.

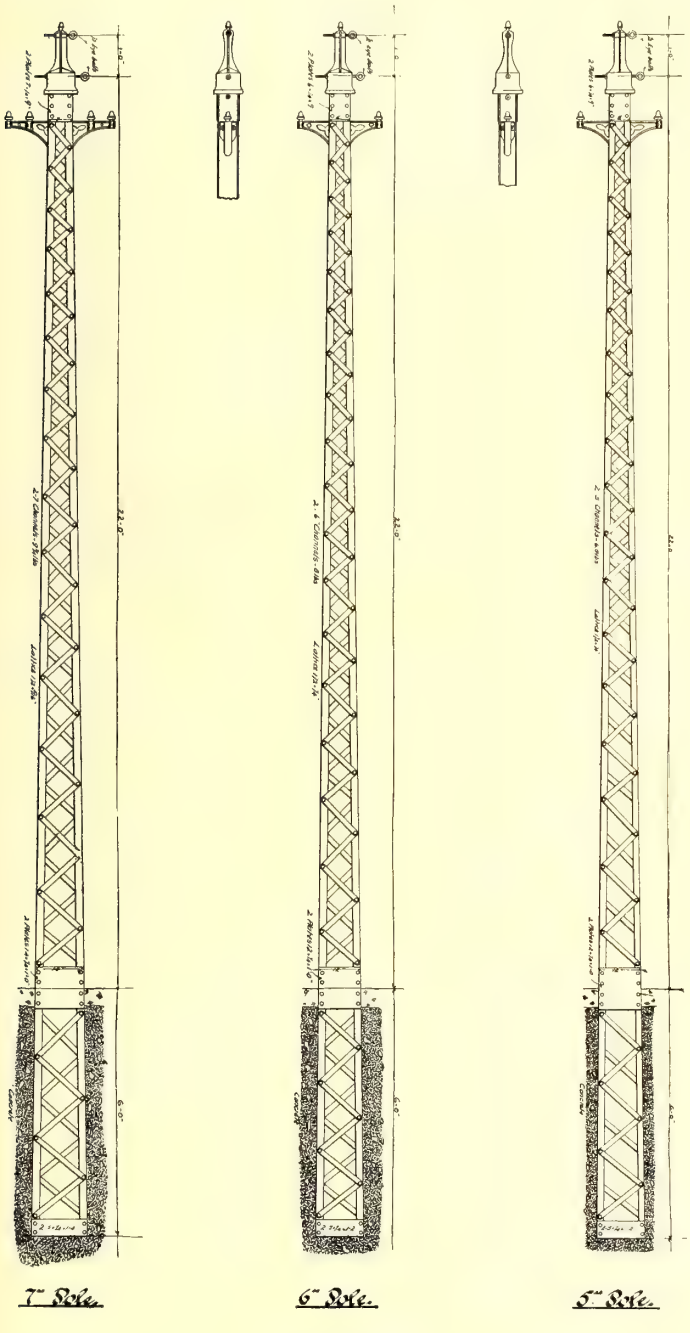
The arc-starting device has a cut-out, with a series coil, which controls the shunt magnets that operate to strike the arc, or, in other words, when the lamp is burning the armature of the cut-out is held suspended and open-circuits the shunt magnet coils, cutting the circuit out of them; but when the lamp is not burning this armature is down, and connects the shunt coils directly in the lamp circuit. Upon current being restored to the lamp it first circulates through the shunt magnet coils, and then through the series coil, cutting out the shunt coils and striking the arc.

Annual Oyster Roast

The sixth annual oyster roast given by the Berlin Iron Bridge Company, of East Berlin, Conn., to its employees was held on Wednesday evening, April 26, at East Berlin, and was a complete success in every way. These annual excursions are looked forward to with great eagerness by all the employees of the company and these dinners are considered largely responsible for the cordial good feeling existing between the managers of the company and the employees.

New Type of Lattice Pole

The accompanying engravings show a style of lattice pole which is manufactured by the Hilton Bridge Construction Company, of Albany, N. Y., and has met with considerable favor on some electric railways. The pole is designed primarily to give the greatest strength and stiffness possible, with an economical use of steel, and is made up with various sections of rolled steel channels, latticed with steel bars, in the manner familiar to every one in the present age of structural steel. By the use of larger sections, the pole may be made to stand the heaviest loads ever carried by line poles, and in all the various sizes of poles the strength is greater and the deflection less under the strains brought by the wires than in the case of much heavier poles made up of iron pipe. The experience of roads using the steel channel poles has been found to verify the calculations of engineers regarding the theoretical efficiency of latticed steel columns for such uses.



LATTICE POLES

The overhead construction, at best, is a source of discomfort to the portion of the public most interested in the æsthetic appearance of city streets, and anything which will improve its appearance is worthy of consideration. For this reason the form of pole illustrated is claimed to have a double bid for popularity—its actual lightness makes it cheap, and its apparent lightness makes it attractive to the eye. It requires no ornamentation except good paint.

The following table shows the principal characteristics of these poles:

TYPE OF POLE.	Weight.	Moment of Inertia.	Moment of Resistance, Unit Stress, C.	Safe Horizontal Pull.*
No. 1	550 lbs.	73.11	15.37 C.	698 lbs.
No. 2	650 lbs.	86.02	18.70 C.	850 lbs.
No. 3	800 lbs.	149.22	27.33 C.	1,242 lbs.

* Applied 22 ft. above ground, assuming maximum fibre stress of 12,000 lbs per sq. in

Hydro-Carbon Car

The gasoline or petroleum engine has been developed to a marked degree within the past ten years, and American ingenuity has produced engines which are reliable and economical. The advantages of this method of producing power are so numerous and well understood that they need not be mentioned here. Suffice it to say, that producing of power by the direct application of heat is the simplest way possible, as no transmitting medium, such as steam, is needed, the only thing necessary being combustible material and the oxygen of the air, which is free and found everywhere.

The practicability of gas engines for railroad use depends merely upon the proper arrangement of power-transmitting appliances, whereby the power from an engine can be applied to the axles so as to revolve them at any desired speed from zero to a predetermined maximum. This has been accomplished in the car illustrated herewith, which made its maiden run recently at Columbus, Ind., where it was inspected by a representative of the STREET RAILWAY JOURNAL.

The car was built by the Vimotum Hydro-Carbon Company, of Chicago, weighs approximately 21 tons, is handled with a 45-h.p. three-cylinder, two-cycle gasoline engine, with the utmost ease and reliability, and starts, stops and reverses on short radius curves and grades without the slightest jar. It is mounted on a pair of standard M. C. B. trucks. The forward axles, besides carrying the regular truck, carry an inner frame, designed along the lines of a locomotive frame work. This frame has three points of suspension, and is provided with equalizing bars to provide for rock and tilt. Boxes are carried by the axles, which slide in ways, formed in this inner frame. Springs are interposed between the frame and axles, which give to the former a vertical resilience. This inner frame carries the engine, which is provided with a governor which regulates the speed to a predetermined number of r.p.m. A belt wheel, carried by the crank shaft, is belted to the initial shaft of the "Reeves" mechanism through a clutch carried thereby. This mechanism is supported on a supplemental frame yoked to the axle, and having the free end of the yoke suspended from the inner frame upon springs. This yoke keeps the axle gears, and mechanism gear, in mesh, but still allows a resilient movement of the mechanism relatively to the axle and to the inner frame. It will thus be seen that everything, from the engine to the axle gears, is resiliently mounted, but all maintain a given fixed relation to each other. All of this is independent of the car body, and the jar due to uneven roadbed, which is received by the inner frame, is absorbed thereby through its connections, and the same is not transmitted to the car body proper, the latter riding absolutely independent of the machinery.

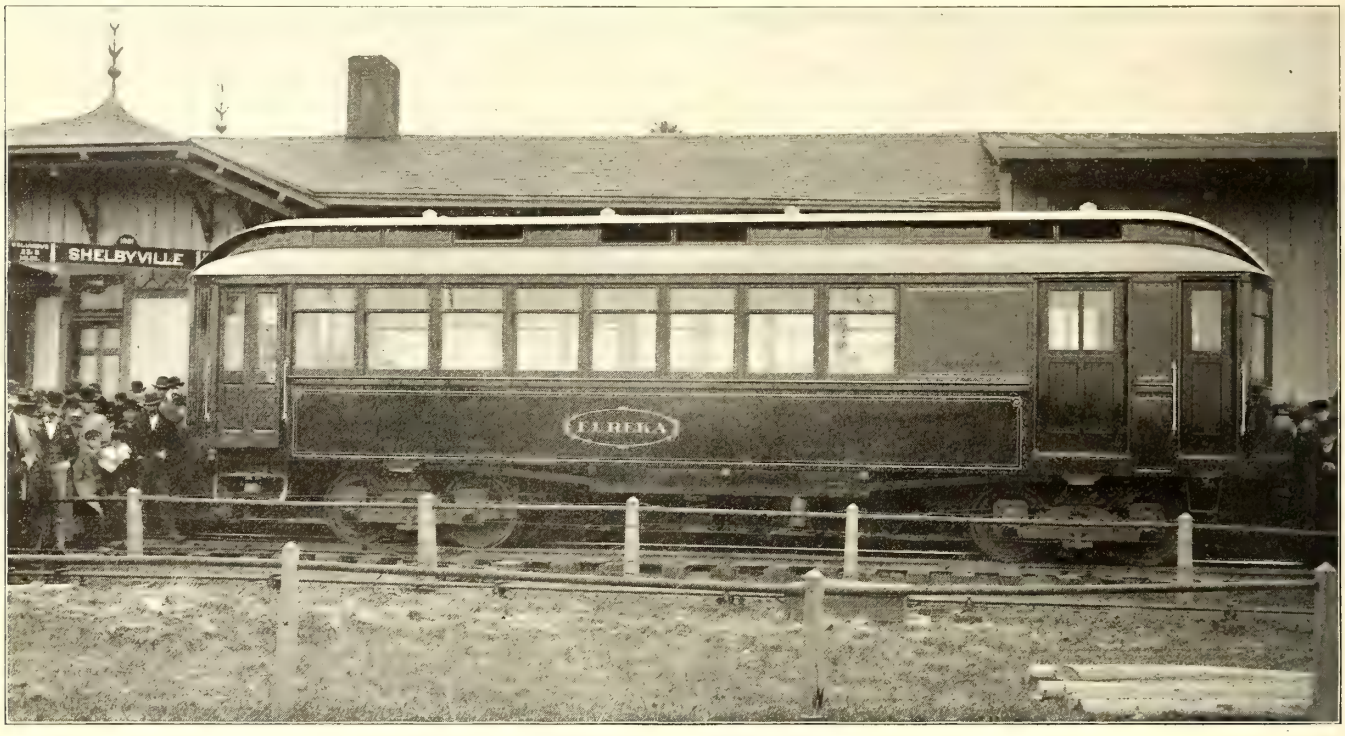
In starting, it is merely necessary to throw a lever, which starts the engine, while the car remains stationary. When the signal is given to proceed, the clutch is thrown into the variable gear, the latter being in a position where its belt has its least lineal velocity. This starts the car easily and smoothly, and the speed is gradually increased to the maximum. To stop, the clutch is released, the mechanism returned to its slowest position, and the brakes set. These operations are accomplished simultaneously by the operator. The reverse is controlled by the engine lever.

Some particulars will now be given of the variable gear to which reference has already been made. This is the outcome of several years of experimenting, conducted by the Reeves Pulley Company, of Columbus, Ind., manufacturers of power transmitting appliances.

The mechanism primarily consists of two parallel shafts mounted in a suitable iron or steel frame. Each shaft carries a pair of driving pulleys, having the form of truncated cones, with their smaller bases facing each other, thus forming a V shaped groove between them. These pairs of pulleys are splined upon their shafts, and are capable of longitudinal movement thereon, but must rotate with their shafts. The corresponding members of each pair of pulleys bear, at their hubs, against ball thrust bearings, carried by levers,

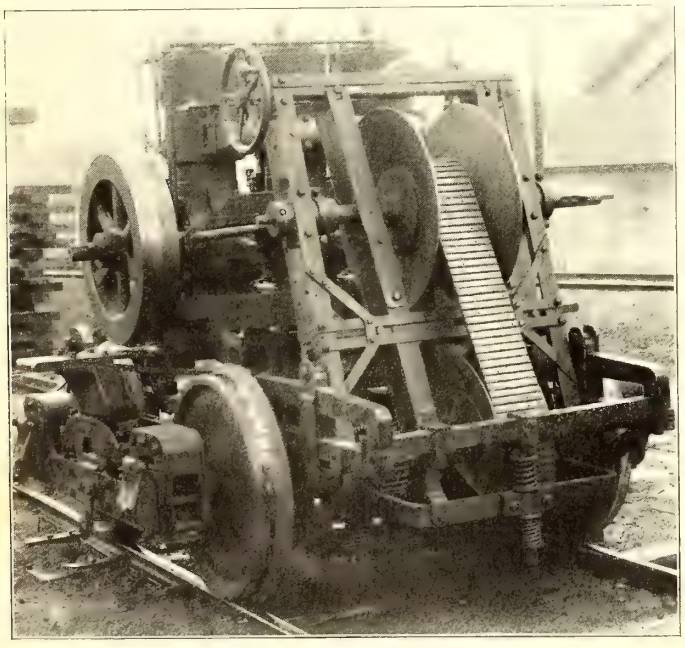
which are pivoted between the shafts and extended at one end to engage with nuts carried by a right and left hand screw shaft which is adapted to oscillate them simultaneously, but in opposite directions. This oscillation causes one pair of pulleys to slide toward each other, and the other pair to slide apart at the same time. An endless belt, of unique construction, is stretched between

The object accomplished in this machine has long been sought for, but a number of seemingly unsurmountable mechanical difficulties presented themselves, which were not met and overcome until the present time. One of these was the belt requirement. It is necessary to have a continuous belt of a predetermined length, and in a machine of this class it was found that if both pair



HYDRO-CARBON CAR AT SHELBYVILLE, IND.

these pairs of pulleys and in the V shaped groove which has its driving surface on the edges thereof, instead of upon the "flat" as in ordinary belting practice. The specially constructed belt is very rigid in cross-section, but is flexible longitudinally, and will pass around a circumference smoothly and easily. It will be readily understood that as one pair of pulleys move together, the belt is caused to move outwardly thereon and assume a large driving diameter, while the other pair move apart and the belt moves down



VIEW OF DRIVING MECHANISM

in the V groove and assumes a comparatively small diameter. If one shaft is driven at an initial speed, the other shaft can be varied to any required degree above and below this initial, as the lineal velocity of the belt regulates the speed of the driven shaft, and this velocity depends upon the diameter upon which the belt is working on the pulleys carried by the initial shaft.

of pulleys were moved in the same ratio, different lengths of belt were required to connect the pulleys when they were in the different positions. This belt length is accurately found by use of the well-known formula.

$$\text{Length} = R(\pi + .0349a) + r(\pi - .0349a) + 2D \cos a$$

$R = \frac{1}{2}$ diameter of large pulley.

$r = \frac{1}{2}$ diameter of small pulley.

$D =$ length between centers.

$$a = \text{angle whose sine is } \frac{R - r}{D}$$

$$\cos a = \frac{\sqrt{D^2 - (R - r)^2}}{D}$$

$\pi = 3.1416$

By this formula it will readily be seen that this variation in belt requirement is considerable, much more belt being required to connect the large diameter of one pair of pulleys with the small diameter of the other pair, than is required to connect the pulleys when the belt is upon the same diameter of each pair, the mean between the large and small diameters. The Reeves Company succeeded in overcoming this by a specially constructed lever which imparts to the pulleys a differential sliding movement along their shafts, so that the proper diameters are presented to the belt to keep it under a uniform tension. The device is complete in itself, and is rapidly going into use in many lines of manufacture where a variation of speed is required. This adaptation of the mechanism to the propulsion of a car is a departure of note.

The machine in this car, complete, weighs 1000 lbs., and is capable of starting and accelerating the car on excessive grades. The mechanism is placed in an upright position so as to economize space, and this position has practically no effect upon the working of the belt, as its driving does not depend entirely upon adhesion, as in ordinary belts, but upon adhesion and due to the initial tension of the belt and the centrifugal force. In this connection, it might be mentioned that this tension due to centrifugal force is taken advantage of in exactly the right place. When the belt is upon the largest diameter of the initial pulley it has its greatest lineal travel, therefore the greatest centrifugal tension. This centrifugal tension aids in keeping the belt from slipping on the smaller diameter of the driven pulleys. As the speed is cut down, the lineal velocity of the belt is decreased, and the centrifugal tension is thereby reduced in proportion to this reduction.

The very best quality of material is used in its construction, and

the best workmanship possible is shown in its design. All parts are interchangeable and standard, and adjustments are provided. As the Reeves Company has had quite a number of these variable gears in hard practical use for four years, and as they are in as good condition to-day as when made, there seems to be no reason why they should not last as long as any other part of a car.

Parlor Car for New Brunswick, N. J.

The Brunswick Traction Company, of New Brunswick, N. J., has recently added to its rolling stock the handsome parlor car illustrated on this page. The main dimensions of this car, which



INTERIOR OF PARLOR CAR

is from the works of the Jackson & Sharp Company, of Wilmington, Del., are as follows: Length of body, 26 ft.; length over bumpers, 36 ft.; length of platforms, 4 ft. 6 ins.; width at sills, 7 ft. 3 ins.; height over belt rails, 7 ft. 9 ins.; height from sill to roof, 8 ft. 10 ins.; height from truck to sill, 2 ft. 6 ins.

The body is constructed from the very latest pattern, is very wide over the frame, and has a shallow concave panel, thus giving plenty of floor space. The window openings are fitted with polished plate, fixed permanently. The roof is of the monitor type, with colonial deck sashes, fitted with fine Venetian glass with gold ornamentation.

The vestibules are of the usual type, except that one side is closed permanently, and the other side is fitted with double folding doors. The glass in all doors is beveled. The interior of the vestibules is finished in quartered oak, and on the side that is closed is placed a large refrigerator, one in each end. The floor is covered with rubber, and all the trimmings are nickel plated.

The interior of the car is finished in St. Jago mahogany, handsomely carved, and between the window sill and the floor it is paneled. In one end of the car are two buffets, with places for holding glasses, etc., and lockers beneath where supplies can be kept. The curtains are of silk tapestry, and fitted with Burrowes fixtures. The lambrequins are made in pairs and are of a handsome silk goods, draped in a neat manner. The carpet is Royal Wilton of a dark green color with a small figure. The ceilings are painted in two shades of green, are decorated in gold, and give a very handsome effect to the car.

All the chairs are mahogany, and are upholstered in silk plush and velour, all in dark green. Two small Chippendale tables are in the center of the car. All the trimmings inside are silver plated. The electroliers are placed so as to divide the light in the car to the best effect. Twenty lights are used in all, including electric headlight at each end. Push buttons are provided at each post. The end doors are of the usual double type, mounted on contra-twist fixtures made by the Adams & Westlake Company.

The trucks are of the Peckham 14 B short wheel base type, with 30-in. wheels, and by using these single steps are used, which is a great advantage. The car is equipped with Westinghouse No. 38 motors.

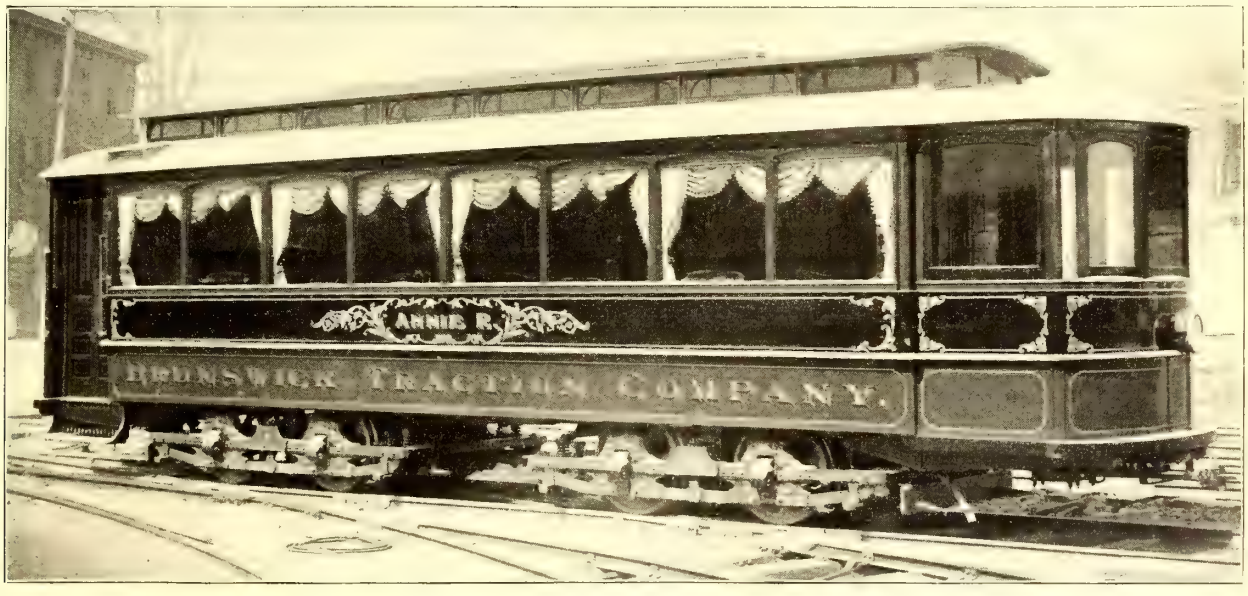
The Jackson & Sharp Company is also building a number of open cars for service on the lines of the Brunswick Traction Company, as well as a number for some of Mr. Radel's other railways.

Lubrication of Bearings

A lubricant adapted for use on locomotives, street cars, passenger coaches and machinery of all kinds, and for which is claimed extreme purity and economy, is manufactured by the Keystone Lubricating Company of Philadelphia. It is stated that the process of the manufacture of this grease is entirely different from that of making any other grease or oil on the market. The raw material is put through a chemical process known only to the manufacturers, and this process separates the foreign matter from the lubricant. The compound is then paddled by a process of direct natural heat until, it is claimed, it is perfectly pure. No gum, rosin, or other foreign constituent is put into the lubricant to give it body, as the process of manufacture leaves it with sufficient body without the addition of other substances.

The manufacturers of the Keystone lubricants have paid special attention to the requirements of electric railways, and they claim that one application of their grease on the bearings of an electric railway motor will go four times further than any other compound. In perfecting their process the following points have been kept in view: To constantly moisten the bearings, to avoid evaporation but to secure perfect adhesion of the bearings, to avoid all foreign elements that might in any way unevenly wear or clog the bearings, and to preserve the bearings bright and clean.

The lubricant remains inactive when the bearings are at rest and works only when the machinery is moving, thus avoiding unnecessary waste.



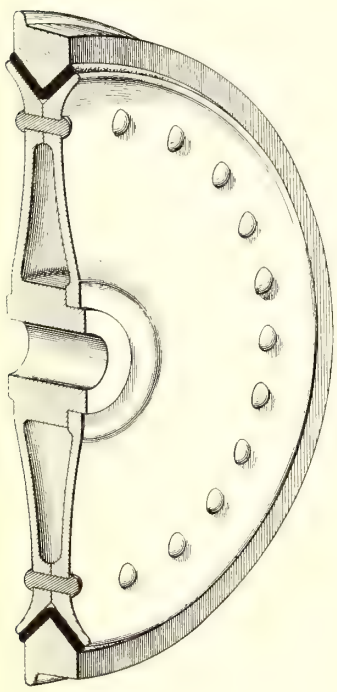
PARLOR CAR FOR BRUNSWICK TRACTION COMPANY

Cushioned Car Wheel

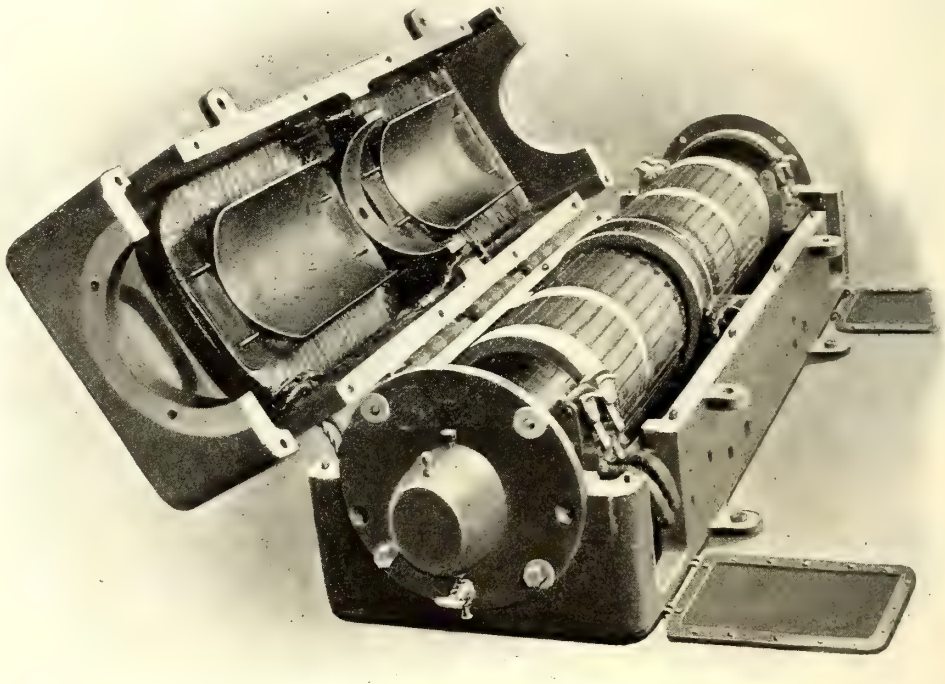
A wheel to reduce the rattle of electric cars in operation is shown herewith. This wheel has an elastic cushion between the rim and body of the wheel, by which the vertical and lateral jar and vibration are absorbed and the noise insulated, and its construction is such that the end thrust is cushioned. It is particularly adapted to electric cars on account of the great weight attached directly to the axle which receives little benefit whatever from any springs on such cars as at present constructed. Electrical connection is made by a simple U shaped metal band inserted through the cushion and held in contact with the rim and body of the wheel.

The cushion is securely confined and has a large bearing surface against the rim and body of the wheel. The wheel is easily and firmly assembled

The first cost is more than for wheels now in common use, but to offset this is the advantage derived by being able to renew a worn out wheel by simply supplying a new rim, which is done without drawing the wheel from the axle. In substituting this for the ordinary wheel, street car companies are not obliged to throw aside any property or to make any changes in construction. The wheel has been thoroughly tested in practice. It was invented by C. H. Cameron, of Chicago, Ill., and he is now endeavoring to make arrangements for placing it on the market.



CUSHIONED CAR WHEEL



MOTOR GENERATOR FOR THIRD RAIL CARS

Public Test of Safety Third-Rail System

On April 12, the Murphy safety third-rail system installed at Manhattan Beach and fully described in the Street Railway Journal for April was subjected to severe tests in the presence of about 500 people. The automatic switches were, of course, the chief object of criticism of the electrical engineers. Their appearance is shown in the cut on page 327. They are of the solenoidal type and are provided with two bobbins. One is a fine wire, high voltage bobbin, and the other is of coarse wire and carries the main current which feeds the section. The operation is as follows: Suppose that the car is in motion and taking current from one of the sections, as described last month. The forward collecting shoe impinges on the section and current flows through the fine wire winding to ground. This raises the plunger, closing the coarse wire circuit and breaking the fine wire circuit. The series current keeps the switch closed as long as the car is taking current from that section. When current ceases in this circuit, and not till then, the switch releases its plunger, and as there is no current to break there is no arc at the switch jaws and thereby a serious disadvantage common to many systems of this class is eliminated. This was efficiently demonstrated at the test. A large box of switches were grouped together for observation, and as the car passed over the various sections of track which they controlled, the switches operated without arcs of any kind, though they were handling currents of from 20 amps. to 60 amps., as shown by the station ammeter.

The switches are subjected to a most severe test before being put into service, being required to make and break circuit with great rapidity for a period exceeding at least twenty-four hours, thereby making a number of breaks equivalent to many thousands of miles of service. The copper laminated jaws of the switches are supplemented with carbon jaws which are arranged to be the last to break circuit, thus providing for arcs in case of accident of any kind.

If the car is stopped all of the switches will fall, thereby cutting the current off from the power house, and means are provided to pick the switches up again. This consists, as mentioned last month, of a storage battery and a little motor dynamo. A storage battery of ten cells drives this motor dynamo which lights the car and provides 500-volt current to pick up the switches. The car lights are therefore never out, which is a great advantage. As the lamps are run directly from the storage battery they are on the multiple plan, which avoids the inconvenient arrangement of five lights or more. Moreover, the lamps being of low voltage with short, stumpy filaments, are of very long life, and being supplied by the storage battery are of uniform brilliancy whatever the line voltage may be.

The car once started the sides of the rotary transformer exchange functions. It takes current from the line and charges the storage battery which, therefore, does not require to be removed and charged, and, in short, does away with all additional attention.

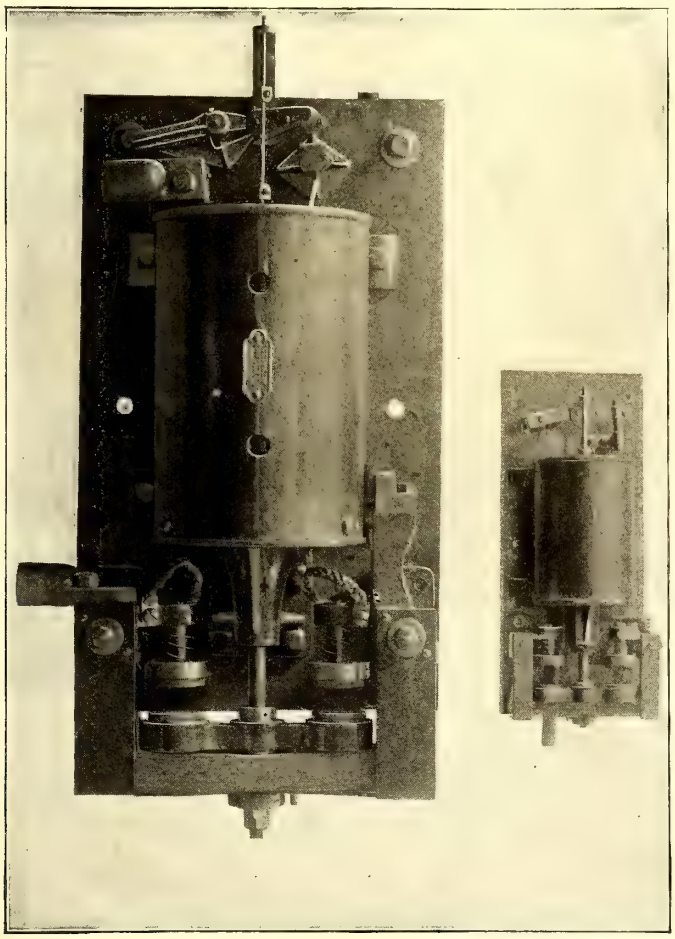
The motor dynamo is an interesting little machine and is shown on this page. It is entirely iron clad and is built on the rugged lines of a railway motor. It has two ratios of transformation This is necessitated by the fact that the storage battery requires to be charged at about 25 volts and discharges at full load at about 20 volts. Therefore the rotary transformer must charge at the rate of from 500 to 25 and discharge at the rate of 500 to 20. This performance is obtained by adding to the windings of the machine a 500-volt field coil which is connected, not to the terminals of the rotary converter, but to the trolley and ground. Hence, when the power house current is absent, the motor dynamo receives the excitation from the low potential side and gives the greater ratio of transformation. When the power house current is at hand, the high voltage coil produces the proper changes in magnetization to alter the ratio of transformation as required.

Another interesting exhibit at the Beach consisted of a large switch for handling heavy locomotive work. This switch is shown on the opposite page, photographed beside a switch for ordinary street railway work. The switch weighs nearly 400 lbs. and has

very powerful and massive jaws, which carry the necessary currents for handling 80-ton and 90-ton locomotives. These jaws are reinforced by carbon contacts which will take any arcing which may occur there. These arcs, however, as a matter of fact, are slight because of the series coil device.

The cost of this system has given rise to a great deal of speculation, and as the Safety Third-Rail Electric Company has not yet gotten its equipments on a manufacturing basis, definite figures cannot be given, but it is believed that the cost of this system will not exceed that of an equivalent first-class overhead system.

The only serious item of depreciation in the system is the switches, and as these consist of about one-third of the total investment for outside electric construction, they can suffer a very large depreciation without bringing the total depreciation figures to any serious magnitude. In fact, the company proposes to guarantee the depreciation of this item for 10 per cent of the first cost of the switches or about 3 per cent of the total investment. When it is remembered that outside construction on the overhead system is frequently written at 15 per cent, this figure becomes very pertinent.



STANDARD SWITCH AND SWITCH FOR HEAVY SERVICE

During the exhibition at Manhattan Beach an elaborate luncheon was served and congratulatory speech-making followed. A large representative body of railway men was in attendance.

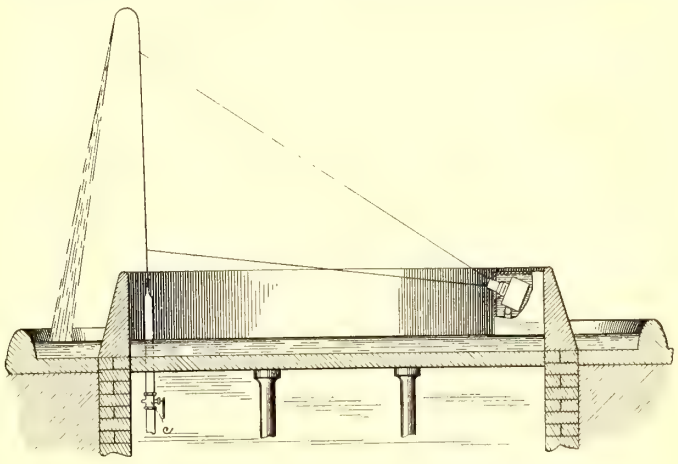
An Ornamental Fountain

After years of experimental work, Paul C. Just, who is in the employ of the North Chicago Street Railway Company, has succeeded in perfecting an improvement for electric fountains, and he has been granted United States patents covering the same.

The invention consists in the combination of a nozzle or other means for throwing a flat jet or sheet of water into the air, and a picture projecting apparatus, such as stereopticons or kinetoscopes so located with reference to said flat jet or sheet of water as to throw a picture or image upon said sheet.

The illustration published herewith shows the invention as it was exhibited at the electric fountain at Lincoln Park, Chicago, in 1898, where it proved a very great success, and one of the most striking and popular exhibitions ever given. It greatly increased the number of people visiting the park on the evenings when the fountain was in operation and the hearty applause of the crowds in nightly attendance evinced the appreciation of the beautiful display.

An electric fountain is not necessary for a display, a single supply pipe from a tank with from 50 lbs. to 65 lbs. pressure fully answering the purpose. A nozzle placed in a pond or lake with the projecting apparatus located conveniently, gives a beautiful effect.



SECTIONAL SIDE VIEW OF FOUNTAIN

The image appears to be suspended or floating in the air. The upward movement of the water is not visible in itself. One remarkable feature about this invention is the extreme distinctness or definition of the image and the fact that the same may be seen as well from the side of the jet or sheet remote from the projecting apparatus as from the side adjacent thereto.

Large Supply House

The Electric Appliance Company, of Chicago, has recently removed into its new building at Nos. 32 to 34 West Van Buren Street, where it will carry a much larger stock of all kinds of electrical supplies than ever before. The interior construction of the new building was especially arranged for the company and is a model of convenience and adaptability. It contains five stories and a basement. On the ground floor are the general offices of the company, to the left that of W. W. Lowe, president of the company, and to the right and opposite that of T. I. Stacey, secretary and treasurer. To the right of the latter are the general offices, and to the left of the general offices is the storeroom. Occupying the rest of the first floor is a room devoted to outgoing and incoming freight.

On the second floor the manager of the shipping department has his office, his assistants' desks and benches for assembling use about half the space of this floor, the rest being devoted to bins for shades and shade holders, sockets, switches and miscellaneous stock. The third, fourth and fifth floors, with the exception of the list of goods stored in them, might well be described in the same paragraph; they are arranged with bins, racks and shelves to best suit the stock carried in them. The telephone department and shop are also located on the third floor as well as the offices of S. A. Dinsmore, the manager of this department.

The last, but by no means the least important part, is the basement, with its accommodations for heavy goods—Armorite and Armorduct tubing, "O.K." bare copper and iron wire, cross arms, brackets, polesteps, etc., etc.

On each floor is a stock clerk, who must be thoroughly posted on the stock under his immediate control. All bins and shelves are lettered or numbered, classified and indexed in such a manner that the assembler can at once place his hands on the item wanted. Every arrangement or device which would in any way help toward the desired end—a quick shipment—has been employed.

The history of the house which has grown in a few years to so prominent a position is briefly as follows:

The company started in business Dec. 1, 1891, using one floor of the building at 242 Madison Street, Chicago, with 2500 sq. ft. of space. One year later another floor was added. In the latter part of 1894 the entire building, or 8000 sq. ft., was required. The present location, at 92 and 94 West Van Buren Street, has 30,000 sq. ft. of floor space. So much in the way of history. With the increased facilities for quickly handling goods, which the new building affords, and with the additions to the strong list of agencies which the company represents, the management may confidently look forward to another prosperous period. The prompt

and businesslike policy which has pleased and multiplied this concern's customers during the past eight years will hardly fail to bring like results in the future business.

Compound to Prevent Slipping of Belts

The Cling-Surface Manufacturing Company of New York city is introducing a compound for rendering power belts soft and pliable, and for increasing the efficiency of a power plant by reducing the slipping of the belts. A very thorough test of this compound was made recently by R. C. Carpenter, professor of experimental engineering at Sibley College, Cornell University, Ithaca, N. Y., and the following is his report upon the results:

The tests were made in every case on the belt testing machine owned by Sibley College; this is constructed so that the belt can be tested under ordinary running conditions and measurements can be made for determining the power supplied, the power delivered, the tension of the belt, the arc of contact on either pulley, and the slip. Three belts have been tested, each before and after treating with cling-surface, and each under various conditions of loading. In all over fifty tests have been made; a considerable number of observations have been repeated in order to check the accuracy of the results.

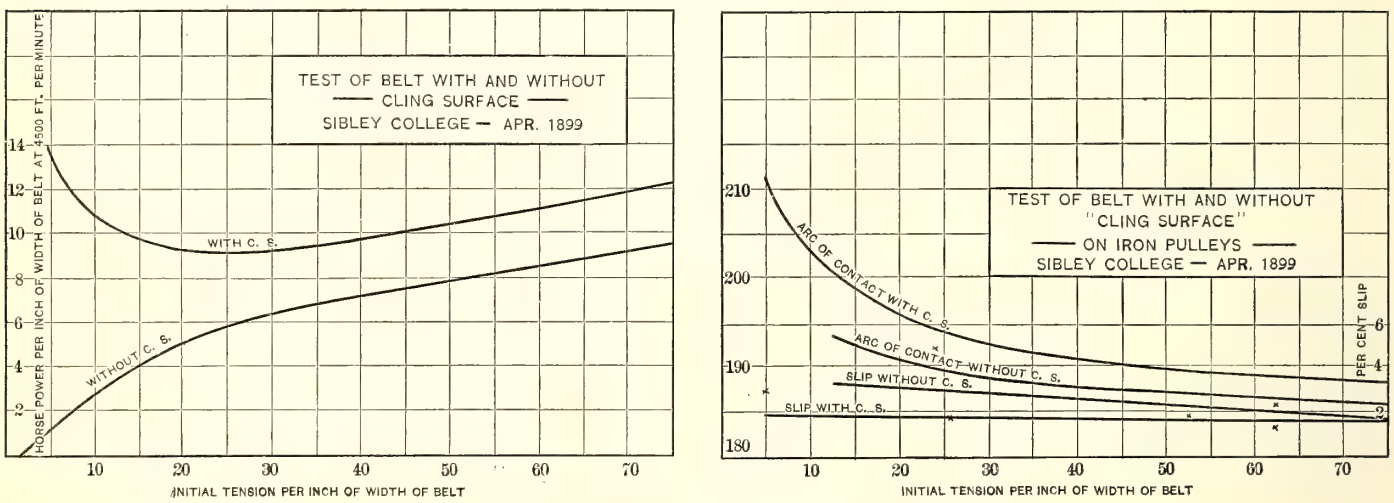
The belts before testing were in every case clean and in good condition, and running under rather better than average conditions.

The cling-surface was applied on several successive days, and in small quantities, in accordance with the directions supplied by the manufacturers, before commencing the tests. The material was almost wholly absorbed at the time of starting the test, and none has since been applied. The material made the belt soft and pliable, and gave it an inner surface somewhat resembling patent leather. This surface was only in the least degree sticky to the touch.

The general results of the test with cling-surface show an increased transmitting power as compared with the same belt in an untreated condition; it also shows an increased arc of contact, and very much less slip. It shows a very high transmitting power when the belt is run extremely loose, or with very little tension on the pulleys, the reverse of which is true with the untreated belt. It will be seen by consulting the report that the greatest transmission capacity for the belt treated with cling-surface was found when there was the least possible tension on the belt, and when the belt was running so slack that the sides nearly touched. It will be noted also that as the tension of the belt was increased the transmitting capacity diminished until a tension of about 20 lbs. per in. of width of belt was reached, after which the transmitting capacity commenced to increase, and from that point continued to increase with increase of tension.

In the test of the same belt not treated with cling-surface the results were quite different, inasmuch as the capacity with very light tensions was practically nothing, and the capacity increased as the tension increased; at no point, however, did the untreated belt have even approximately the same capacity as the treated belt with the same tension; moreover, the treated belt transmitted much more power with a very light tension than the untreated belt with a heavy tension. The test with the belts treated and untreated, running on wooden pulleys, showed essentially the same characteristics. The general effect of the cling-surface appears to enable the belt to transmit a power equal to its entire capacity without producing heavy stresses on the driving boxes of the pulleys; or, in other words, it enables the full capacity of the belt to be obtained for transmitting power when the belt is so loose that the sides nearly touch.

The general results of the tests of the untreated and treated belts when running on iron pulleys is shown in the accompanying diagrams, Figs. 1 and 2. In Fig. 1 the horizontal distances show the tension on the belt in lbs. per in. of width, the vertical distances show the h.p. transmitted per in. of width of belt for a speed of 4500 ft. per minute. The lower line represents the results obtained with the untreated belt; the upper line the results obtained with the treated belt. It will be noted that the lower line continually rises, showing an increase in capacity with an increase of tension; the upper line descends at first, showing a decrease in capacity with increase of tension, and later rises. In no place does the transmitting capacity of the treated belt fall below that of the untreated belt. In comparing the respective results it will be noted that the treated belt has a carrying capacity of 13.8 h.p. when the tension per in. of width is 5 lbs, while for the same conditions the untreated belt has no carrying capacity; furthermore, it is noted that the carrying capacity of the treated belt, even at this low tension, is nearly 40 per cent higher than that of the untreated belt, even when the tension has been increased to 80 lbs. per inch of width of belt. The diagrams in Fig. 2 show the arc of contact and the maximum percentage of slip for belts run both in the treated and untreated condition with different tensions and on iron pulleys. From this it is seen that the slip of a treated belt



DIAGRAMS SHOWING RESULTS OF TESTS

The falling off in carrying capacity with increase of belt tension for the treated belt is doubtless due to the rapid change in the arc of contact, which diminishes with increase of tension. This causes a diminution in the transmitting power which is greater than that produced by the increase of pressure due to the increased tension on the belt. With the untreated belt such change is very slight, and consequently a falling off in carrying capacity for light tension takes place.

In regard to the questions raised as to the preservative qualities of cling-surface and to the permanency of the effect produced by its application, the writer would say that our tests have of necessity been of too short duration to give conclusive answers. The general effect of the cling-surface is to soften the belt and to put it apparently in the best condition for transmitting power and retaining its good qualities. The surface produced by the cling-surface remains apparently unchanged after several weeks of use, and the inference to be drawn is that the material has an effect which continues permanent for some time at least.

The Gothenburg (Sweden) County Council on April 4 decided by a vote of 32 to 14 to buy the local tramway's concession and properties for £70,000; this sale is subject to approval of the shareholders. The tramway company had its head office in London, and was started by English capital under a forty-year concession running from 1879. The following are the chief characteristics of the road: Capital stock, £50,000; 6 per cent debentures, £4300; reserve fund, £2800; dividend, 5½ per cent; number of horses, 132; rolling stock, thirty-six cars and four busses; mileage in operation, 6¾ miles.

Railroad Air Brake Men's Association

The sixth annual meeting of the Railroad Air Brake Men's Association was held in Detroit, Mich., on April 11, 12, and 13, the headquarters being at Hotel Cadillac. This is an international organization of 400 members, composed of men in Mexico, Canada and the United States, who are occupied with the care, operation or maintenance of air brakes. The Grand Trunk, Michigan Central, Wabash, and the Lake Shore Railroads each placed an inspection car, completely fitted with air brake apparatus, in the Union Depot yard for exhibition.

At the opening session on April 11, addresses were made by Mayor Maybury and Robert Miller, the veteran Michigan superintendent of motive power, and the President's annual message was received.

One of the most pleasant incidents of the meeting was the trip over the lines of the Detroit & Pontiac Railway, arranged by William D. Ray, of the G. P. Magann Air Brake Company, of Detroit. The trip was made in a special car, equipped with the Magann storage air brake system, and a number of tests of the brakes were made on the trip.

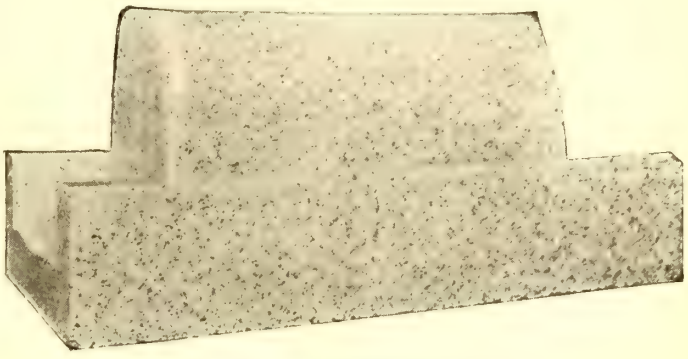
The party, consisting of over fifty delegates, started in the afternoon of April 12, made the 17-mile trip to the Birmingham power house in remarkably short time, and the true Detroit hospitality was shown on this occasion in many ways, and the air brake men enjoyed themselves thoroughly. After leaving the city limits, the car was run at very high speed. While going at the rate of 47 miles an hour an emergency stop was made with the air brakes, and the car was brought to a standstill within a few feet. Numerous service stops were also made, and it was noticed that each stop only caused a reduction of .6 of a lb. of air, showing what efficiency the storage air brake system has reached. At Birmingham the car was run over a pit, where the apparatus was inspected and air applications made.

A special test was conducted on March 15, when car No. 5 left the power house at Birmingham for Detroit with 230 lbs. of air. The car made two round trips, consuming 160 lbs. of air and making a total of 300 stops. The time consumed was six hours. The car made a total mileage of 104 miles. After completing the two round trips there was still 70 lbs. pressure. The car was equipped with double action cylinders.

It will be seen from these results that there was only about 8-15 of a lb. of air used for each stop. On March 16 a car made 165 stops, consuming 88 lbs. of air.

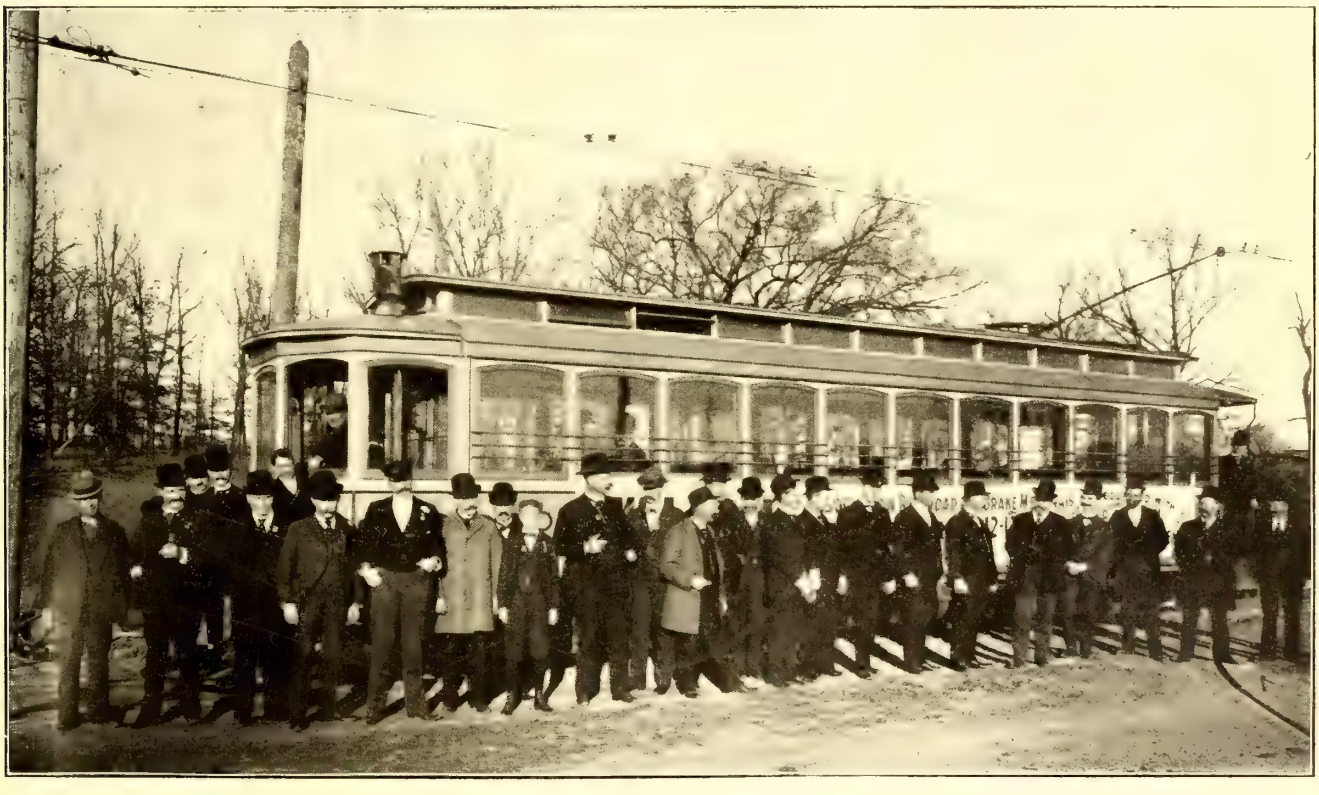
Reconstructed Granite

In the April issue of the STREET RAILWAY JOURNAL some particulars were given of the third-rail railway at Coney Island. One of the important features of this line is the insulating blocks made of reconstructed granite, used between the rail sections. This material is so novel, and possesses so many remarkable properties, that it is thought that a description of it would prove of interest.



THIRD-RAIL SECTION BLOCK

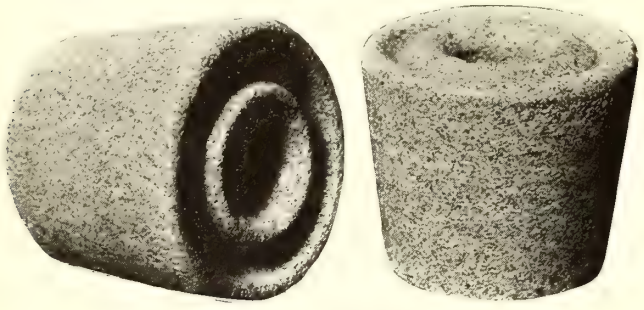
"Reconstructed Granite" is exactly what its name implies, and consists of choice Maine granite, pulverized, moulded into form and fused together at a temperature of 3000 deg. F. It differs from the natural stone, of which it is composed, in several very important respects, viz: (1.) In being absolutely fireproof, as it can be heated red-hot and thrown into cold water without being in the slightest degree injured or affected thereby. (2.) It resists the action of every known solvent, acids and alkalies of all kinds, except hydro-fluoric acid, and is only superficially affected by that. (3.) It is absolutely frost-proof, having been tested in liquefied air at an estimated temperature of 350 deg. below zero not only without injury, but was as strong while frozen as before, and not at all brittle, in this respect differing from all other materials tested in this way. As it is a well-known fact that all natural rocks are disintegrated by extreme cold, and as 80 deg. to 90 deg. below zero is the coldest temperature known upon earth, the test is a severe one. (4.) Natural granite not only contains a considerable percentage of moisture, but has a constant tendency to absorb



GROUP OF MEMBERS OF AIR BRAKE ASSOCIATION

more when exposed to dampness, whereas this material contains no moisture whatever, and being vitrified clear through (when prepared for electrical insulation), cannot absorb any. (5.) Its crushing strength, as shown by tests by the United States Government at the Watertown Arsenal, ranged as high as 14,560 lbs. per cubic inch, which is far above the average strength of the natural stone. Its tensile strength is from 480 to 500 lbs. per sq. inch.

Its great strength, its uniformity throughout, its non-absorbent properties, and its susceptibility to being rapidly and economically moulded into all ordinary shapes, at a comparatively low cost, would seem to make it a valuable insulating material, especially for railway work, when it would be constantly exposed to the



CUP INSULATORS OF RECONSTRUCTED GRANITE

weather, and frequently buried under ground, for these reasons it is rapidly growing in favor upon electric railways, especially for third-rail insulation. Herewith are shown two forms of these insulating blocks made of this material, the first being the section insulator of the "Murphy system" tested at Manhattan Beach, and the other the cup insulators of what is known as the "Martin system," now being introduced upon the Brooklyn and other elevated railroads. There are also many other forms.

A recent test at Niagara Falls showed that it required 56,600 volts to penetrate about ½-in. of this material with a merely nominal absorption after soaking the fragments for many hours. Many other tests equally satisfactory have been made by eminent electricians.

Reconstructed granite is manufactured at Norristown, Pa., by the Reconstructed Granite Company, of New York. These works are very extensive, covering nearly 7 acres of ground, and have direct connection to all parts of the country by both the Pennsylvania Railroad and the Philadelphia & Reading (B. & O.) Railroad, both of which have sidings into the works.

Storage Battery Auxiliary of the New York, New Haven, & Hartford Railroad

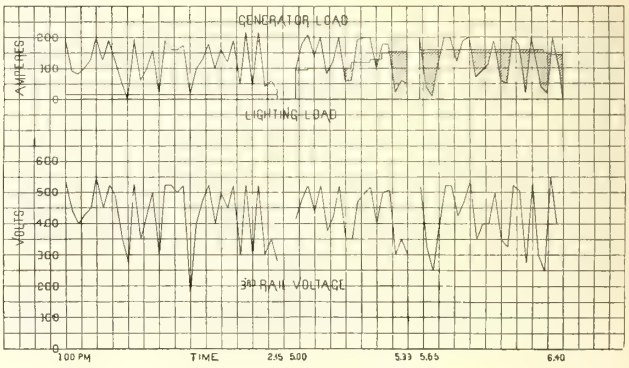
A little over a year ago the New York, New Haven & Hartford Railroad Company installed a plant with storage battery auxiliary at Hartford, Conn., for the purpose of lighting the Hartford station, that has been operating successfully ever since and which exemplifies in an unusual manner the advantage of a storage battery as a regulator, and its adaptability to unusual conditions. It will be remembered that the New York, New Haven & Hartford Railroad operates the Hartford-New Britain section of its line electrically by the third-rail system. Five hundred volts are used and the voltage is subject to all the fluctuations incident to such a system, on account of the current required for starting and accelerating the trains. The fluctuations on the circuit are more violent at Hartford as it is located at the end of the third-rail system, and were so great that lamps could not be operated from an ordinary motor-driven generator without battery. A combination of the motor-driven generator and regulating battery was, therefore, finally decided upon.

The generating unit consists of a 45 kw. shunt-wound generator direct connected on a common bed-plate to a specially compound wound 500-volt motor, the compounding being so designed as to run the motor as nearly as possible at a constant speed through large variations of voltage in the motor circuit, which is derived from the third-rail system of the railroad.

The scheme of operation and the results obtained are well exemplified in the curves shown in the diagram herewith. The lower curve gives an excellent idea of the extreme variations in the motor circuit. It will be noticed that this covers a range of 375 volts, or from a minimum of 175 volts to a maximum of 550 volts. The battery is directly across the system as a regulator, receiving its charge through the hours of light load as will be seen by reference to the left-hand set of curves in the cut, and only being required to furnish a small amount of current when the generator current drops off, due to fall in the voltage on motor, to a point below the lighting load shown by the straight line across the curve; but as the lighting load increases, it will be noticed from the right-hand set of curves in the same figure, there is a large portion of the time when the generator is unable to furnish the current required for the lighting load and which is in turn supplied by the battery, which thus keeps a practically constant pressure on the lamp circuits, discharging whenever the generator current falls below the load and charging when the reverse occurs.

In addition to this service, when the lighting load falls off to a minimum the generator is shut down and the battery furnishes all the current required at such time, constant potential being maintained by the ordinary method of cutting in reserve cells by switches on the lower panel of the switchboard.

The storage battery consists of sixty-two cells of Chloride Accu-



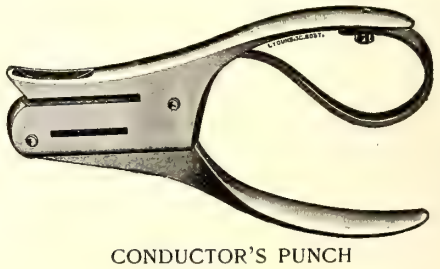
LOAD LINE—HARTFORD BATTERY

mulator, manufactured and installed by the Electric Storage Battery Company, of Philadelphia. Each cell contains eleven plates, but the tanks are large enought to provide space for additional plates to double the capacity of the present plant. The plates are of type "G," 15½ ins. x 15½ ins., while the containing tanks are 23⅜ ins. x 19¾ ins. x 22⅞ ins. high. The cells are installed in one tier on special porcelain insulators, the plates being burned up to solid lead busbars in accordance with the standard practice.

Conductors' Punches

The R. Woodman Manufacturing & Supply Company, of Boston, Mass., is one of the largest and oldest manufacturers of small steam and street railroad supplies, such as ticket punches, ribbon, office and perforating stamps, railroad baggage checks, coat and time checks, employees' hat and breast badges, uniform buttons of every description, etc., and is constantly bringing out new specialties.

One of its latest devices for street railway use is a transfer ticket



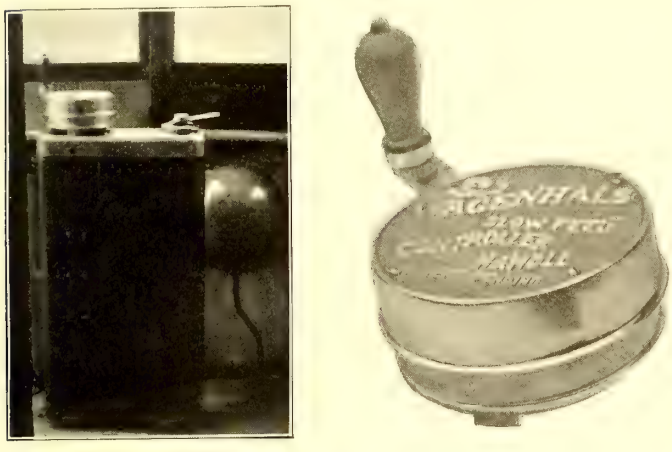
CONDUCTOR'S PUNCH

punch fitted with a new elliptical spring, which, it is thought, will be found a great improvement over the old types of springs. These punches are milled out over the top of the die so that conductors can very readily see all dates and figures which are to be punched in the tickets. The cutting dies for the punches are made from the very best Jessop's tool steel and this accounts for their lasting qualities and durability. Over four thousand of these punches are now in use on the street railways of Boston and vicinity, and the company has large orders on file from a number of roads in Canada.

The Corporation of Glasgow will shortly begin work looking to the conversion of their entire system, and they hope by the date of the Glasgow Exhibition in 1901, which will immediately follow the Paris Exposition, a considerable portion of the system may be converted to electricity.

A Slow Feed Controller Handle

In the accompanying illustrations is shown a new controller handle which has been devised by a practical electric railroad manager and which is believed to be one of the best checks ever devised for preventing the waste of energy by careless or indifferent motormen. There is, of course, no question as to the enormous amount of current that is absolutely wasted by green motormen by the improper handling of the controller. In addition to this direct loss, the increased cost of repairs to motor and parts damaged by excessive currents is by no means a small item. To



SLOW FEED CONTROLLER HANDLE

compel the motorman to use his power economically is the aim of the new invention.

The standard series parallel controller has nine points and the average motorman will cover these in six seconds with a consumption of 250 amps. with two 35-h.p. motors. With the new slow feed handle the time in which the motorman shall cover the nine points is under the control of the manager, who, by regulating an attachment on the controller can limit the time to eight, ten or twenty seconds, as he may desire. No alterations in the present type of controller are necessary to adopt the use of the handle, the old handle simply being lifted from the stud and the new handle put in its place. The device is manufactured by the Wagenhals Manufacturing Company, of Cincinnati, Ohio.

Lubrication of Gearing

The lubrication of the teeth of gearing is a subject of much greater importance and requires closer attention than is often given it, and too often waste lubricants from the bearings, engines, and machinery generally, are considered good enough to supply the gear teeth. The conditions under which gear teeth operate are so very much different from those of a revolving bearing that it is not proper to assume that the same lubricant will do for both; in fact, after careful experiments it has been found that by the application of a lubricant made especially for the purpose, the life of gear teeth can be very perceptibly prolonged.

Gear teeth should be constructed to have as little side clearance as possible and the perfect working gear would be one absolutely without side clearance. As a matter of fact, it is nearly impossible to so adjust gearing as to prevent all initial side clearance. This clearance soon gives rise to a hammer blow, commonly termed "back lash," thus tending to crystallization and breakage. As soon as this "back lash" has once started it very soon increases and the destruction of the metal is very much more rapid. It is evident that a lubricant to satisfactorily answer the varying requirements of gear teeth must possess tenacious qualities to adhere and be able to deposit on the working surface of the teeth, preventing metallic contact and consequent wear and noise and reducing side clearance, thus forming a cushion for "back lash." This is the exact opposite of the requirements of a lubricant for revolving journal bearings. A lubricant for accomplishing this result of a "gear shield" is made by the Ironsides Company, of Columbus, Ohio. This material has been used for some time and it is stated has greatly prolonged the life and decreased the noise of gearing on which it has been used. It is adapted to all conditions from the even running motor gearing on street cars to the most ponderous and heavily loaded gearing of rolling mills.

Annual Report of the General Electric Company

The following is an abstract of the seventh annual report of the General Electric Company:

PRESIDENT'S REPORT.

SCHENECTADY, N. Y., April 26, 1899.

To the Stockholders of the General Electric Company:

The prosperity which has attended other lines of business during the past year has been shared by your company. The important extensions made to its factory plants during the past eighteen months have proved to be most timely, and the company is now greatly benefited by the increased facilities they afford.

The matters of stock reduction and revaluation of the patent account of the company were brought to your attention in the last annual report. Since then a reduction has been made of 40 per cent in the share capital of the company, by vote of the stockholders at a meeting specially called for that purpose, the common stock being reduced from $30,460,000 to $18,276,000, and the preferred stock from $4,252,000 to $2,551,200. The patent account has been reduced from $8,000,000 to $4,000,000.

The profits for the year, after deducting all general patent and miscellaneous expenses, were	$3,896,884.10	
Deduct deficit as of Aug. 18, 1898, after reducing patent account and capital stock	1,840,761.03	
		$2,056,123.07
Less interest on debentures and current dividend on preferred stock		371,638.40
		$1,684,484.67
On Jan. 31, there had been paid or charged against surplus all the old accrued dividends on preferred stock		1,527,913.68
Surplus, Jan. 31, 1899		$156,570.99

By order of the Board of Directors,
C. A. COFFIN,
President.

FIRST VICE-PRESIDENT'S REPORT.

SCHENECTADY, N. Y., April 25, 1899.

C. A. Coffin, Esq., President General Electric Company:

Sir—I submit herewith a brief report of the operations of the Sales Department for the fiscal year ending Jan. 31, 1899.

Total sales (amount billed to customers)	$15,679,430.86
Cost of goods sold, general expenses and taxes, including sundry losses and allowances for losses	13,094,534.25
Profit on sales	$2,584,896.61

ORDERS RECEIVED.—The increase over last year in orders received is 21 per cent. Apparatus orders represent 52 per cent of this increase, supply orders 39 per cent, incandescent lamp orders 9 per cent. The increase in each class is:

Apparatus orders	19 per cent over last year.
Supply orders	24 " " " " "
Incandescent lamp orders	23 " " " " "

Over 124,000 separate supply orders were received and over 8,400,000 incandescent lamps were ordered, during the year.

About 89 per cent of the year's orders were on our standard terms—cash within sixty days.

Orders Received for the Past Five Years.

Fiscal year ending Jan. 31, 1895	$12,160,119
" " " " " 1896	13,235,016
" " " " " 1897	11,170,319
" " " " " 1898	14,382,342
" " " " " 1899	17,431,327

The local office stocks are maintained in good salable condition. The annual inventory shows these stocks classified as follows:

Active	92.5%	$442,380.43
Inactive	6.5%	30,666.60
Obsolete	1.0%	4,976.01
Totals	100.0%	$478,023.04

The improvement in this respect is shown by the following comparisons:

Local Office Stocks for Past Five Years.

	1895.	1896.	1897.	1898.	1899.
Active	68%	82%	86%	90%	92.5%
Inactive	27%	14%	12%	8%	6.5%
Obsolete	5%	4%	2%	2%	1.0%

GENERAL REMARKS.—The past year shows the largest volume of business for the company for any fiscal year since its organization. The increase is well distributed, as shown above.

During the past year large power houses have been constructed or projected in or near many of our large cities, which power plants are centers of distribution of the electric current for railway, lighting and many other and constantly increasing uses and applications. The establishment of such large stations will result in decreased cost and increased use of electric power.

The utilization of water powers by electrical transmission has also been a marked feature of the past year, and the successful transmission of electrical power over the 80-mile line of the Southern California Power Company, at Los Angeles, Cal., is the long-distance record to date of commercial transmission.

Some of the more important water power transmission plants which have been sold by this company are given in the following table:

Total H.P.	Power used at	Transmission Distance in Miles.	Voltage.
1670 H.P.	Redlands, Cal	21	10,000
3000 "	Portland, Ore	14.5	6,000
4000 "	Sacramento, Cal	22.5	11,000
2000 "	Pachuca, Mexico	19	10,000
1407 "	Fresno, Cal	55	19,000
2667 "	Salt Lake City	14	10,000
1206 "	Bakersfield, Cal	16	10,000
5000 "	Ogden & Salt Lake City	40	15,000
800 "	Hookset, N. H	10	10,000
1440 "	Cordova, Argentine Republic	16	10,000
1000 "	Varese, Italy	14	5,000
4000 "	Los Angeles, Cal	80	33,000
2000 "	Provo, Utah	40	40,000
5000 "	Schenectady, N. Y	19	12,000
4000 "	Butte, Montana	21	15,000
235 "	Tuscarora, Nev	10	11,000
300 "	Cripple Creek, Col	10	6,300
1000 "	Hiroshima, Japan	15	11,500
8000 "	Minneapolis, Minn	10	11,000
670 "	North Gorham, Me	14	10,000
800 "	Kingston, Jamaica	21	16,000
400 "	Trenton, Canada	12	11,000
2000 "	West Kootenay, B. C	20	20,000
765 "	Victoria Goldstream, B. C	12.6	10,000

Many of these lines have been in operation for several years, and we have yet to learn of a fatal accident resulting from the use of such high voltages. This record is in striking contrast with the popular expectation and fear expressed as to the results, when such lines were first proposed.

The Spanish War led to an increase in our business in the items of searchlights, cables, marine dynamo sets, etc., considerable as to each item, but small in proportion to our total business.

The increased business of the past year has considerably increased the burden upon our department and local office managers and selling agents whose faithful and efficient work is deserving of commendation.

Respectfully submitted,

EUGENE GRIFFIN,
First Vice-President.

THIRD VICE-PRESIDENT'S REPORT.

Schenectady, N. Y., April 25, 1899.

C. A. Coffin, Esq., President, General Electric Company:

Sir—I submit herewith a report on manufacturing and engineering for the fiscal year ending Jan. 31, 1899.

MANUFACTURING.—The method of determining our factory costs which has proven satisfactory in previous years, has been continued during the present year, such factory costs including all material and labor plus a percentage to cover general expense items and an ample allowance for depreciation. The inventories have been most carefully taken. Financial statistics relating to factory investment are given in the report of the second vice-president. Large additions have been made to our manufacturing plant, and others are now in progress. At the Schenectady Works the large iron foundry mentioned in last year's report as in course of erection, was completed last summer and is now fully occupied. A brick and steel machine shop, covering three and one-fourth acres (142,000 sq. ft.) was begun last June and is now being equipped with the necessary machinery. This large shop will provide unsurpassed facilities for the economical production of the largest apparatus, the demand for which is increasing steadily. Extensions amounting to about 40,000 sq. ft. have been made to other existing buildings, including a suitable building for the safe storage of our valuable patterns. At the Lynn Works the capacity of the steel foundry has been increased 40 per cent, and we have in construction a new building for the manufacture of meters and instruments, the total addition amounting to 35,000 sq. ft.—all substantial, well-lighted, brick buildings. At the Harrison Works, we have, in order to meet the increased demand for incandescent lamps and to improve our facilities, started a new fireproof, four-story building containing about 60,000 sq. ft., which will be completed this summer.

The area of the factory buildings now in use aggregates 1,800,000 sq. ft. (41.3 acres enclosed), and the number of employees now at work is about 9000. In addition to the buildings mentioned, we have expended about four hundred thousand dollars ($400,000) for machinery and tools in the complete equipment of the new buildings and to maintain existing machinery at the point of maximum efficiency and economy.

ENGINEERING.—The demand for electrical machinery of large capacity and special design has continued to increase. A number of the great electrical generators (5000 h.p.) for the new station of the Metropolitan Traction Company at New York, have been completed, and we have under construction an additional order for similar machines, including the transformers and rotary converters to be used in transforming the alternating current into continuous current for the operation of the electric street cars in the borough of Manhattan. The equipment by us of the Buffalo & Lockport Railway with electric locomotives for handling freight, and motor cars for passenger service, is interesting as an instance in which the steam locomotive has been completely displaced by electricity both for freight and passenger service.

The number of installations using alternating generators, in a single generating station, and supplying through our rotary converters, located at convenient distributing points, continuous current for light and power, as described in my last report, has been added to during the year by installations at Philadelphia, Boston and other places. Plants involving the transmission of electricity to long distances have continued to increase in number, those already in operation having been found economical and reliable. We have now in operation about forty long distance transmission plants, employing potentials of from 10,000 volts to 40,000 volts and transmitting power from 10 miles to 80 miles.

About two-thirds of the power required for operating our Schenectady Works is now regularly supplied from a water power at Mechanicsville on the Hudson River, 19 miles away; the production of electricity at high pressure directly in the stationary armature winding of the generators used in this transmission, has, as anticipated, been successful, and has been followed in other similar installations because of its economy and simplicity.

A notable illustration of the flexibility of long distance electric transmission is to be found in the supply of Salt Lake City with electricity from two generating plants, located some 50 miles from each other, the energy being united so as to simultaneously supply electricity over the same set of mains.

The St. Anthony Water Power Company's plant, mentioned in my previous report, has operated so successfully since its installation that additional apparatus to bring the total up to about 10,000 h.p. has been ordered during the past year.

The apparatus for use in the 80-mile transmission to the city of Los Angeles, Cal., mentioned in my last report, has been in successful operation for some months.

Many important orders for electric locomotives, large generators, etc., have been secured in competition with various European manufacturers.

Confidence in the reliability of electrical apparatus is now well established and a general appreciation of its simplicity, flexibility and economy has resulted in a rapid increase in the use of electric motors in older fields and the opening of new. Electric motors are therefore being used in increasing numbers for the driving of machine tools in large and small factories, presses in printing establishments, for ventilating, pumping and mining operations. We have designed many motors specially adapted for such work during the past year.

Our engineers have been actively engaged during the past year in developing the apparatus and details required in new work and in improving and reducing the cost of existing standard lines of apparatus. Numerous improved forms of transformers, arc lamps, meters and instruments, have also been introduced.

We have continued to protect our new designs as far as possible by applications for letters patent.

The work of our factory managers and engineers is worthy of the highest commendation.

Respectfully submitted,

E. W. RICE, Jr.,
Third Vice-President.

SECOND VICE-PRESIDENT'S REPORT.

From the report of Second Vice-President J. P. Ord the following figures are taken and comparison made with reports of previous years:

CONSOLIDATED BALANCE SHEET.

ASSETS.

Dated Jan. 31.	1896.	1897.	1898.	1899.
Patents and franchises	$8,000,000	$8,000,000	$8,000,000	$4,000,000
Factory plants	3,468,002	3,400,002	3,400,002	3,400,002
Real estate (other than factory plants)	453,585	643,016	586,529	615,035
Stocks and bonds	5,479,332	8,545,796	7,455,873	7,226,422
Notes and accounts receivable	6,584,123	4,578,601	4,537,301	5,086,680
Work in progress	961,386	517,866	283,832	507,336
Inventories	4,219,884	4,034,753	3,860,553	4,882,238
Cash	879,686	703,484	1,425,875	1,456,794
Profit and loss (deficit)	13,917,071	12,957,413	11,725,561	--------
Totals	$43,963,069	$43,380,931	$41,275,526	$27,174,507

LIABILITIES.

Capital stock, common	$30,460,000	$30,460,000	$30,460,000	$18,276,000
Capital stock, preferred	4,252,000	4,252,000	4,252,000	2,551,200
5 per cent. gold coupon debentures	8,750,000	8,000,000	6,000,000	5,700,000
Accrued interest on debentures	72,916	66,666	50,000	47,500
Accounts payable	428,153	402,265	263,526	431,496
Unclaimed dividends	--------	--------	--------	11,739
Mortgages	--------	200,000	--------	--------
Reserve for extension to factory plants	--------	--------	250,000	--------
Profit and loss (surplus)	--------	--------	--------	156,571
Totals	$43,963,069	$43,380,931	$41,275,526	$27,174,507

CONSOLIDATED PROFIT AND LOSS ACCOUNT.

EARNINGS.

Years ending Jan. 31.	1897.	1898.	1899.
Sales	$12,540,994	$12,396,093	$15,679,431
Royalties and sundry profits	279,402	128,845	792,591
Interest and discount	88,336	90,371	119,954
Dividends and interest on securities owned	282,144	299,418	342,000
Profit on sales of stocks and bonds	79,817	116,356	324,462
Discount on debentures purchased and canceled	57,139	14,015	2,422
Balance brought forward	12,957,413	11,725,561	--------
Totals	$26,285,245	$24,770,660	$17,260,859
Balance from previous year	$13,917,071	$12,957,413	$1,840,761
Cost of goods sold	9,691,501	9,241,822	11,275,612
General expense and taxes, sundry losses and allowances	1,834,419	1,654,757	1,818,922
Patents and patent expenses	349,919	333,335	269,440
Interest on debentures	431,250	333,333	290,000
Depreciation of inventories	50,355	--------	--------
Depreciation of consignments	10,730	--------	--------
Reserve for factory extensions	--------	250,000	--------
Dividends on preferred stocks	--------	--------	1,609,552
Balance	--------	--------	156,571
Totals	$26,285,245	$24,770,660	$17,260,856

Large Register Order in St. Louis

The consolidation of the principal lines in St. Louis has been followed by a careful consideration of the field and the placing of a number of orders for the new equipment necessitated by increased traffic. One of the first of these orders to be placed was that for registers and was secured by Mr. Carson, president of the Sterling Supply & Manufacturing Company. The order was placed by Mr. Coleman, general manager of the St. Louis Traction Company, the corporation which will operate the lines controlled by Alexander Brown & Sons, and the type specified was the double recording register. This register was described in the last issue of the STREET RAILWAY JOURNAL, and is arranged so that it can record both cash fares and transfers.

The order was one of the first to be placed by the new company and Mr. Carson is to be congratulated upon the recognition secured for the new Sterling double register.

Cord for Arc Lamps and Trolley Cars

The Samson Cordage Works, of Boston, Mass., are devoted exclusively to the manufacture of cords and small ropes for suspending arc lamps, etc., and for use with trolley poles on electric cars. The Samson cord is made from the very best cotton yarns, and is guaranteed free from waste stock. It is braided and finished by the Samson patented and secret process, and is inspected with great care to insure freedom from flaws.

The Samson cord is the result of thirty years' experience in the manufacture of small braided cords, and it is easily distinguished by the colored spots which are woven at frequent intervals through the surface of the cord. When desired, the cords are treated to a coat of waterproofing, that greatly adds to their durability when the material is used where it is subjected to excessive moisture.

Electrical Exhibition at Madison Square Garden

Final arrangements for the electrical exhibition to be held at Madison Square Garden, New York, during May, are being completed. This exhibition promises to exceed in number of exhibits and public interest any previous electrical show that has been held. One of the most prominent features of the 1899 exhibition will be the display of automobiles, and it is thought the exhibit of electrical vehicles will be by far the largest and best ever seen in America, and second only to the great exhibits at Paris. Another interesting feature will be the wireless telegraphy experiments and instruments. The experiments in wireless telegraphy will be more extensive than the ones last year and arrangements have been made for sending messages between different points in the Garden and also from the Garden to points of interest in different parts of the city.

Several valuable Government exhibits have been secured and these will be grouped and attractively displayed. They include apparatus from the army and navy, the signal corps and the weather bureau, and will embrace also not a few interesting relics of the war with Spain.

Recent Consolidations

The air is still full of rumors of consolidations and combinations of street railway companies, many of them simply reports but a number of them well defined. Among the latter may be briefly mentioned the following cities where negotiations are either completed or are well under way.

In Chicago, the Chicago Consolidated Traction Company has made application for the listing of 150,000 shares of its capital stock on the Stock Exchange. This company was chartered Jan. 28, 1899, and in February, 1899, acquired by purchase the entire property of the following named companies: Chicago Electric Transit Company, North Chicago Electric Railway Company, Chicago & North Shore Street Railway Company, North Side Electric Street Railway Company, Evanston Street Railway Company, Cicero & Proviso Street Railway Company, Ogden Street Railway Company, and the Chicago & Jefferson Urban Transit Company. This company has a capital stock of $15,000,000 and the funded debt is $6,085,000, all bonds of the underlying companies.

It is also reported that negotiations which have been in progress for a long time for the consolidation of the larger street railway systems of Chicago have been practically completed. This plan does not contemplate the purchase of the three large companies operating south of Seventy-first Street, i. e., South Chicago Street Railway Company, Calumet Electric Street Railway Company, and the Chicago Electric Traction Company, but does include the Chicago City Railway Company, the North Chicago Street Railroad Company and the West Chicago Street Railroad Company.

In St. Louis, the St. Louis Traction Company has been organized for the purpose of purchasing several street railway properties in the city. In addition to this, the stock of the Lindell Street Railway Company has been increased from $2,500,000 to $10,000,000, which is said to be the preliminary step to the consolidation of all the lines in the city.

All the gas and electric lighting plants in the city of Washington, with the exception of the property of the Capital Traction Company, have been purchased by a syndicate composed chiefly of Baltimore capitalists. It is stated that the purchased roads will soon be consolidated under one system. It is understood that the companies effected are the following: Anacosta & Potomac River Railway Company, the City & Suburban Railway Company, the Georgetown & Tenallytown Railway Company, the Metropolitan Railroad Company and the Washington & Great Falls Electric Railway Company.

As stated in another column of this issue, the Brooklyn Rapid Transit Company has absorbed several additional companies, and now controls practically every street railway and elevated railway line in the borough of Brooklyn, with the exception of the Coney Island & Brooklyn Railway Company.

Société des Tramways Unis de Bucharest is the title of a new company organized at Brussels for operating the tramway system of Bucharest, Roumania. The capital is 8,000,000 fr., and the directors are Josse Allard, Brussels; Eugène Baelde, Saint-Josse-ten-Noode; Hector de Backer, Brussels; Emile Costinesen, Bucharest; Maurice Blanck, Bucharest; Alexandre-Grégoire Jenescu, Bucharest; Samuel Kocherthaler, Berlin; Lucien Van de Vin, Brussels, and Charles Charlier, Brussels.

Railroads in Cuba

The National Railway Publication Company, of New York city, publishers of the "Travelers' Official Railroad Guide," has issued a supplement, giving complete maps, timetables, and lists of officers of all railroads and steamship lines in Cuba. The supplement also contains a page of very interesting notes on the general characteristics of the island of Cuba, with special reference to the conditions of travel by railroad. In part it says:

"The railways are not far behind the times when the conditions by which they have been surrounded and the traffic they have to provide for are carefully considered. The right of way is fenced in, if that is a proper term to use for cactus hedges and stone walls. The roads are laid with steel rails, from 50 to 62 lbs. to the yard, joined with fishplates, with rock ballast, and generally well tied and surfaced. The passenger trains are equipped with air brakes. The freight cars are of smaller dimensions than cars recently built in the United States, and more like those of thirty years ago. The transportation of baggage is paid for, the baggage system resembling that in use on European railways. Three instances will serve to illustrate the rates charged: From Havana to Cardenas, 105 miles, the charge for a trunk of moderate size and weight is $1.30 in Spanish silver, including crossing the ferry from Havana to Regla; from Cardenas to Cienfuegos, 118 miles, the charge is $1.20 in Spanish silver; and from Cienfuegos to Matanzas, 135 miles, the charge is $1.90 in Spanish silver. These charges in American money are equal respectively to 78 cents, 72 cents and $1.08. The railroad fares are generally about five cents a mile in United States money, which means about eight cents a mile in Spanish silver.

"The passenger cars are well adapted to the climate, as well as to the service for which they are intended. Each train, as a rule, consists of three coaches, respectively first, second and third class, although the classes are occasionally divided by partitions in the same car. The conductors and employees on the railroads are usually intelligent, polite and well versed in their duties. On most of the roads buffet lunches are served en route at reasonable prices. Cab fares and porter fees are said to be very reasonable."

Exhibition at Philadelphia

Of the numerous national and international expositions projected for the next three or four years in different parts of the United States, the one to be held in Philadelphia in September, October and November of the present year is in many respects the most important to the trade and commercial interests of the country. The Philadelphia Exposition of 1899 will be an exposition for the development of American manufactures and the expansion of the American export trade and it will be the first national exposition of that character ever held in the United States. The exhibit will be conducted under the joint auspices of the Philadelphia Commercial Museum and the Franklin Institute. The Exposition grounds are situated on the west bank of the Schuylkill River, south of the South Street Bridge and embrace a valuable tract of land of 56 acres in extent, deeded to the Commercial Museum by the city of Philadelphia. The grounds are easily accessible and the buildings are so arranged as to give the greatest convenience to exhibitors and visitors. The Congress of the United States, the Legislature of Pennsylvania and the councils of Philadelphia have indorsed this enterprise and the applications for space already received indicate its complete success.

New Transfer Arrangement in New York

Announcement was made recently that the Third Avenue Railroad Company and the Manhattan Elevated Railway Company, of New York City, had signed an agreement whereby transfers were to be issued to each other's lines at an additional cost to the passenger of 3 cents. The agreement was reached after careful consideration of the probable results, and it is thought the new arrangement will be exceedingly far reaching in its effect upon the traffic of both systems.

The portion of the city most directly benefited by the new transfer arrangement will be the upper part of Greater New York lying in the borough of The Bronx, as it will be possible for a resident of that portion of the city living anywhere near the lines of the Union Railway Company to reach City Hall or the Battery for 8 cents for the trip, and in comparatively good time. This he can do by riding to the northern end of Third Avenue on the electric cars of the Union Railway, and there transferring to the Third Avenue Elevated for an additional fare of 3 cents.

The better traveling facilities secured by the new system will, of course, be shared by the residents of Manhattan Island, though perhaps to a lesser degree. By means of the 125th Street cross-town line and the Forty-second Street and Amsterdam Avenue lines, it will be possible to go from the lower east side to the upper west side, and from the lower west side to the upper east side, or vice versa, for 8 cents instead of 10. Transfer tickets will be issued from the elevated stations to passengers that have paid their fare on the elevated, and from the surface cars to passengers that have paid their fare to the Third Avenue Railroad Company. Over 3,000,000 transfer tickets were required to inaugurate the system.

Metropolitan Street Railway's Rapid Transit Offer Withdrawn

In the last issue of the Street Railway Journal was printed the proposition of the Metropolitan Street Railway Company to the Board of Rapid Transit Commissioners to build an underground railroad in New York for the purpose of furnishing rapid transit to all parts of the city. On April 17, however, the attorneys of the Metropolitan Street Railway Company sent the following letter to the Board, withdrawing its offer for the reasons given:

"Since attending the meeting to which you invited us, with our clients, this afternoon, we have considered the situation as it was then presented, and determined upon the action then indicated to you orally.

"You will remember that at the time of making our proposition of March 27, to build an underground rapid transit railroad, we advised you that our clients considered the difficulties and risks of the undertaking so great that they were not willing to assume them unless assured of popular approval and support; and the correspondence was made public in advance of any action upon it with the understanding that, if it did not prove to be really acceptable to the people of this city, we were to be at liberty to withdraw the offer at any time.

"We made the proposal as advantageous for the city as we consistently could, with a reasonable prospect of profitable investment, and so favorable to the city that from the figures made by our experts as to cost and carrying capacity, the profits seemed to our clients doubtful, and their desire to make the investment, even under the most favorable circumstances, was but slight. While the proposition seemed at first to be received with general approval, and in many quarters was treated in the same spirit in which it was made, we are forced to recognize, and you agree, that criticisms often originating in adverse interests, and attacking the only details of the plan which gave any prospect of profit, have made a lodgment in the public mind, and created an impression that we are trying to drive a hard bargain, and get possession of privileges of great value without rendering an adequate return. Our clients are not willing to occupy this position, and they are satisfied that under such circumstances success in the enterprise would be impossible. They are not willing on these terms to undertake to provide a sum which they estimate at fully $60,000,000, with the certainty of changes in financial conditions long before the work is done and to invest in a novel enterprise of doubtful profit.

"They therefore feel constrained to withdraw their proposition to build the underground rapid transit railroad.

"As you are aware, that proposition had its origin not merely in our clients' wished-for profits, but in a natural inclination to continue and perfect the system of passenger transportation in this city to which they have devoted a great part of the last fourteen years, with results not only profitable to them, but beneficial to the public, and which they could not have accomplished except for the approval and support generously accorded to their efforts by the people of the city. They wish us to express their appreciation of the courtesy and consideration with which you have received and treated them throughout the negotiations."

Death of M. K. Bowen

Menard Kenner Bowen, president of the Chicago City Railway Company, died on Sunday evening, April 9, shortly after an operation for acute appendicitis. He left his office Friday afternoon in his usual health, intending, the following day, to start for Colorado Springs upon a holiday, but in the evening severe pains came on and at a consultation of physicians at midnight, the trouble was recognized as appendicitis and in an advanced stage, and it was determined to remove him to the Chicago Hospital for an operation. This was performed Saturday morning at an early hour, but the disease had progressed too far to be checked, and although the patient rallied after the operation and made a hard struggle for life, the end came at about nine o'clock Sunday evening.

The funeral on Wednesday was one of the most impressive ever seen in Chicago, by reason of the presence in the assembly at Mr. Bowen's residence of many hundred street railway employees, as well as some of the wealthiest and most prominent citizens of Chicago. An escort of 800 men in the train service department of the Chicago City Railway, with the band of the Cottage Grove Avenue Trainmen's Association playing a funeral march, accompanied the body to the train for Jackson, where it was to be interred. The entire procession was over half a mile long. Mr. Bowen leaves a widow and two children, twelve and four years old, respectively.

It is probable that few street railway managers have so fully won the confidence and affectionate regard of their employees as M. K. Bowen. When he became superintendent of the Chicago City Railway in 1891, it was determined by the employees, then a rough, heterogeneous mass of men of all nationalities, and practically all members of labor unions, to make the new superintendent's work as hard as possible, and, in fact, to "run him out of town." Instead of accomplishing this, the unruly element was weeded out, and a strong and coherent body of employees was formed, which quickly came to look upon Mr. Bowen as an absolutely fair-minded, straightforward man, on whose sense of justice they could rely and whose magnificent ability as an organizer and manager they could admire. Mr. Bowen has rarely failed in carrying out any plan which he had at heart, and his directors recognized his services by advancing him from the position of superintendent to that of general manager, and eventually of president of the company—a company, one of the strongest and most prosperous in the United States. It is characteristic of the man that when early on Saturday morning he knew that the operation must be performed, and realized as others did not that the result of his long struggle of years against disease was likely to be fatal, he put aside his own pain and trouble long enough to send for Superintendent Nagle, of the Chicago City Company, to whom he gave some final directions concerning its management, and bade farewell.



M. K. BOWEN

Mr. Bowen was a man in the prime of life, being but forty-one years of age. His father was Gen. John S. Bowen, a graduate of West Point, and his grandfather, Pierre Menard, first Lieutenant-Governor of Illinois. He was educated at St. Louis and Washington Universities, and at the age of nineteen, entered the Government service as assistant engineer in civil engineering work on the Mississippi River. In 1880 he was engineer in charge of the topographical survey of the St. Louis & San Francisco Railway from Fort Smith, Ark., to California. He first became identified with street railway work in Kansas City, becoming chief engineer and superintendent of construction for the Kansas City Railway Company, then building its cable line. A little later he became the New York representative of the Short Electric Railway Company, and in 1891 entered upon his eight years' service with the Chicago City Railway Company.

During his connection with this system Mr. Bowen was instrumental in bringing about important changes and extensions. The methods of conducting the business of the company were revised, new lines constructed, old ones rebuilt, and the motive power changed to electricity on all but the trunk lines, which are operated by cables. Mr. Bowen himself made no pretensions to inventive genius, nevertheless he demonstrated his ability to design and improve methods, and his opinion on all matters pertaining to street railway management had come to be highly regarded.

To his many friends in street railway circles, Mr. Bowen's death causes grief as at the loss of a close personal friend. He was singularly winning and generous in his friendships, granting to all credit for the best intentions and rarely taking offence. An unkindly word of another was almost unheard from his lips, for his principle in life seemed to be to "think no evil of any man." He was a rare character and a friend long to be remembered among those who enjoyed his friendship.

Personal

MR. W. R. BENSON has been appointed manager of the Easton Consolidated Electric Company, of Easton, Pa.

MR. C. D. MENEELY has been appointed assistant secretary and treasurer of the Brooklyn Rapid Transit Company.

MR. H. M. BRINCKERHOFF has been made assistant general manager of the Metropolitan Railway Company of Chicago.

MR. JAMES R. CRAVATH, a well-known electrical engineer, was married on April 19 to Miss Ruth M. Rew, at Grinnell, Ia.

MR. WILLIAM P. GANNON has been elected president of the Syracuse Rapid Transit Railway Company, in place of Charles R. Flint.

MR. U. H. McCARTER has entered upon his duties as secretary and treasurer of the New Jersey Electric Railway Company, of Hoboken.

MR. ARTHUR ORR, a prominent Board of Trade operator and capitalist, has been elected director of the Chicago City Railway Company in place of Mr. Bowen.

MR. GEORGE HURD, of Toledo, Ohio, has been appointed manager of the Janesville Street Railway Company, of Janesville, Wis., in place of Fred O. Greene, resigned.

MR. J. L. HINES, formerly president of the New Jersey Electric Street Railway Company, of Hoboken, N. J., has resigned, and has been succeeded by Mr. Chandler W. Riker.

MR. J. W. MEAKER, JR., will open an office in Chicago, where he will handle street railway specialties. Mr. Meaker has for some time been connected with the Meaker Manufacturing Company.

MR. ALBERT S. RICHEY, formerly electrician for the Citizens' Street Railway Company, at Muncie, Ind., has resigned to accept a position as electrical engineer of the Marion City Railway Company and its interurban branches, at Marion, Ind.

MR. G. HARRY GARRISON, secretary and treasurer of the Cortland & Homer Traction Company, of Cortland, N. Y., has resigned his position to accept another one in Troy. Mr. Garrison on the eve of his departure was tendered a farewell banquet by a number of his friends.

MR. FRANK W. CARR has accepted the position of Superintendent of The Falk Company, of Milwaukee. Mr. Carr for some time past has been the chief engineer and superintendent of electrical construction for the West Chicago Street Railway Company, and is a thoroughly well-informed electrical engineer.

MR. L. D. TANDY, one of the engineers of the railway department of the General Electric Company, has severed his connection with that company and sailed for Europe, April 15. Mr. Tandy will make his headquarters in London and will be associated with Messrs. John Hays Hammond and Henry A. Butters in their continental electric railway enterprises.

MR. F. L. HART, until recently general manager of the Baltimore City Passenger Railway Company, has been engaged by the Crosby-Lieb syndicate in Washington as manager of the street railway and electric lighting properties which are now in process of consolidation, and has at once commenced work on the construction of 20 miles of underground conduit track construction.

MR. MAURICE COSTER, for three years manager for the Westinghouse Electric & Manufacturing Company at Chicago, has sailed for Europe, where he will enter upon the duties of general manager of the Société Industrielle de Electricité Procédés Westinghouse, a French company newly formed to manufacture and sell Westinghouse electrical machinery and apparatus on the continent of Europe.

MR. W. F. HAM, formerly secretary of the Nassau Electric Railway Company, has been appointed auditor of the entire Brooklyn Rapid Transit system, and has entered upon his new duties. Mr. Ham is an expert accountant, and has given the subject of street railway accounts most careful study. He was one of the organizers of the Street Railway Accountants' Association, and has been one of its hardest workers since its beginning.

MR. ERVIN G. LONG, vice-president of the Peckham Truck Company, of Kingston, N. Y., was married to Miss Cora A. Reynolds on Wednesday afternoon, April 26, 1899, at Christ Church, Poughkeepsie, N. Y. Mr. Long is one of the best-known supply

men in the street railway field, and his large circle of acquaintances will wish him the heartiest congratulations at this time. Mr. Long has recently returned from a very successful business trip in Europe.

MR. FRANK X. CICOTT, who was well known in electrical and tramway circles on both sides of the Atlantic, died recently at the home of his sister in Detroit. Mr. Cicott had just returned from a trip around the world, undertaken to investigate the possibilities for the investment of American and European capital in tramway enterprises abroad, and some articles from his pen on foreign practice have appeared in recent issues of this paper. Mr. Cicott was at one time director of the United States Government mint at San Francisco.

MR. BURT VAN HORN has received the appointment of general manager of the International Traction Company, of Buffalo. As announced in the last issue of the STREET RAILWAY JOURNAL, this company is completing the consolidation of a number of street railway companies in the city of Buffalo and vicinity, and the combined system will be one of the largest in the East. Mr. Van Horn is well known to the street railway fraternity, and he enjoys the reputation of being an exceptionally able and well-informed street railway manager. He has the best wishes of his many acquaintances in entering upon his new duties.

MR. R. M. DOUGLASS, until this month secretary, treasurer and general manager of the Schuylkill Valley Traction Company, of Norristown, Pa., has accepted the position of general superintendent of the Cleveland Electric Railway Company, having entire charge of the property, under President Everett. Mr. Douglass entered the street railway field about five years ago, his first work being the building of the Syracuse & East Side Street Railway, of which he had general charge until the sale of the property. He then went to the Brooklyn Heights Railway Company as superintendent, but on account of severe and protracted illness he gave up this position in order to take that at Norristown, where he has since been an active and efficient manager.

MR. E. H. CHAPIN, who was formerly connected with the STREET RAILWAY JOURNAL and later with the Standard Oil Company, of New York, has recently opened an office in Rochester, with headquarters in the Granite Building, where he will represent the Burnett Company, of New York, dealers in railroad, electrical, marine, mining and milling supplies, and also the Swan & Finch Company, of New York, refiners and dealers in lubricating oils and grease. This latter concern has been engaged in the manufacture of oil and grease since 1853, and is well known in the trade. Mr. Chapin's energy and popularity insure a successful business in anything which he undertakes and in his new business he has the best wishes of his former co-workers on this publication.

MR. DAVID G. HAMILTON, the new president of the Chicago City Railway Company, succeeding Mr. Bowen in that position, is one of the best-known street railway men in the United States, having been for many years a regular attendant at the conventions of the American Street Railway Association, where his advice and counsel have always been sought and have had great weight. As Mr. Hamilton has been the responsible financial head of a half-dozen or more street railway properties in St. Louis of which Mr. Robert McCulloch has been the chief executive, and his street railway experience, gained partly in this connection and partly as a large stockholder and director, and latterly second vice-president, of the Chicago City Railway Company, has been intimate and wide. Mr. Hamilton was born in Chicago in 1842, and nearly all his life was spent in that city. He studied law at the old Chicago University, and entered upon a practice later on, but after a number of years he became interested as investor and financier in many important financial undertakings in Chicago, and especially in real estate. He is Western director of the Union Life Mutual Insurance Company, of Maine, a member of the board of trustees of the University of Chicago and of De Pauw University, and is a member of several clubs of Chicago.

AMONG THE MANUFACTURERS

THE EDW. P. ALLIS COMPANY, of Milwaukee, Wis., has just booked a large order from Russia for mining and pumping machinery.

PEPPER & REGISTER, of Philadelphia, Pa., have removed their offices to rooms 712 and 715 Fidelity Mutual Life Building, North Broad Street, Philadelphia.

THE Q. & C. COMPANY, of New York city, is about to make extensive shipments of pneumatic tools to Russia, Paris and London. This company is doing an excellent foreign business.

E. F. DE WITT & COMPANY, of Lansingburg, N. Y., manufacturers of the "Common Sense" sand box, have appointed the W. R. Garton Company, of Chicago, Western agents for these sand boxes.

DICK BROS. & CO., bankers, of New York and Philadelphia, announce that William R. McLaughlin, formerly of the "Electrical World," will represent them in the placing of investment securities.

THE JACKSON & SHARP COMPANY, of Wilmington, Del., reports that it is exceptionally busy at this time, having more orders for both open and closed car bodies than it has had at any one time in years. This company has also just shipped some large double truck, double deck cars to the Argentine Republic.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., is sending out Bulletin M, which is devoted to the Sturtevant electric propeller fans, for ventilating buildings of all classes, smoking and dining rooms, restaurants, kitchens, bakeries, boiler rooms, etc.

THE ELECTRICAL INSTALLATION COMPANY, Monadnock Block, Chicago, announces to the trade in a handsomely engraved notice that after May 1 it will be at home to its friends in new offices at 1516 and 1517 Monadnock Block, directly over and four floors above its old location.

THE HENRY R. WORTHINGTON PUMP WORKS, of New York, are well filled with foreign orders, and their weekly shipments to Europe average two carloads. This concern will furnish the pumping machinery which is to furnish the water supplied for the coming Paris Exposition.

THE JEWELL BELTING COMPANY, of Hartford, Conn., has completed and has ready for shipment two leather belts which were ordered by a firm in a leading city in France. The belts are ½-in. in thickness, 5 ft. in width, and together are 225½ ft. long. They weigh over 2400 lbs. and will undoubtedly be the widest belts in France.

THE ABENDROTH & ROOT MANUFACTURING COMPANY, of New York, manufacturer of the Root improved water tube boiler and Root's spiral riveted pipe, on May 1, removed from its former location at 28 Cliff Street, to the new building erected at 99 John Street, where it will occupy commodious offices on the sixth floor.

THE EDW. P. ALLIS COMPANY, of Milwaukee, Wis., will furnish two 750-h.p. direct connected vertical cross compound condensing engines to the North River Light, Heat & Power Company, of Hoboken, N. J., and two direct connected cross compound condensing engines of 300 h.p. and 450 h.p., respectively, for a new electric railway at Lebanon, Pa.

WILLIAMSON & COMPANY, of Allegheny, Pa., have published a descriptive catalogue of the Ramsey signal system. This system is now well known to electric railway managers, and is in operation on many single track roads. The catalogue contains a number of interesting testimonial letters, and also a complete diagram showing the working of the system.

THE TURNER ENGINEERING COMPANY, of Bucyrus, Ohio, is furnishing the "Turner" water tube boiler, 250 h.p., for the Findlay Ohio Street Railway; two 200 h.p. for the Central Traction Company, and three 225 h.p. for the Indianapolis Ice & Cold Storage Company. Large boilers of this type recently put into service are showing excellent results.

THE WESTERN ELECTRICAL INSTRUMENT COMPANY, of Newark, N. J., is making contracts for its new factory at Waverly, N. J., a suburb of Newark. A railway switch has been constructed to the spot, and ground was broken recently for the erection of what will be one of the most complete manufacturing establishments in the United States.

JOHN E. DE LEON, of Buffalo, N. Y., after numerous experiments, has perfected a unique electrical exhibition for street railway parks and pleasure resorts. His exhibition consists of several feats upon a bare wire cable charged with electricity. The cable and his body are outlined with numerous incandescent lights of various colors, and some very startling and attractive results are secured.

THE DUPLEX CAR COMPANY, of New York, has found it necessary to extend its factory capacity, on account of the number of orders received. Many of the cars this company is building for foreign delivery are arranged with a single seat on one side of the aisle and a double seat on the other. The officers of the company report excellent prospects for a large business during the next few months.

THE DORNER TRUCK & MANUFACTURING COMPANY, of Cleveland, Ohio, has received an order for trucks from the Cleveland & Eastern Railway Company. The truck used will be the company's latest type, No. 15 Criterion pivotal motor truck. The Dorner Truck & Manufacturing Company also has some good orders for its No. 11 Criterion single motor truck, and two orders of ten trucks each for its new Moore truck.

THE FRANK M. PIERCE ENGINEERING COMPANY, of New York city, has closed a contract with the Amsterdam Street Railway Company, of Amsterdam, N. Y., to install a 250-h.p. Erie Ball engine to be direct connected to two 80-kw. G. E. generators. The Frank M. Pierce Engineering Company has also shipped a 100-h.p. engine for electric work at a mining plant in North Japan; also two 125-h.p. engines to the same country.

WINTHROP G. NORRIS & COMPANY, of Boston, Mass., have completed plans and specifications for a power station and car barns for the Gardiner, Westminster & Fitchburg Railway Company. This will be a direct connected station, with Slater compound condensing engines. The road will be 9 miles in length with a branch of about 2 miles from South Fitchburg to Wauchusett Lake. The work will be pushed rapidly to completion.

CHANGE OF OWNERSHIP.—It is announced that all the capital stock of the Commercial Electric Supply Company, of St. Louis, Mo., has been purchased by William F. Nolker, his sons and associates. Mr. Nolker proposes to increase the capital stock of the company and to place the Commercial Electrical Supply Company in a very enviable position. The management and general personnel of the company will remain about as heretofore.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has taken the contract for the new roof on the East Armory of the Colt's Fire Arms Manufacturing Company, at Hartford. This roof is 60 ft. wide and 500 ft. long, and is to be entirely recovered. The new roofing is to be the Berlin Iron Bridge Company's anti-condensation fireproof roof lining, consisting of anti-condensation lining underneath the corrugated iron outside covering.

THE ERICSSON TELEPHONE COMPANY, of New York, has moved its offices from 20 Warren Street to 296 Broadway. This company's specialties have been sent to a large number of cities of this and foreign countries, and the Ericsson telephones need no introduction. The company's latest catalogue contains interesting descriptive matter on the different types of receivers and transmitters and telephone sets that are carried in stock.

THE AMERICAN RAIL JOINT & MANUFACTURING COMPANY, of Cleveland, Ohio, has closed contracts with the Erie & Cambridgeboro Electric Railway Company for joints on about 25 miles of track; with the Orleans & Jefferson Railway Company for 9 miles, and the Kansas City & Leavenworth Railway Company for 11 miles; a total of about 21,000 joints. This company so far this season has made contracts for about 40,000 joints.

THE ELECTRICAL INSTALLATION COMPANY, of Chicago, is furnishing the overhead construction for the Northeast Electric Railway of Kansas City, and the Grand Avenue division of the Brooklyn Avenue Railway Company of Kansas City, and also about a thousand iron poles for the Metropolitan Street Railway Company of Kansas City. It has also recently secured a contract for building an extension to the Vicksburg Electric Railway, Vicksburg, Miss.

C. TOWNSEND BLAKE, of Philadelphia, Pa., reports that he is now installed in his new offices at 612 Girard Trust Building, Philadelphia, and is prepared to transact business in his former prompt manner. He is prepared to buy and sell and to quote prices on all unlisted street railway, steam railroad and gas bonds. In addition to this he has opened a municipal department under the management of Robert Hancocks, and will be pleased to negotiate either for the purchase or sale of any issue of municipal bonds.

LAING, WHARTON & DOWN, LTD., of London, are sending out a neat catalogue describing the Vril electric launches, which are manufactured by this firm. These launches are operated by storage batteries, and the machinery is fitted in water-tight compartments, taking up no room that can be occupied for passenger accommodation. During the time the launch is running the machinery requires little attention, and is free from danger. The services of but one man are required to both control the machinery and steer.

THE GARTON-DANIELS ELECTRIC COMPANY, of Keokuk, Ia., is sending out some interesting leaflets describing Garton lightning arresters. A paragraph from one of these is particularly worthy of note. It is as follows: "Use plenty of pole arresters—they cost much less than repairs, and do not require constant attention. Never ground your lines. Offer the discharge many paths to earth before coming to your station. Relieve the strain on the insulation of your entire system." The manufacturers of the Garton arresters claim that these instruments contain all the desirable features of a lightning protective device.

SPECIAL CATALOGUE.—The Peckham Truck Company, of Kingston, N. Y., and New York city, has just issued another one of its series of elaborate and valuable catalogues. This one is devoted to the Peckham system of single electric trucks, and consists of fourteen sheets, 15 ins. x 8 ins., of heavy paper bound together with fasteners, with heavy covers. Upon one side of each sheet is printed a handsome engraving of some special type of single truck, and on the opposite side of many of the sheets appears an engraving of a car mounted upon that particular truck. The engravings of the trucks are printed with tinted background, and the details of all the parts are clearly brought out. This company has also issued a catalogue of the same general style devoted to double trucks.

MERCHANT & COMPANY (Inc.), of Philadelphia, New York and Chicago, have recently received an order from the War Department for 786 of their galvanized "Star" ventilators, for use on the officers' quarters and barracks to be erected at Havana and Matanzas, Cuba. There will be 587 "Star" ventilators, 24 ins. in diameter, and 199, 14 ins. in diameter. Some idea of the size of the order can be had, when it is stated that if these ventilators were placed in a line with their edges touching, they would cover a distance of nearly half a mile. Within the last few months Merchant & Company (Inc.) have also supplied 500 ventilators, 18 ins. in diameter, for the new government hospitals at Fortress Monroe and Savannah.

THE KEUFFEL & ESSER COMPANY, of New York city, the well-known manufacturers of everything required in the science of drawing and measuring, report a constantly increasing demand for their goods. This company is known throughout the world, and its goods are recognized as standard by a very large number of leading architects, surveyors, draftsmen, etc., of the country. This firm makes most of its goods in its own factory and absolutely controls nearly all goods which it imports. It warrants all materials and instruments to be exactly as represented. Its profusely illustrated catalogue of over 400 pages should be in the hands of everyone interested in any way in drawing or measuring instruments or materials, and this pamphlet will be sent free of charge on request.

THE W. R. GARTON COMPANY, of Chicago, of which W. R. Garton is president and treasurer, and Ray P. Lee is secretary, has just moved into its new quarters, suite 603-604 Manhattan Building, where it enters the second year of its existence under the most auspicious of circumstances. This company represents, among others, the Electric Railway Equipment Company, of Cincinnati, Ohio, whose exceptional line of iron and steel, tubular and ornamental poles, brackets and trimmings, as well as a most complete line of figure 8, and round trolley, overhead material is so well and favorably known. The W. R. Garton Company has closed several very large contracts in these lines; in fact, reports a business for the various manufactures whom its represents of over $50,000 during the last forty days.

A WELL-KNOWN SUPPLY AGENCY.—Charles N. Wood, of Boston, Mass., agent and representative for many of the leading street railway supply houses in America, reports a constantly increasing business. Mr. Wood has recently formed a consolidation with the Frank Ridlon Company, with offices at 200 Summer Street and 31 State Street, Boston, and this has resulted in a very large increase of orders. Among the firms represented by Mr. Wood are the R. D. Nuttall Company, International Register Company, American Heating Corporation, Wilson, Thompson & Company, Van Wagoner & Williams Hardware & Mining Company, etc., so he is in a position to execute promptly contracts for almost any specialty required by a street railway company. Mr. Wood's extensive exhibit at the last convention, at Boston, will be remembered by all convention goers.

THE GENERAL ELECTRIC COMPANY, of Schenectady, N. Y., has issued from its press during the past month the following catalogues and circulars: Bulletin No. 4168, describing single-phase alternating current generators, 60-cycle revolving armature type; Bulletin No. 4169, describing the two-rate meter and system; Bulletin No. 4170, running light tell-tale boards; pamphlet by Carl D. Haskins, on the "Management of Central Station Meter Systems;" and an exceedingly tasteful brochure devoted to the subject of fan motors. The latter is profusely illustrated, showing all the various types of alternating and direct current fan motors for ceilings, walls and desks, and other special requirements. The company has also issued Bulletin No. 4106, on direct current lightning arresters, magnetic blowout type, M. D.; No. 4167, on assembled commutator segments for railway motors; and No. 4171, on railway line material.

THE MANHATTAN RAILWAY COMPANY, of New York, has recently placed one of the largest single orders for transfer tickets ever given. This company has made transfer arrangements with the Third Avenue Railroad, and as the system went into effect April 29, it was necessary to have the tickets printed on very short notice. To inaugurate the system many millions of tickets were required, there being 427 stations, each requiring its special ticket. The general style was not decided upon until Tuesday noon, April 18. A special paper was required, therefore it had to be made for the purpose. Geometric lathe work tints had to be engraved, and owing to the work required special machinery had to be arranged. All this had to be done, and at least three million transfer tickets delivered by Tuesday noon, April 25. The work of furnishing these tickets was given to the Globe Ticket Company, of Philadelphia, and the confidence placed in this concern by the Manhattan Railway Company speaks well for its resources and reputation.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, Mo., is pushing the street railway branch of its business this season, and is evidently receiving some very gratifying results. The head of this department, Charles Scudder, Jr., reports some very flattering results and a constantly increasing demand for the company's goods, of which it has a most excellent assortment, and of a quality that will bear inspection. The company is now Western agent for some of the most prominent manufacturers in the country and has taken every precaution in the selection of the goods represented. This has resulted in the company offering to the trade a very high grade of supplies necessary in the construction and maintenance of a street railway. The company is carrying a very complete railway stock in St. Louis, which has been found to be of great assistance and value in sustaining its reputation for prompt shipment, which its experience has shown to be second only to the quality of the goods furnished.

THE WARREN-WEBSTER COMPANY, of Camden, N. J., report the following recent sales of Webster vacuum feed water heaters and purifiers: S. S. Mascotte; Creedmore Mining Company, Creede, Col.; Freemont Electric Light Company, Cripple Creek, Col.; Washington County Court House, Washington, Pa.; St. George's Hotel, Evansville, Ind.; St. Louis Club, St. Louis, Mo.; New York, New Haven & Hartford Railroad Company Depot, Providence, R. I.; Gaensslen Fisher Glue Company, Gowanda, N. Y.; Cleveland Twist Drill Company, Cleveland, Ohio; Masonic Temple, Boston, Mass.; Arapahoe County Poor Farm, Denver, Col.; Winship Machine Company, Atlanta, Ga.; J. R. Keim & Co., Philadelphia, Pa.; Boston Rubber Shoe Company, Malden, Mass.; Walworth Con. & Supply Company, Boston, Mass.; Morris Building Company, Mills No. 3, Brooklyn, N. Y.; Massachusetts Cotton Mills, Lowell, Mass.; Hazard Manufacturing Company, Wilkesbarre, Pa.; Calvin, Pardee & Company, Harwood Colliery, Pa.; Conkling Chemical Company, S. Chicago, Ill.

THE HARRISBURG FOUNDRY & MACHINE WORKS, through their Boston office, have been awarded the contract for furnishing Harrisburg standard engines of a capacity of over 4000 h.p. There are ten engines in the order, each engine weighing 60,000 lbs., which will develop 350 h.p.; maximum capacity 400. These engines are for the immense new plant of the Great Northern Paper Company, which has purchased thousands of acres of timber land, erected enormous buildings and machinery in the northern part of the State of Maine, and which will be the largest paper producing plant in the world. This order is just one-half of the entire order, which will be nearly 10,000 h.p.. This, it is stated, is the largest order for engines of the wheel governing type ever placed in this country, and was obtained in open competition at better prices than were made by other concerns. The Harrisburg Foundry & Machine Works have been so crowded with work as to necessitate running day and night for the last six months, and it is fortunate that their new plant is so rapidly nearing completion, for it is only on account of this that it has been possible for them to accept the present rush of orders.

A. L. IDE & SONS have recently made the following contracts for "Ideal" engines: Fountain City, Wis., one 70 h.p., belted; Monterey Electric Light Company, Monterey, Mexico, one 250-h.p. and one 110-h.p. tandem compound engines, belted; Kingan & Company, Indianapolis, one 70-h.p., direct connected; Emery, Bird, Thayer Dry Goods Company, Kansas City, one 260-h.p., direct connected; the Kuntz-Remmler Company, Chicago, one 45-h.p., belted; Kingman Plow Company, Peoria, Ill., one 100-h.p., belted; Janney, Semple, Hill & Company, Minneapolis, Minn., one 60-h.p., direct connected; Caro Light & Power Company, Caro, Mich., one 300-h.p., belted; Bonham Electric Light Company, Bonham, Tex., one 60-h.p., belted; F. W. Horne, Yokohama, Japan, one 40-h.p., direct connected; Boston Store, Davenport, Iowa, one 100-h.p., direct connected; Pilgrim Hotel, Marshalltown, Iowa, one 60-h.p., direct connected; Illinois Central Railroad Company, Chicago, Ill., one 80-h.p.; Deadwood & Delaware Smelting Company, Deadwood, S. Dak., one 100-h.p., direct connected; Hillman Building, Chicago, one 125-h.p. and one 150-h p. tandem compound engines, direct connected; Illinois State Reformatory, Pontiac, one 200-h.p., belted; Lancaster Electric Light Company, Lancaster, Wis., one 100-h.p., belted; Kieckhefer Bros., Milwaukee, one 190-h.p., direct connected; C. J. Smith & Sons, Milwaukee, one 125-h.p., direct connected; Anheuser-Busch Brewing Association, two 125-h.p., direct connected; Chicago & Great Western Railroad Company, for shops at Oelwein, Ia., one 180-h.p. and one 300-h.p.; City of Barnesville, Minn., one 60-h.p., direct connected; Empire Zinc Company, Joplin, Mo., one 150-h.p. and one 100-h.p., direct connected; Mississippi River Commission, two 500-h.p. tandem compound engines; W. J. Lemp Brewing Company, St. Louis, two 100-h.p. engines, direct connected, and one 60-h.p., direct connected.

New Publications

Circular No. 10. Published by the Street Railway Accountants' Association of America. Paper. 17 pages. Illustrated.

This pamphlet is being sent out from the secretary's office of the Street Railway Accountants' Association, and is a full and clear explanation of the objects, aims, and advantages of the association. To street railway companies desiring to improve and extend the usefulness of their accounting departments this pamphlet will be of considerable interest. The book contains also the constitution and by-laws of the Accountants' Association, with a list of members.

Preliminary Report on the Income Account of Railways in the United States for the Year Ending June 30, 1898. Paper. 70 Pages. Compiled and published by the Interstate Commerce Commission, Washington, D. C.

As stated in the title, this is a preliminary report of the Interstate Commerce Commission on the income and expenditures of railways in the United States, for the year ending June 30, 1898. From this report it appears that the total gross earnings of the railways during the year were $1,238,523,380, an increase over the previous year of $116,433,607. Of the aggregate gross earnings, $332,892,782 are from passenger service and $874,865,487 from freight service. The operating expenses of the roads were $811,-241,458, an increase over the previous year of $58,716,694. The net earnings for 1898 were $427,281,922, an increase of $57,716,913. The total mileage reported is 181,334 miles of track.

Trade Catalogues

The Ramsey Signal System. Published by Williamson & Co., of Allegheny, Pa. 12 pages. Illustrated.

Vril Electric Launches. Published by Laing, Wharton & Down, Ltd., London. 30 pages. Illustrated.

The Sturtevant Electric Propeller Fans. Published by the B. F. Sturtevant Company, of Boston, Mass. 4 pages. Illustrated.

Catalogue. Published by Ericsson Telephone Company, of New York city. 24 pages. Illustrated.

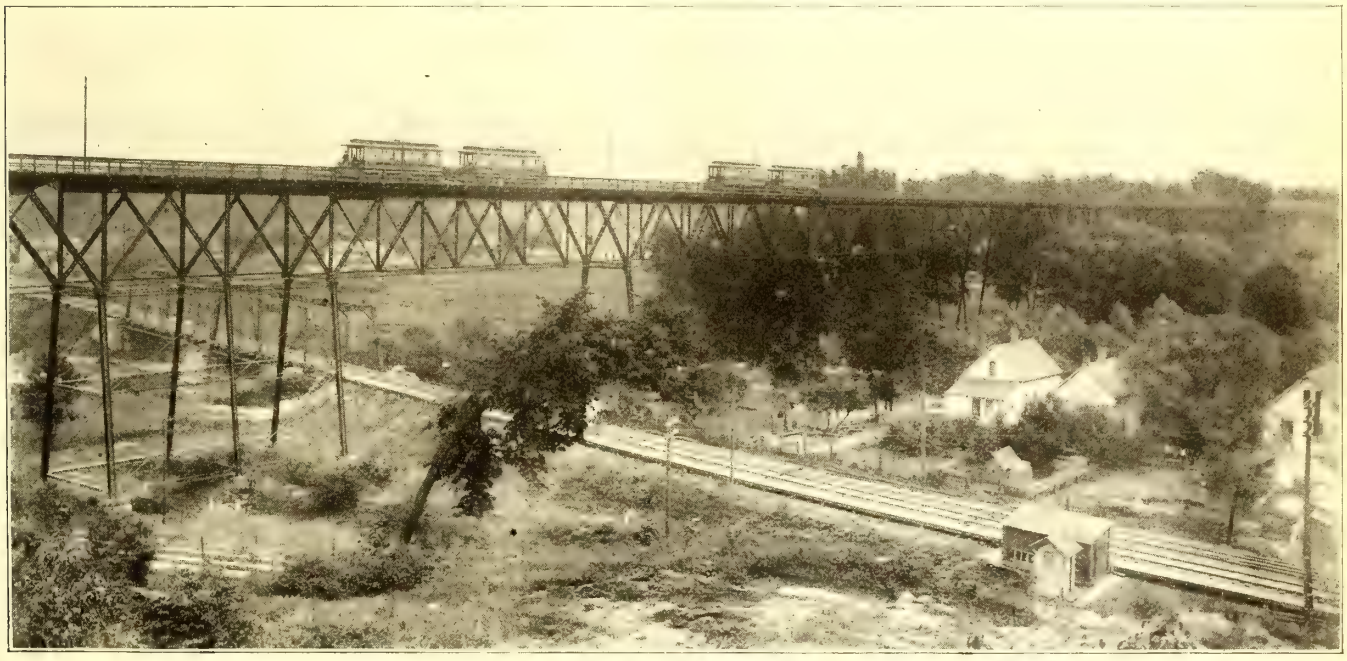
Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, JUNE, 1899. No. 6.

THE ELECTRIC RAILWAY SYSTEM OF MILWAUKEE AND EASTERN WISCONSIN

U. JUN 3 1899 S. PATENT OFFICE

In the State of Wisconsin and counties of Milwaukee, Waukesha, Racine and Kenosha lies an electric railway system remarkable in many respects, and the recent development of which is little known to the "outside world." Its nucleus is the city railway system of Milwaukee, which is a consolidation, effected in 1891-2, of several smaller lines until then in independent operation. Additions have been made by the purchase of existing lines and the building of new ones, until now the system reaches out 7 miles to Whitefish Bay on the north; 25 miles to Waukesha Beach on the west, and nearly 35 miles to Kenosha on the south. A dozen cities and villages, with an aggregate population exceeding 350,000, are served by the 225 miles of track which at present comprise this system—a trackage which places this among the half-dozen great properties of the country.



VIADUCT AT WAUWATOSA—MILWAUKEE STREET RAILWAY SYSTEM

This is not all. The plans of the present management are broad and comprehensive, and include the immediate construction of a line extending from the southern terminus of the present system through to Chicago, connecting there with the Chicago city system; while on the west and north it is intended to push the lines rapidly onward through the beautiful lake district, in which are thousands of summer homes of Chicago, St. Louis and Milwaukee business men.

For financial and business reasons this entire system centering in Milwaukee is operated by two separate companies, the Milwaukee Electric Railway & Light Company, which owns the city lines and does the city and commercial electric lighting, and the Milwaukee Light, Heat & Traction Company, which owns all the interurban lines, and also has electric lighting departments in several of the cities reached by its railway lines. The entire capital stock of the Milwaukee Light, Heat & Traction Company is in the treasury of the Milwaukee Electric Railway & Light Company, and a controlling interest in the stock of the latter is owned by the North American Company, of New York, which also owns a controlling interest in the Cincinnati Edison Electric Company. In practice the two Milwaukee companies are operated as one, although their accounts are kept entirely separate.

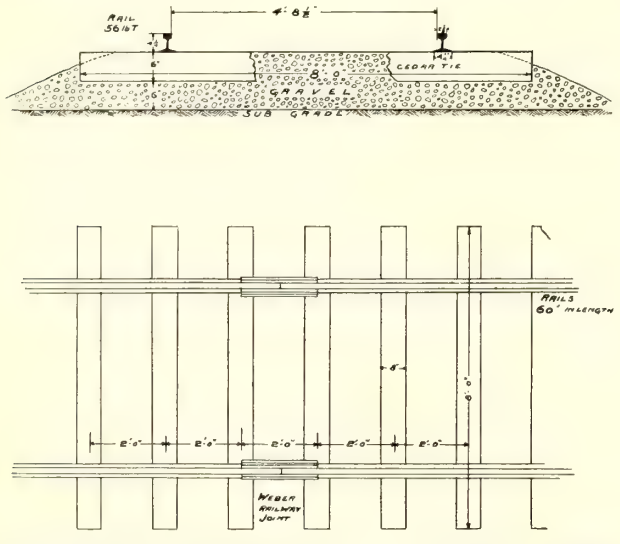
RAILWAY FARES AND LIGHTING CHARGES

Within the city limits of Milwaukee a uniform 5-cent fare is charged, and transfers are given freely for a continuous trip. Outside the limits the rates vary from 10 to 60 cents single fare, and 50 per cent is added for the round trip. The fare from Milwaukee to Racine, for example, is 40 cents single trip, 60 cents round trip; from Milwaukee to Kenosha it is 60 cents single trip and 90 cents round trip; from Milwaukee to Waukesha Beach it is 50 cents single trip, 75 cents round trip; and from Milwaukee to Whitefish Bay it is 10 cents single trip, 15 cents round trip. The rate for a private car from Milwaukee to Waukesha Beach is $25 round trip, each car seating fifty passengers,

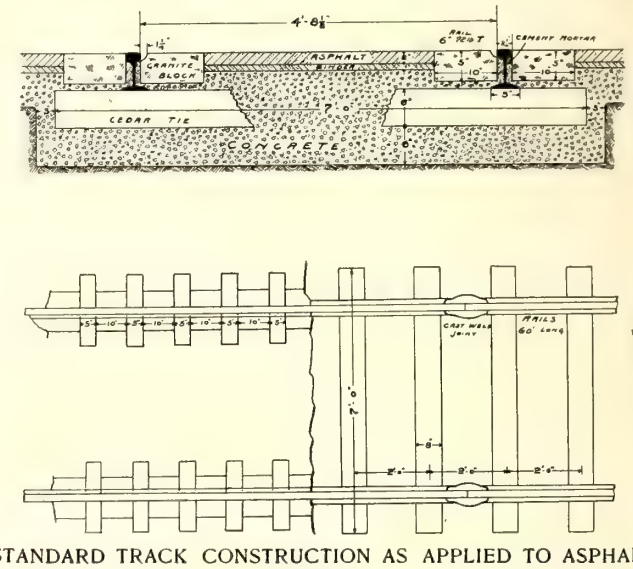
and the city rates for private cars vary from $5 for the short single-truck car to $15 for the magnificent illuminated car "Marguerite," the rates being based on a three-hour run, with an extra charge for each additional hour.

The charges for lighting are as follows:

For direct current low tension power for lighting circuits, 20 cents per 1000 watt hours, subject to 25 per cent discount for incandescent lamp use up to 125,000 watt hours per month, and 50 per cent discount above that figure. Current for electric motors is charged for at the rate of 10 cents per thousand watt hours, subject to discounts ranging from 5 per cent for use of 100,000 to 200,000 watt hours per month to 50 per cent for use of 1,000,000 watt hours per month. Minimum charges are, of course, provided for by special schedule.



STANDARD TRACK CONSTRUCTION FOR INTERURBAN LINES



STANDARD TRACK CONSTRUCTION AS APPLIED TO ASPHALT PAVING

ROADBED

The traffic earning power of a combined urban and interurban system of this kind is largely dependent on speed of transit in competition with other transportation agencies, and high car speeds are possible only when track and roadbed are in first-class condition, and the lines are reasonably straight. These facts have been fully appreciated by the present management, and the work of straightening the interurban lines and improving the roadbed has been steadily going on for the past two years, and large sums of money have been expended in securing private rights of way to cut off curves, reduce distances between population centers and decrease running time. Other large sums have been spent in grading and leveling roadbed and improving alignment and surface of track, to the end of approaching more nearly to steam railroad standards. Within the city limits a large amount of old chair rail construction has been replaced by heavy T rail sections, laid directly on ties, and in several of the best paved streets, such as Grand Avenue, a concrete foundation is being put under the ties, the whole forming a solid, massive construction, difficult to improve upon.



T RAIL TRACK CONSTRUCTION ON GRAND AVENUE

The standard city roadbed construction is shown on this page, and an illustration is also given of the new work now going on in Grand Avenue. The company is fortunate in being able to use T rail in both city and interurban work, the Milwaukee pavements being such that this can be done without difficulty. The standard rail for city work is a 6-in. 72-lb. Shanghai section, rolled in 60-ft. lengths. Recent purchases have been made of the Johnson Company and the Pennsylvania Steel Company. It is laid on oak ties 6 ins. x 8 ins. x 7 ft., set 2 ft. apart on centers. In pavements which have a concrete foundation the ties are placed on a 6-in. bed of concrete, and on other streets broken stone ballast is used.

About two years ago the first experiments in cast welding joints were made by the Falk Company, and on track which was then so poor that without these improvements its immediate replacement would have been necessary. Today this track is even better than when the joints were put in, in many places having been worn to better surface, and it is believed that the rail was given five or six years' additional life by use of the cast welded joints. By the end of this year all the joints within the city limits, over 40,000 in number, will be cast welded. The original work was done by the Falk Company, whose methods and processes are well known and have proven satisfactory in Milwaukee. Later contracts, however, have been awarded to the Milwaukee Rail Joint & Welding Company, which will, by the end of this year, have installed over 25,000 joints. Their process is somewhat different from that of the Falk Company. A casing or jacket, formed of two L-shaped pieces of rolled steel, is placed under and at the side of the joint and is temporarily fastened to the rail by clamps. The metal is then poured round the joint inside this jacket, after which the clamps are taken off and the jacket remains in position, giving additional strength to the cast iron which it incloses. This company has also successfully placed its joints on exposed rails in the interurban track between Milwaukee and South Milwaukee,

although the full results of this work have not as yet been demonstrated by long time tests. Slip joints are provided, as shown herewith, every 500 ft., and the contraction and expansion of the track has been found to amount to about 1¼ ins. per 100 ft. of track, so that at the slip joints the rails are sometimes 6 ins. apart.

The standard suburban roadbed construction consists of a 56-lb. T rail 4¼ ins. high, rolled in 60-ft. lengths, laid



CURVE CONSTRUCTION WITH FIG. 8 TROLLEY WIRE

on broken stone or gravel ballast with Weber joints. The Weber joints have, so far, given entire satisfaction, and after a year of service the rail ends are firm in position, without the slightest depression.

The company makes its own special work, and its shops have turned out a number of extremely complicated pieces. The frogs and crossings are re-enforced by strips of hardened steel let into recesses and pinned in position. These can be easily replaced when worn out.

On the line to Wauwatosa, recently purchased from a company which formerly operated a dummy line upon it, is a fine and costly viaduct, crossing the valley of the Me-



CAST WELD STEEL JOINT IN EXPOSED TRACK

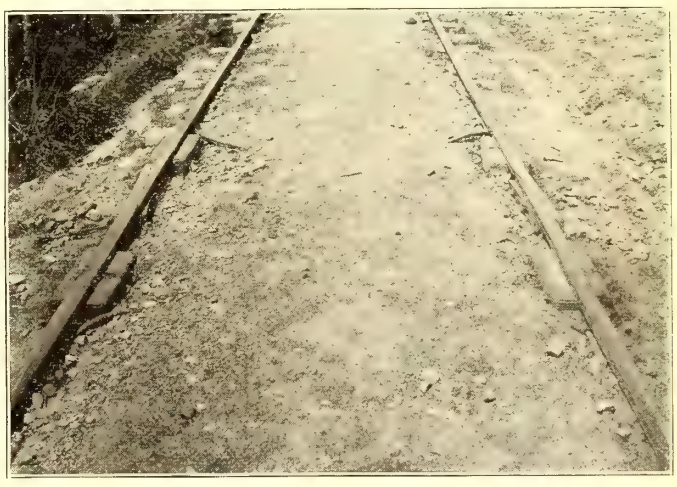
nominee River and the tracks of the Chicago, Milwaukee & St. Paul Railroad. Another viaduct, 1075 ft. in length, having between its termini a transition curve of approximately 125 ft. radius, is now being constructed between the grounds of the Calvary Cemetery and those of the Soldiers' Home, near the Menominee River viaduct. At about the center of the new viaduct will be an elevated station to be used by visitors to both the cemetery and the Soldiers' Home, and upon its completion it will be part of a new through line to Waukesha Beach, on which the time of transit from the center of the city will be considerably less than at present. By improvements of this kind the system is being greatly strengthened and the future traffic earning capacity increased.

The greatest attention is given to the maintenance of roadbed. Handcar inspection of all the high speed lines is made every morning, and necessary realignment, surfacing and improvement of joints and special work are at-



STEEL JACKETED, CAST WELD RAIL JOINTS IN CITY TRACK

tended to without the slightest delay. The city track is constantly under inspection by men employed for that purpose, who have, however, other work to do, such as



SPLIT JOINT IN EXPOSED TRACK

greasing curves, sanding the track, etc., and at least once a week the superintendent goes over all the interurban and most of the city lines in his "office car." The importance of this constant and rigid inspection may be judged from the fact that speeds of 45 miles per hour or more on certain portions of the interurban lines are of daily occurrence.

OVERHEAD AND UNDERGROUND CONSTRUCTION

During the last two years almost the entire mileage of overhead line work has been rebuilt with new and strong

material throughout. The 000 "Fig. 8 trolley wire" is the company's standard, and is giving absolute satisfaction in all respects, the report of its value being, indeed, quite enthusiastic. The chief disadvantages which have in other places been urged against this type of trolley wire, namely, the difficulty of supporting it satisfactorily, and of running



STANDARD CITY CARS

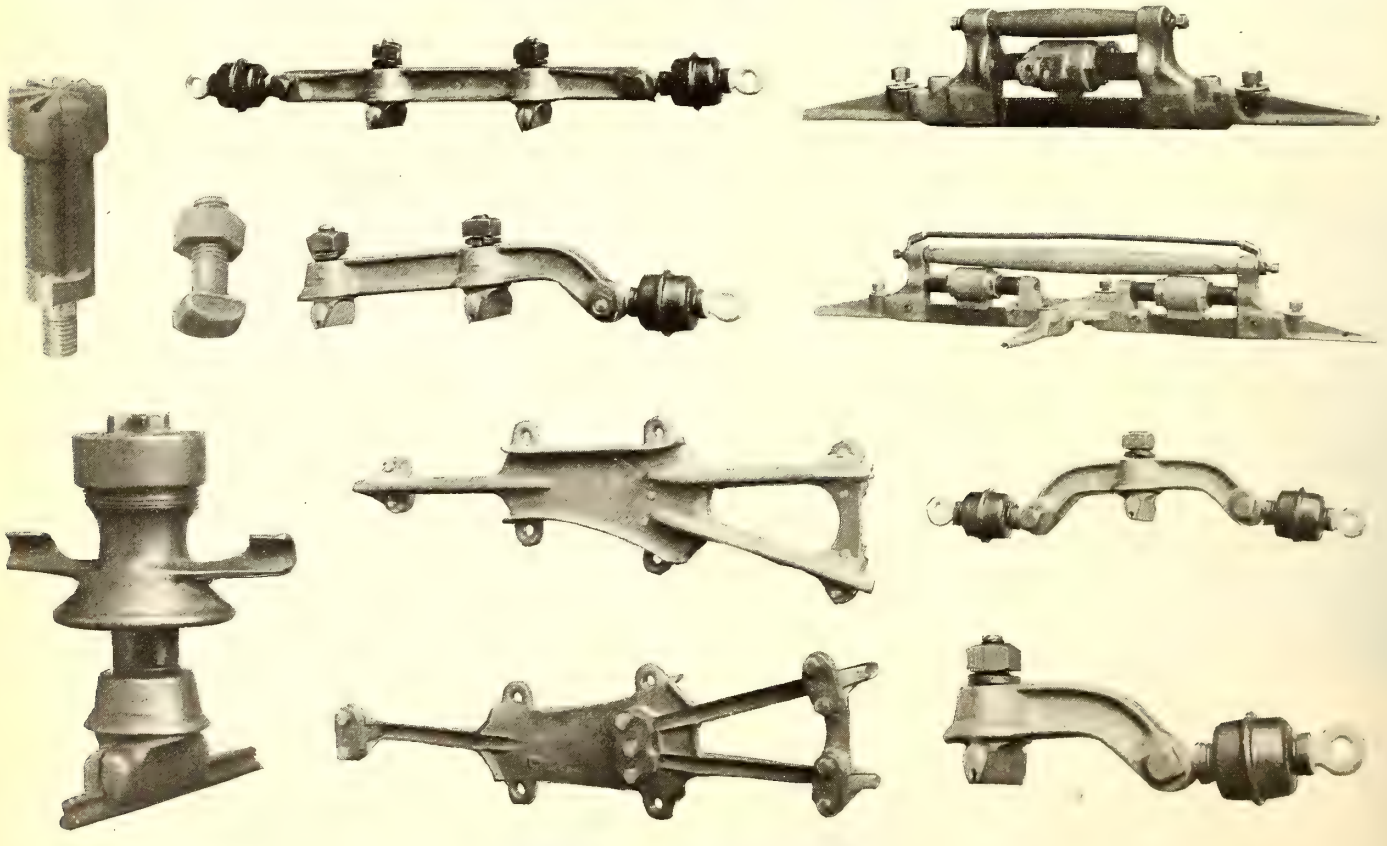


100 DUCT CONDUIT NEAR STATION

good curves, and the large section required, are not regarded as important by the Milwaukee management.

A special clip, devised by the company's engineers in conjunction with those of the Electrical Railway Equipment Company of Cincinnati, is used for supporting this Fig. 8 wire. It seems to have entirely overcome all obstacles to the use of this wire, and some of the finest curves and straight line work to be seen in any city (see page 341) are to be found in Milwaukee. A large section of trolley wire means, of course, the cheapest possible reinforcement of the feeder system, as there is no charge for insulation. The great advantage of the Fig. 8 wire is, of course, the doing away with sparking at the clips, by reason of the fact that a perfectly clear path for the trolley is obtained.

In other respects the company has taken great pains in developing a complete line of overhead appliances. These are manufactured by the Electric Railway Equipment Company. Anderson & Johns' insulation is the foundation for this material, and bronze is the metal employed. Illustrations of some of the special appliances used are shown herewith. They are solidly and well constructed, and so carefully have all details been designed that trouble from broken trolley wire is now very rarely experienced.



FORMS OF FIG. 8 LINE APPLIANCES

A large number of center poles are used, but are not liked by either the company or the public, and the span wire construction is preferred in all cases. Iron poles are used generally within the city limits, and wooden poles outside. Many of the iron poles are "lattice" construction, but the heavy tubular pole is preferred as being stronger, more durable and less costly to keep in good condition.

The overhead construction is carefully and regularly in-



STATION AT WEST PARK

spected for wear, broken span wires and defective insulation. For this purpose the repair and inspection car and the patrol wagon are used, shown on page 350, and are fitted up with all tools required for quick repairs.

The underground feeder system is installed in the business district of Milwaukee. Camp vitrified brick conduits are used, and recent purchases of feed wire have been made from the Standard Underground Cable Company



OFFICE BUILDING OVER LIGHTING STATION

STORES, YARDS, AND CONSTRUCTION FACILITIES

The company's plans for new construction have been, and are, so extensive that the construction work has been organized most carefully, and purchases of material and supplies made and arranged for on a large scale. The company owns a 10-acre gravel pit near Waukesha, from which all its grading material is obtained, and contracts have recently been closed with a large blast furnace near its yards by which the slag and other furnace refuse can be obtained in any desired quantity for surfacing of track. Ties, paving stone and other material are always on hand in quantity, and the company was fortunate in purchasing a large tonnage of rails and track material before the recent advance in prices.

For the purpose of storing this construction material and facilitating its receipt by rail and water, the purchase of a 5-acre swamp abutting the tracks of the St. Paul and the Chicago & North Western railroads on one side and the Kinnickinnic River on the other was made some time ago, and has since been piled and filled in so as to form an extensive and very valuable piece of real estate. Arrangements have just been made by which the company's street railway tracks in the vicinity are connected with a loop line in this yard, and a branch from the St. Paul and North Western tracks also enters the yard.

Construction work is facilitated by a large equipment of work cars, which the company is permitted to use on the city tracks, as well as the interurban, and which, of course, greatly reduces the cost of transportation of material.

The company's storerooms at the Kinnickinnic car house, near its yards, are among the most extensive to be



WORK TRAIN ON GRAND AVENUE

found in any street railway system of the country. The inventories show that there are now on hand about $125,000 worth of "live" material and supplies, most of it purchased before the recent large advance in prices. The stores are most neatly and systematically arranged.

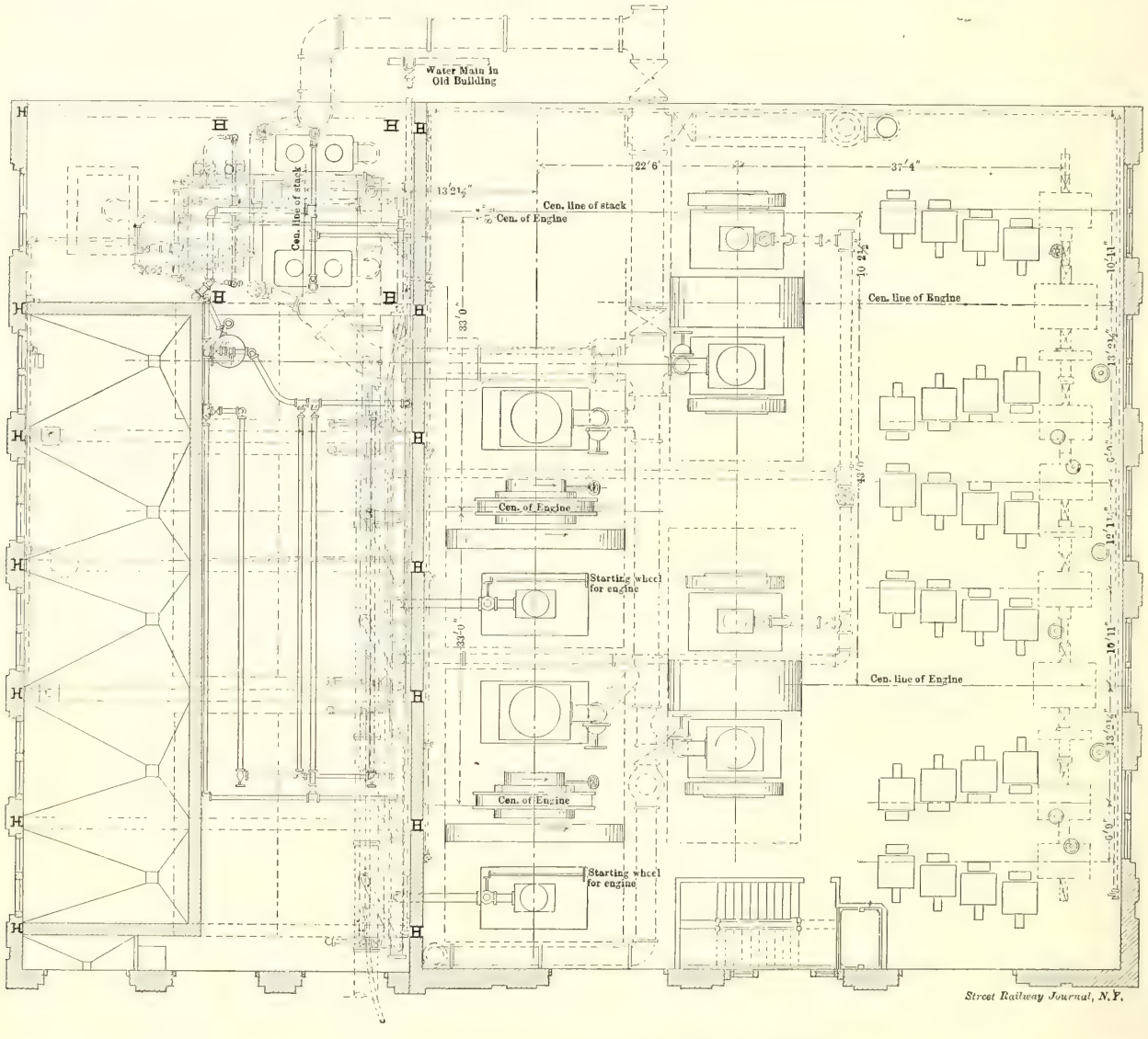
POWER STATIONS

The railway and lighting system is now being operated from seven power stations, large and small, two of which are merely held in reserve to provide for breakdowns elsewhere. It is probable that several of these stations will disappear as soon as the large new station now building is completed. Three-phase transmission will come into extensive use a little later. The main station, both old and new, is located on River Street, on the banks of the Milwaukee River, in the very heart of the city. Three stations, bought from other companies which are now consolidated with the present one, are found within the Milwaukee city limits. The fifth station is at Racine, the sixth at Waukesha, and the seventh at Wauwatosa. The relative capacities of these stations are as follows:

	Railway.	Lighting.
River Street station	2250 kw.	1120 kw.
Racine station	875	167
Waukesha station	600	...
Eleventh and Wells Street station (reserve)	400	...
Wauwatosa station (reserve)	130	150
Badger station	Approx.	1000
Broadway station	...	1115
Total capacity	4255 kw.	3552 kw.

The River Street station was built in 1891, and was one of the first large railway power stations in America. Its equipment is now out of date, though it is giving fair satisfaction, and the company is building a large new power station in the plot adjoining the present one, the intention being that after completion of the new station the old will be demolished and its place taken by an extension of the new.

The present equipment in the old station consists of eighteen Galloway boilers, with coal and ash conveyors, made by Link Belt Engineering Company, and eight triple expansion marine type engines, of which five are each direct connected to two 200-kw. Edison multipolar railway generators, and three are connected each to two



PLAN OF NEW POWER STATION, SHOWING PIPING

100-kw. multipolar Edison three-wire lighting generators. These engines were designed by the Edison General Electric Company, and several of them were manufactured by Filer & Stowell Company, of Milwaukee. There is also in the station one Allis vertical compound engine, direct connected to two 200-kw. Edison lighting generators; one McIntosh & Seymour engine, belted to two 60-kw. Edison bipolar lighting generators; one triple expansion engine, direct connected to two 50-kw. Edison generators, which were formerly lighting machines, but have now been rewound for railway booster service; and one McIntosh & Seymour horizontal tandem compound engine, belted to one 150-kw. Edison bipolar railway generator. The Edison multipolar generators are all of the end-bearing commutator type, with side-bearing brushes, and the armatures serve as flywheels. They were originally somewhat too light in construction to stand the strains of railway service; but have been so altered as to be fairly satisfactory and efficient machines, and no serious electrical troubles have ever been developed in them. The present station cannot be called economical, however, as the cost of power production slightly exceeds one cent per kw. hour, of which about $.0066 is for fuel, and it is expected that the new River Street station will reduce this cost of production fully one-half.

The new station, of which plan and elevation is given herewith, will contain five Edgemoor water-tube boilers, with Green traveling chain grates; McCaslin coal conveying machinery; one Green economizer; two 1400-h.p. and two 1100-h.p. Allis engines; four 1050 and four 400-kw. General Electric generators; twenty 100-light Brush arc machines, and the usual steam and electric auxiliary apparatus.

The furnaces will be fed from large hoppers, located near the top of the boilers, and which are filled in turn from bunkers of from 1500 to 2000 tons capacity, supported on strong iron pillars above the boilers. The conveying apparatus will be used in combination with steam shovels for filling these bunkers from boats or cars, and will also handle the ashes. The conveyors are of the McCaslin overlapping gravity bucket conveyor type, and are manufactured by John A. Mead & Co., of New York. They handle both coal and ashes, and the buckets overlap, so that no filler is required except an ordinary chute.

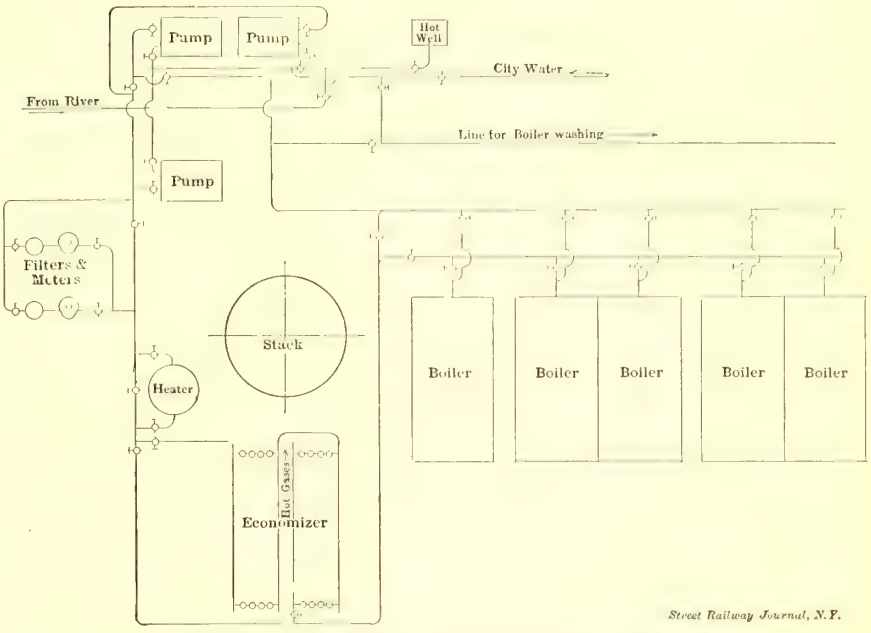
Both buckets and links are of malleable iron. The coal will pass from the bunkers, through the hoppers, direct to the traveling chain grates. These are made by the Green Engineering Company, of Chicago, and it is guaranteed that the grates will burn from 18 lbs. to 36 lbs. of coal per sq. ft., and will prevent the formation of smoke.

The boilers, made by the Edgemoor Iron Works, of Edgemoor, Del., have each 233 18-ft. lap-welded tubes, 4 ins. in diameter, and three 34½-in. drums. They are to carry 160 lbs. steam pressure, and are guaranteed to evaporate 10½ lbs. of water from and at 212 degs. with less than 2 per cent moisture under ordinary conditions of running, when coal having not less than 13,000 B. T. U. is used, with ¾-in. (water column) draft, and when boiler is operated at not less than 750 h.p. Centennial standard. The guarantee also covers 11 lbs. under proper test conditions. The total capacity of the five boilers working together is guaranteed to be not less than 4100 h.p., Centennial standard. The Green Engineering Company, of Chicago, will install the boilers.

The Green economizer is composed of 768 tubes, in 128 sections, ranged in four groups of 32 sections each. Each section contains six tubes, 9 ft. long and 4 9-16 ins. in external diameter. These tubes are connected top and bottom to headers. The scrapers are to be operated by a 220-volt 4-h.p. electric motor. It is guaranteed that the average fuel burned shall be 12 per cent less when the feed water from the hot well is put through the economizer than when the economizer is not used, it being understood that the boilers are running at full-rated capacity.

The stack is of steel, brick lined, and will be about 200 ft. high and 16 ft. internal diameter in the clear. Its capacity is about 22,000 to 25,000 h.p.

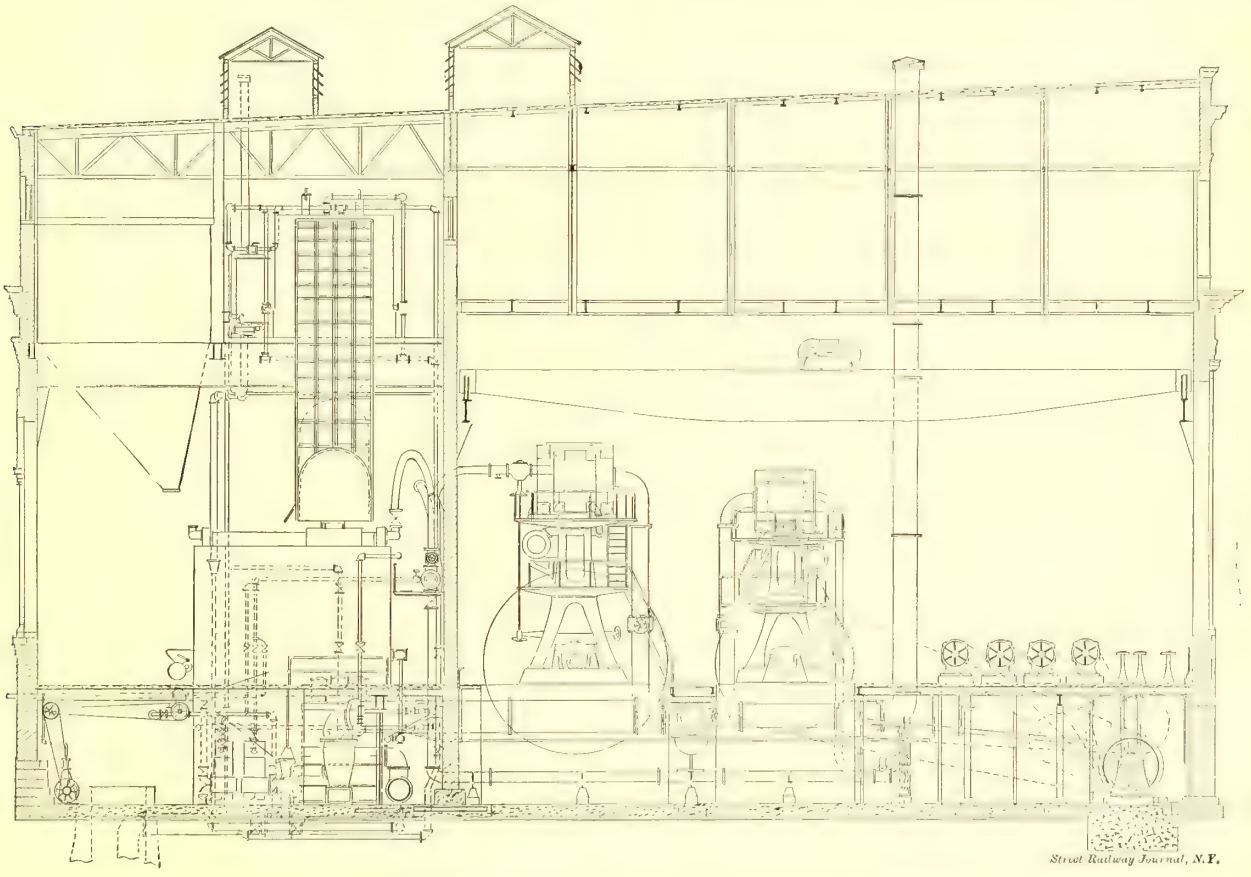
There are two duplex vertical Blake pumps, of the standard Admiralty type, and two Blake condensers of the same size and type as those used on the Kaiser Wilhelm der Grosse.



GENERAL DIAGRAM OF FEED-WATER SYSTEM

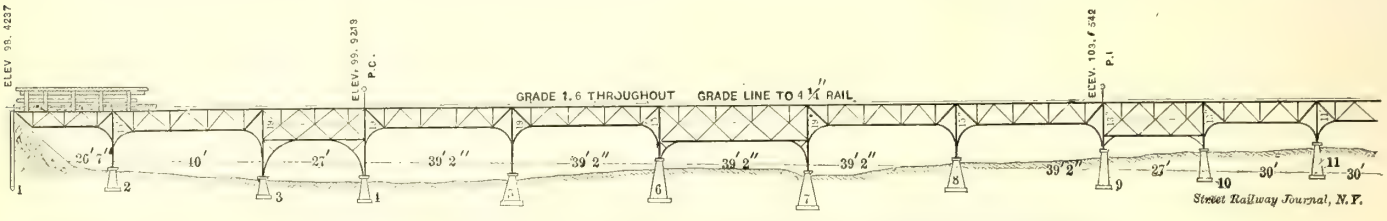
In the engine room is a 30-ton 80-ft. span electric crane, with three motors, built by Pawling & Harnischfeger, of Milwaukee.

Both railway and lighting engines are built by the E. P. Allis Company, of Milwaukee, and are of the cross-com-



CROSS SECTION OF NEW POWER STATION

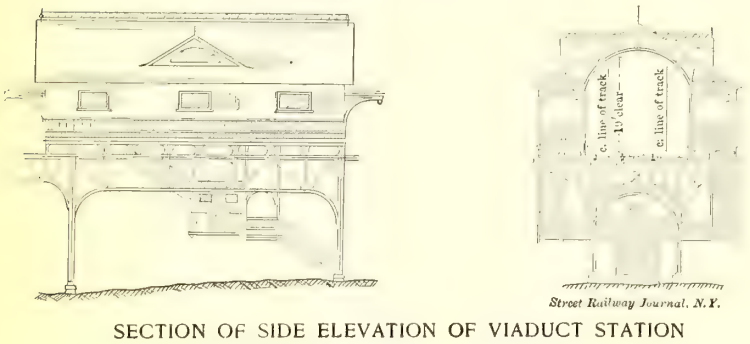
pound vertical type, with Reynolds-Corliss valve gearing. The railway engines have cylinders 28 ins. and 60 ins. x 48 ins., and are guaranteed to indicate 1400 h.p. at the point of highest steam economy, and 2400 h.p. at maximum load, with a boiler pressure of 150 lbs. and a vacuum of 26 ins. These engines run at 80 r.p.m., and it is guaranteed that the regulation shall be such that the minimum



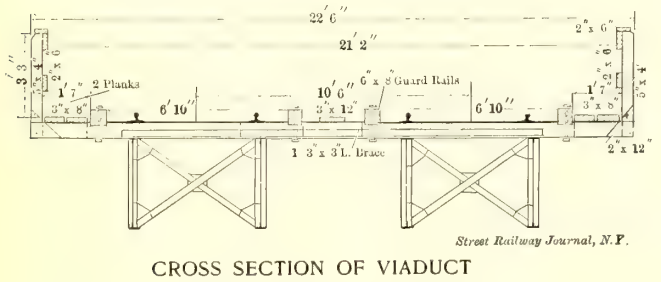
PORTION OF DOUBLE TRACK VIADUCT—CALVARY CEMETERY EXTENSION

speed shall not be less than 79 revolutions and the maximum 83. The flywheel is 20 ft. in diameter, and weighs 120,000 lbs. The cylinders are not steam jacketed, but the receiver is equipped with reheating coils fed by live steam. The valves are placed in the cylinder head, by which arrangement the clearance is reduced to about 1½ per cent on the low pressure cylinder, and nearly that on the high. It is guaranteed that when running under uniform load of 1400 i.h.p., with 150 lbs. pressure at the throttle, with 26-in. vacuum in exhaust pipe, and at 80 r.p.m., the engines will consume but 13½ lbs. of dry steam per i.h.p.

The lighting engines will run at 120 r.p.m., will indicate



SECTION OF SIDE ELEVATION OF VIADUCT STATION



CROSS SECTION OF VIADUCT

1100 h.p. at highest economy and 1600 h.p. maximum, and the speed will not be below 118 nor more than 123 r.p.m. with any variation of load. The cylinders are 22 ins. and 46 ins. x 42 ins., and the flywheel is 15 ft. in diameter, weighs 35 tons, and has a face 60 ins. wide, grooved for rope driving. An economy of 13½ lbs. is also guaranteed for the lighting engines under conditions similar to those just stated.

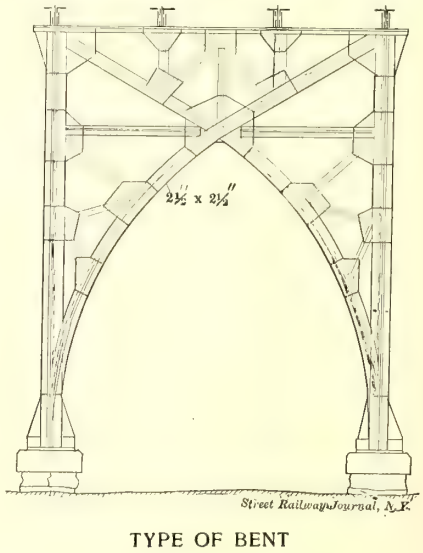
The railway generators, built by the General Electric Company, are of their "M.P.14" type; are rated at 1050 kw. or 1755 amps. at from 500 to 575 volts, and are direct connected to their engines. It is guaranteed by the makers that after ten hours' run at normal full load the temperature rise will not exceed 40 degs. C., and that after one hour run at a load 50 per cent above the normal full load, immediately following the ten-hour run at normal load, the temperature shall not exceed 50 degs. C. above the surrounding air. It is also guaranteed that a load 50 per cent above the normal can be carried without sparking at, or moving of, the brushes. The commercial efficiency at full load is to be 95 per cent, and at half load 94 per cent.

The twenty 100-light Brush arc machines, built by the General Electric Company, which are to be installed in this station form part of an order for sixty of the same type given by Mr. Beggs for use in Cincinnati and Milwaukee, this being the largest single order for arc light machines ever placed. The arrangement of these generators and of the counter shafting and rope drives by which they are run is clearly shown in the plan and cross sectional views herewith.

There will be in the station an immense marble switchboard built by the General Electric Company, arranged for forty-eight arc light circuits and forty-eight machines, and for all other railway and lighting circuits.

CAR HOUSES AND OTHER BUILDINGS

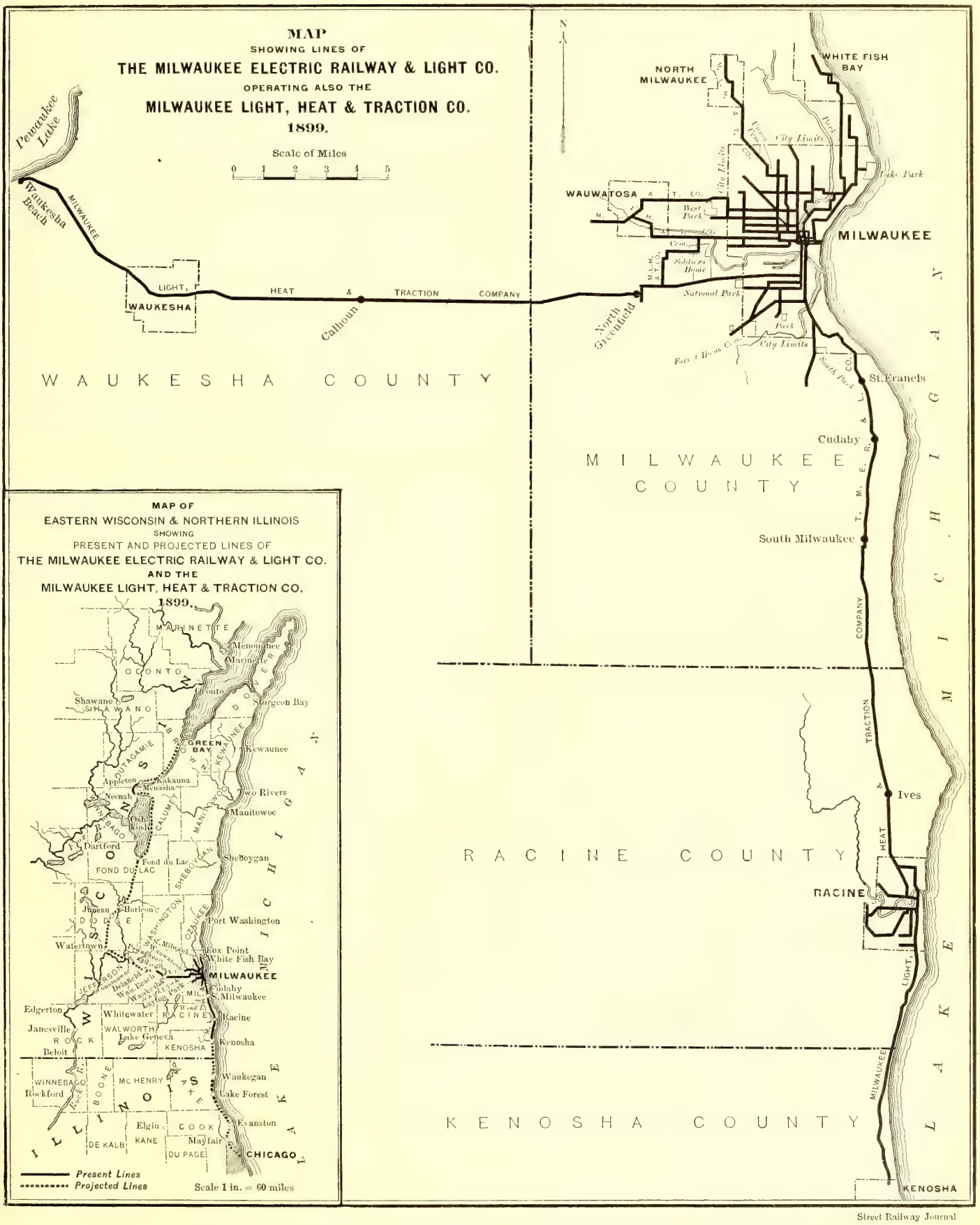
The company owns a number of car houses, located at various points upon the line, and an office building directly over one of the lighting stations recently purchased. For the purpose of facilitating car movement, especially at



TYPE OF BENT

times of sudden rain or snow storms, when the patrons are driven quickly to the cars, an option has been secured on a valuable piece of ground, 320 ft. x 240 ft., in the heart of the city, on which it is proposed to put up a building which will have a variety of uses. The ground floor will be the loop line terminal for practically all the east and west lines of the city, and three floors will be given up to car storage, with special means for quickly putting cars into service below. The company's offices will also be in this building, and there will be ample space devoted to the uses of the employees, in the way of gymnasia, library, reading rooms, meeting rooms, instruction rooms, etc.

The principal shop, the Kinnickinnic car house, is fitted up for the performance of all necessary repairs of rolling stock and power station equipment. Here also are to be found the foundry and the shops for the manufacture of



Street Railway Journal

MAP SHOWING ELECTRIC RAILWAY SYSTEM OF THE MILWAUKEE ELECTRIC RAILWAY AND LIGHT CO.

special work, as well as the storerooms, while, as before-stated, the large construction yards belonging to the company are close by, crossing the tracks of the two large railroads entering Milwaukee.

CAR EQUIPMENT

The standard cars of the Milwaukee Electric Railway & Light Company in its city service, and of the Milwaukee Heat, Light & Traction Company in the suburban and interurban service are so unusually sightly, comfortable and attractive to the riding population that a somewhat extended description of their characteristics is well worth while. The color scheme is nearly the same as the Broadway Metropolitan cars in New York—colors which always give a bright appearance to the cars in the streets. Inside, the finish and trimmings throughout are in quartered oak, and cane-bottomed cross-seats with center aisles—a seating plan always popular with the public—are combined with large windows, so that an excellent combination summer and winter car is obtained. The car interior finished in this way, without elaborate over-ornamentation, has a particularly *clean* look, and the whole aspect is decidedly pleasing.

The double-truck interurban cars of this general type were built by the Barney & Smith Company, of Dayton, and the St. Louis Car Company. The length over corner posts is 29 ft., and over bumpers is 41 ft. The width over all is 8 ft. 5 ins. The height from top of rail to bottom of sill, loaded, is 2 ft. 6 ins., and the inside height from floor to roof is 8 ft. 2 ins. The center and main side sills are of heart Southern pine, and a ½-in. iron plate, 5 ins. wide, furnishes additional strength to the side sills. The end sills and all cross and trap-door framing are of white oak, and posts, rails, rafters, etc., are of straight-grained white ash.

There are eighteen reversible and four stationary seats



PARLOR CAR

in the car, all made by the Hale & Kilburn Manufacturing Company, of Philadelphia. The curtains are made by the E. T. Burrowes Company. The car trimmings are of solid bronze, and folding iron gates are used on platforms. Electric push buttons summon the conductor.

The International double register is the company's standard, and is believed by the management to be the simplest and most durable in the market. The city cars are heated in the winter by coal stoves, and the interurban cars have the Baker hot water heater. In these long interurban runs it is not considered wise to run the risk of losing power and freezing passengers.

The cars are lighted by four two-light clusters and two platform lights, with a switch for an electric headlight.



INTERIOR OF OFFICE CAR

On the long-run interurban cars electric arc headlights are used. These have done much to reduce night accidents, and are considered by the management to be one of the most important equipment features of the modern interurban road, in spite of their wastefulness in the use of current. These headlights take about 5 amps. of current, and over 80 per cent of the power must be used in the dead resistances, but it is believed that power is the cheapest thing found in electric railroading, while accidents are among the dearest from every point of view. The arc headlight is really a searchlight, and by its use the track and road are lighted up for about a quarter of a mile in advance of the car, making accidents as rare as in daytime.

In addition to the Barney & Smith and St. Louis cars, which are, as above stated, the company's standard at present, we find also in service twenty Brill cars on the National Avenue line and a large number of short cars of different makes, some of which have been, and are being, rebuilt for continued service, but most of which will be replaced by new purchases in the near future.

There is no question in the opinion of the management as to the great advantage of double-truck over single-truck cars in both city and interurban service. They are held to be easier on track and more attractive to passengers, and while taking more power to operate, it is not believed that the cost of power per passenger carried is greater, while the transportation cost is, of course, reduced. Moreover, by means of these cars a longer headway can be maintained without public dissatisfaction, for overcrowding is less likely to occur.

After a series of elaborate and most carefully conducted

tests, it has been decided to equip these cars, both city and interurban, with four G. E. 1000 motors as a standard. The advantages of this equipment lie chiefly in the greater traction obtainable and the much more rapid acceleration, by which means higher schedules of speed are possible. The tests have shown that the power consumption in such an equipment is less than where two motors of equal or greater aggregate power are used, and experience has shown that repairs of the four-motor equipment are less than of the two-motor, in spite of the duplication of apparatus. This is a surprising and very interesting result, but certainly appears to be borne out by the repair figures for 1898, which show an expenditure of only $.0038 per car mile for repairs of electrical equipment—an extremely low figure.

Recent purchases of trucks have been of the Barney & Smith "H" type and the St. Louis Car Company's trucks, but no permanent standards have been established. The wheels are furnished by the Terre Haute Car Wheel Company, are 33 ins. in diameter, weigh about 385 lbs. each, and are guaranteed for about 40,000 miles of serviceable running, which guarantee has been maintained. The axles are of hammered iron, 4 ins. in diameter.

The Waukesha and Wauwatosa interurban cars are equipped with the Christensen automatic air brakes, with



SPECIAL EXCURSION CAR

independent motor compressor, and the highest satisfaction has been expressed by the management at the work of these air brakes, which are considered essential in the high-speed interurban work, of which there is so much around Milwaukee.

A number of parlor cars, nicely fitted up for excursions, are in service, and one car, "Marguerite," is especially ornate, being lined on the outside with incandescent lamps, and lending itself well to decoration. The superintendent has fitted up a special office car, with which inspection of the lines is, as before stated, carried on regularly, while, at the same time, considerable office work can be accomplished by means of the stenographer and typewriter who accompanies him on his trip.

There are several emergency and patrol wagons located at several points in the city. These wagons are kept ready for immediate call in exactly the same way as is done by the fire department, harnesses being suspended in such a manner that the horses can be immediately put into position and the wagons run out of the house with but a few seconds delay. On a recent inspection trip a patrol wagon was called by telephone at a point one-half a mile away from its house, and it arrived on the ground in less than 2¼ minutes after telephone connection was made.

For the purpose of providing against blockades from breakdowns on the road each motorman is given a toolbox, which is numbered with his badge, and for which he is responsible. This box is equipped with all the tools necessary for above repairs on the road. While it is not the company's purpose to allow the motormen to do anything except emergency work on the cars, they are given



STANDARD INTERURBAN CAR

a training sufficient, it is believed, to enable them to get their cars into the station under ordinary conditions.

The construction cars have already been referred to, and an illustration of one is given on the following page.

The snow equipment is somewhat extensive, and is strong enough to grapple with any storms which may visit Milwaukee; in fact, there have been some fine records made in dealing with heavy storms which have blocked railroad travel while the electric cars have been able to run.

It is found from the company's books that the entire cost of maintaining the rolling stock in 1898 was $.0091 per car mile, of which $.0022 was expended for car bodies, $.0017 on trucks, $.0038 on electrical equipments, and



INTERIOR OF STANDARD CAR

$.0014 on superintendence, tools and miscellaneous expenditures. These are extremely low figures, in spite of the fact that the rolling stock has been kept up in first-class condition without the slightest depreciation.

CAR SERVICE

The average speed schedules of the city of Milwaukee are somewhat high, being from 8 to 9 miles per hour on an average, while on the suburban and interurban lines



PATROL WAGON

they are 20 miles per hour. The run from the center of Milwaukee to Waukesha, a distance of 20 miles, is regularly made in fifty-five minutes, and has been made in forty-five minutes. These are high figures in view of the fact that several miles of the distance lie in the city proper, with considerable local traffic, while there are numerous curves and detours on the line which have not yet been gotten rid of. Two Waukesha cars regularly make nineteen half-trips a day, or 380 miles each, this being one of the highest electric car day records to be found in this country.

The greatest care and attention is given to the securing of punctuality in the operation of the entire system. Each of the lines, city as well as suburban, has several time points, and the motorman is called strictly to account if he falls more than a minute behind time at any of these points. Results have shown to the management that this element of punctuality is most important in obtaining traffic, and goes far to offset a slight increase in the time interval between cars, since it is less important for the would-be rider to get a car at the moment he steps upon the street than it is to know that if he steps upon the street at a particular moment he will get his car. Largely owing to an increase in speed, gradually brought about in the last two years, the present management has succeeded in giving a superior service to the public with a less number of car trips and car miles, so that the earnings per car mile have been materially increased without a corresponding increase in expenses, and this is one of the potent causes for the large financial improvement in the properties.

An hourly service is maintained between Milwaukee and Waukesha, Whitefish Bay and Racine-Kenosha; a half-hourly between Milwaukee and South Milwaukee; and a fifteen-minute alternate service on two lines between Milwaukee and Wauwatosa. In the city the cars are run on a time interval of from six to ten minutes.

There is on this system a most complete private telephone system, and all of the dispatching business on the interurban lines is conducted by telephone. At the present time more than fifty points on the system are connected with the central office by telephone, and the number will be largely increased in the near future. On arriving at switches, or other meeting points, instructions are sought for and received by each conductor over the telephone, and a notation of the call and of the instructions given is made on a large sheet in the dispatcher's office, where also is made a record of every kind of trouble reported on the system, including accidents (even of the most trivial character), breakdowns, failures to make time, etc. This feature of operation is to be still further improved and extended in the near future, but is already efficient and satisfactory.

The company has regularly in its service a surgeon, whose duty is to drive immediately upon call to any point in the system where an accident may have occurred, and to render every assistance in his power to the injured person. This course is dictated not only by humanity, but by wise economy, since it is almost always possible to obtain a truthful statement of the accident immediately after its occurrence, while after several days' delay garbled or deceptive accounts are not infrequent. As a matter of fact, the company's disbursements for injury are small, in spite of the high speeds maintained by the cars, the regular fund, amounting to 3 per cent of the gross earnings, which has been set aside for the past two or three years, proving so far sufficient to take care of all disbursements on this account.



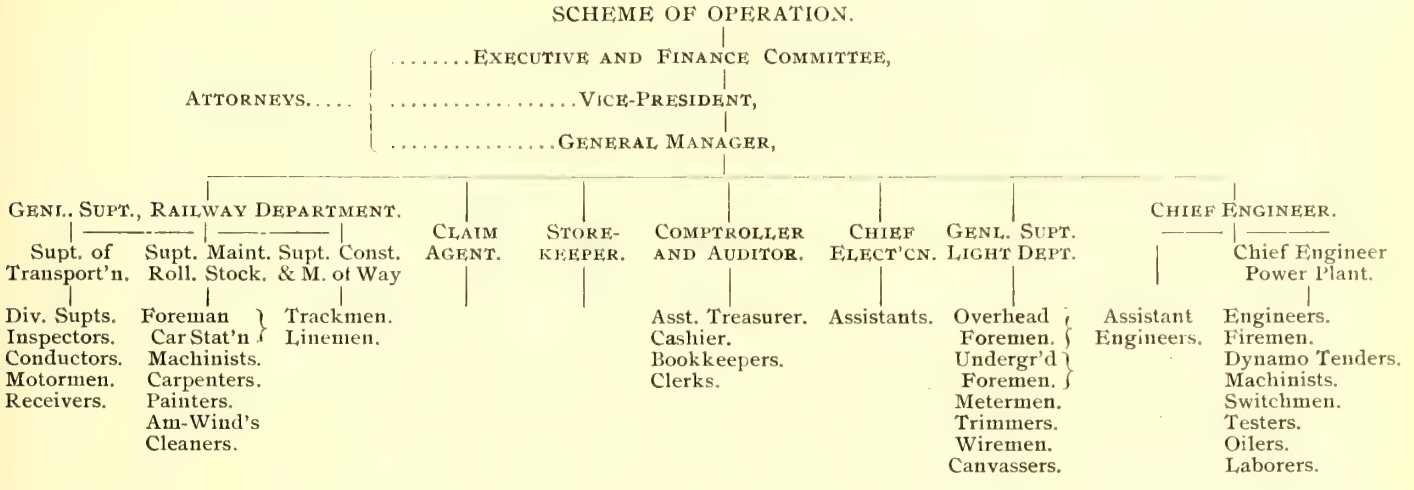
RACINE-KENOSHA CAR



INSPECTION AND REPAIR CAR

ORGANIZATION

The company's scheme of organization is clearly shown in the accompanying diagram.



The executive and finance committee consists of Charles W. Wetmore, chairman; William Nelson Cromwell, of the law firm of Sullivan & Cromwell, and George R. Sheldon, all of New York.

Henry C. Payne, the company's vice-president, has been connected with the property ever since the original purchase of the constituent companies by Henry Villard and the North American Company in 1891-2. He is one of the ablest and most influential men in the State of Wisconsin, and his influence and assistance have been of inestimable value to the company. Mr. Payne was president of the American Street Railway Association in 1893-4.

The responsible executive head of the company is its general manager, John I. Beggs, to whose skillful and aggressive work the great improvement in the physical and financial condition of the property during the last three years is largely due. Mr. Beggs' reputation as a successful manager of corporate enterprises, particularly in the field of electric lighting and the manufacturing of electric apparatus, is established by numerous successes and no failures during the past twenty years; but it was reserved for Milwaukee to prove that in the larger field of electric railroading even greater success would be achieved. His policy is broad and far reaching, as has been indicated at several points in the previous discussion, and it is not too much to say that one of the most valuable lighting and railway properties in the West is now being developed by him, and will eventually reach proportions far larger than at present.

The comptroller and auditor, H. C. Mackay, is in charge of the accounting department. The company's accounting system closely follows the standard of the Street Railway Accountants' Association of America, although greater detail in many of the accounts is required by the general manager. Owing to the rapid development of the system, and especially to the recent purchases of important interurban lines, the accounting system in its details is still in a formative condition.

The general superintendent of the railway department, T. E. Mitten, has been with the company for five years, and is in direct charge, under General Manager Beggs, of the operation of the railway lines.

The chief engineer, Chester P. Wilson, was formerly general manager of the Sioux City Traction Company.

The company's chief electrician is O. M. Rau, who is now acting as general superintendent of the light department.

In the month of April there were 1673 employees on the company's payrolls, of whom 84 were in the general office, 709 in the transportation department, 305 in the maintenance departments, 106 in the power stations, 83 in the lighting department, and 386 in the construction department.

FINANCIAL RESULTS

It has before been stated that remarkable changes have been made during the three years of the present management in the financial and operating statistics of the Milwaukee property. The real character of these changes can best be seen by an examination of the comparative statistics of operation expressed in "per car mile" and "per passenger" figures. The following results are for the railway department of the Milwaukee Electric Railway & Light Company only, it being impossible to obtain a similar comparison for the Milwaukee Light, Heat & Traction Company on account of the recent purchases of its most important properties:

GENERAL FINANCIAL STATEMENT.

	per car mile.		
	1896.	1897.	1898.
Total receipts, all sources	$.1547	$.1857	$.2074
Operating expenses, actual disbursements	.1047	.1063	.1108
Earnings from operation	.0500	.0794	.0966
Reserves and taxes	.0309	.0256	.0477
Net income applicable to return on investment	.0191	.0538	.0489
Interest on funded and floating debt	.0340	.0405	.0413
Surplus for stock	.0149*	.0133	.0076

*Deficit.

	per passenger carried.		
	1896.	1897.	1898.
Total receipts, all sources	$.0493	$.0504	$.0496
Operating expenses, actual disbursements	.0334	.0289	.0265
Earnings from operation	.0159	.0215	.0231
Reserves and taxes	.0099	.0069	.0114
Net income applicable to return on investment	.0060	.0146	.0117
Interest on funded and floating debt	.0108	.0110	.0099
Surplus for stock	.0048*	.0036	.0018

*Deficit.

OPERATING EXPENSES IN DETAIL.

	per car mile.		
	1896.	1897.	1898.
General expense	$.0136	$.0164	$.0199
Conducting transportation	.0724	.0673	0702
Maintenance, way and structures	.0064	.0116	0116
Maintenance, rolling stock	.0123	.0110	.0091
Total	$.1047	$.1063	$.1108

	per cent to total op. ex.		
	1896.	1897.	1898.
General expenses	13.00	15.42	17.91
Conducting transportation	69.10	63.26	63.41
Maintenance, way and structures	16.10	10.94	10.46
Maintenance, rolling stock	11.80	10.38	8.22

The most remarkable feature of the above statement is found in the 33 per cent increase in total receipts per car mile, and in the fact that the earnings from operation per car mile have been nearly doubled in the three-year period. Surplus for stock is affected largely by the amount set aside for "reserves and taxes," and as the company's practice in this respect is remarkably conservative and most admirable in conception, an explanation of the meaning of "reserves" is in order.

DEPRECIATION AND OTHER RESERVES

For the first six or seven years of operation depreciation in operating expenses was overlooked and neglected in the scheme of finance, and nothing was set aside to take care of the "deferred operation expenses," which come when track and equipment are worn out, and large sums of money have to be put into the property in order to replace them. In many cases in American street railway practice the investment or capital account has to furnish these sums of money, which are, nevertheless, operating expenses pure and simple, and a measure of the "depreciation" which has taken place during the previous operating period. European practice is, on the contrary, very rigid in requiring all railway and manufacturing companies to take from their operating expenses every year a certain amount to cover depreciation before declaring dividends to stockholders.

Two or three years ago the Milwaukee company awoke to the realization of the mistake which had been made in not providing a reserve fund for depreciation, and it was decided to immediately reorganize the finances on a far more conservative basis. The plan adopted was as follows:

Fifteen thousand dollars is set aside each month as a reserve fund for depreciation of railway plant, and $2,000 for depreciation of lighting plant. At the same time 3 per cent of the gross earnings of the railway and 1 per cent of the gross earnings of the lighting departments are set into a reserve fund to provide for injuries and damages arising in the operation of the property. In an "insurance fund" is placed an amount large enough to provide not only for actual disbursements in insurance premiums, but also for a surplus which it is intended shall take care of the uninsured losses from fire. A certain percentage of the gross earnings is also set aside for legal expenses, and, finally, $10,000 per month is passed into the fund for amortization of franchises, which expire about twenty-five years hence. The theory of this last item is that in case the company's franchises are not renewed at their expiration there is likely to be realized a large loss of capital, unless such a fund as this be provided in order that the investors may receive their principal, dollar for dollar.

All of these moneys taken out of the earnings in the way above stated are credited on the books to their respective ledger accounts, and are actually represented in the cash, bank, or otherwise liquid assets of the company. The sum of these accounts appears in the general statement in the item of "reserve and taxes" as in the above tables, and is a direct deduction from "earnings from operation."

If, now, it becomes necessary to replace twenty-five worn out cars, or to rebuild 5 or 10 miles of worn out track, the money for this is taken out of the bank, cash, or liquid accounts, and is charged directly to the reserve fund for depreciation. Small renewal expenditures arising in the current operation of the property and not involving the actual purchase of new rolling stock or bulk material, are charged directly to operating expenses as a current disbursement, and not to this reserve fund. Insurance and general expenses paid out are, however, charged to their respective funds, as these funds are established, not only for the purpose of gradually accumulating a reserve, but also as a bookkeeping method for pro rating the annual disbursement for these accounts evenly upon the twelve monthly statements. Taxes are dealt with in a similar manner and as an "accrued" obligation.

It is not intended that the depreciation fund shall ever contain large sums of money, but, on the contrary, most of the money is actually expended each year in the purchase of new rolling stock and replacement of track. Such a fund, however, has the effect of evening up expenditures over a series of years and taking out of the earnings that proportion which ought to be given over to maintaining the property in good condition, so that its actual value shall be always equal to its book value.

In the light of this discussion the following final figures will be interesting as a gauge of the financial results of the Milwaukee property during the past three years.

	per cent op. ex. to gross receipts.		
	1896.	1897.	1898.
Per cent op. ex. (actual disbursements) to gross receipts	67.7	57.2	53.4
Per cent op. ex., reserves and taxes, to gross receipts	87.7	71.0	76.4

The figures heretofore given appertain, as stated, to the street railway department only of the Milwaukee Electric Railway & Light Company. Its lighting department is, however, by no means unimportant, but in proportion to the investment therein contributes largely to the net revenues of the company. The surplus left for stock after paying the operating expenses, reserves and taxes, and the interest on its own investment, amounted in 1898 to nearly 40 per cent of the company's total surplus for stock. It is not probable, however that this high percentage can be long maintained for the railway earnings, gross and net, will doubtless increase far more rapidly than the lighting.

All in all, this great Milwaukee system has had the benefit of an operating and financial management of the most admirable character—a management which, if continued, can hardly fail to give it rank among the most substantial and valuable street railway properties in the world.

Accident Cases in Australia

The following is clipped from the legal department of the "West Australian" of March 17, 1899, and shows how railroad accident cases are treated in that country, where, it would seem, it is a serious offense for a man to get in the way of a locomotive:

Infraction of Railway By-Law.—Thomas Hodgins was charged with driving a horse and buggy across the railway when a train was approaching. Mr. Purkiss appeared for the Railway Department, and defendant was undefended. An engine driver said that defendant drove across the line in front of a train, the engine of which witness was driving, on the 1st inst. The engine struck the hind wheel of defendant's buggy and capsized and smashed it. The horse broke away, and defendant, unhurt, got up and ran after it, but the horse got into a cattle pit. When spoken to by witness, defendant admitted having tried to get across, as he thought he had time to get over, and his horse shied. Defendant said that he was driving an unruly horse at the time, and was afraid he could not pull him in, and that he would run into the train. He thought the only chance he had of saving his own life and that of the horse was to try and get across the line. He tried at first to pull the horse up. He got nearly across, when the engine struck the back wheels and defendant was thrown 10 ft. He was cut and shaken, but got up to try and catch the horse, which ran into a cattle pit and got its sinews cut. He considered the crossing dangerous. Defendant was fined 20s. and costs, in default one month's imprisonment with hard labor.

Letter Boxes on Cars

An interesting experiment is now being tried by the Hartford Street Railway Company, of equipping a number of its electric cars with ordinary drop boxes for the receipt of letters. These boxes are attached to one side of the rear vestibule of the car, so that they are protected from collision with passing vehicles or other accident. The public is invited to use these letter boxes for depositing their mail, and no charge is made by the railway company to the government for carrying these letters. All the cars of the company start from the center of the city, which is directly opposite the post office, and when they arrive at that point the boxes are emptied by the postal authorities. As the cars always wait a minute or two at this point, they are not detained by the process; neither has there been a material delay in receiving letters on the road from persons wishing to mail letters.

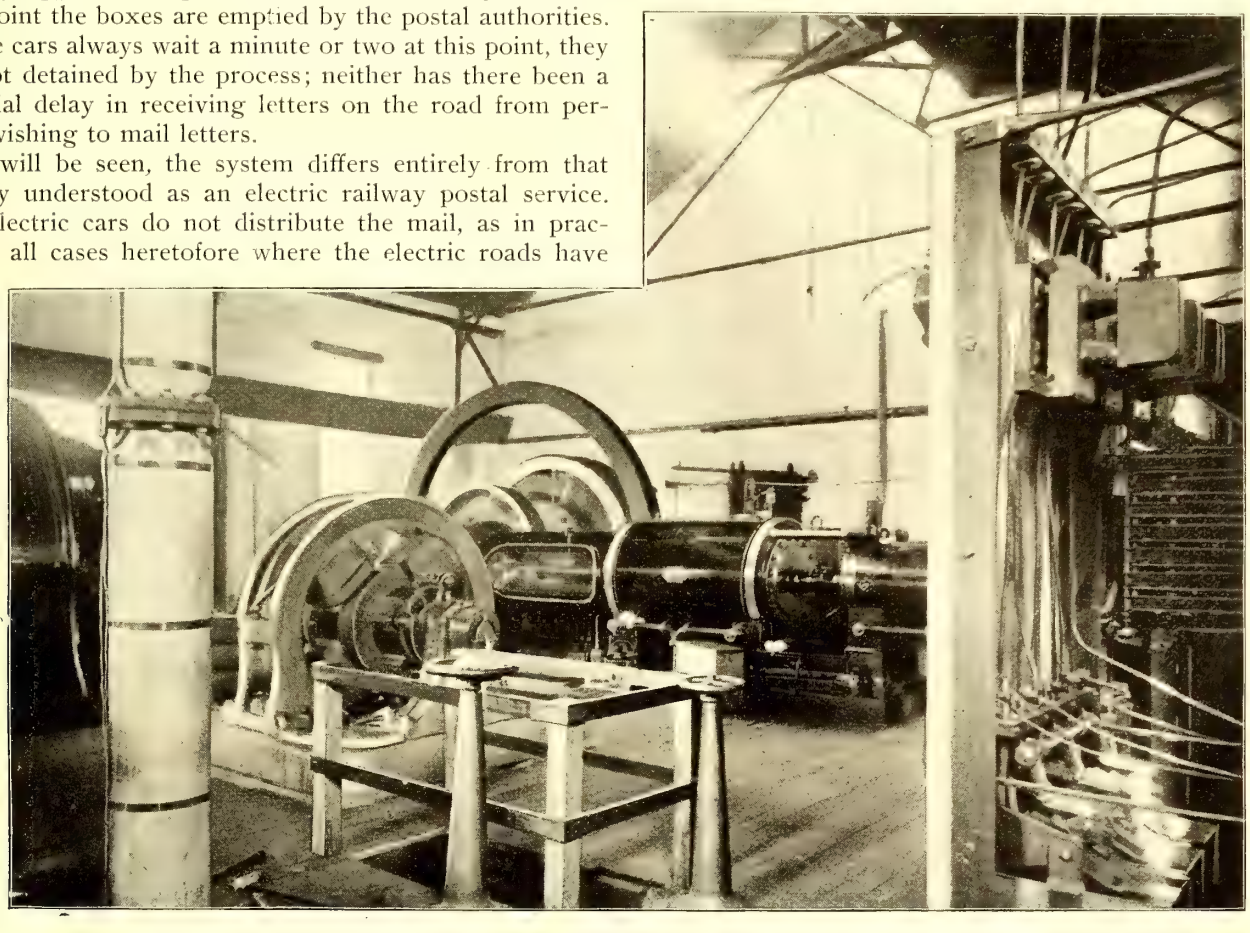
As will be seen, the system differs entirely from that usually understood as an electric railway postal service. The electric cars do not distribute the mail, as in practically all cases heretofore where the electric roads have acted in connection with the postal service, but assist in collecting the mail. The advantage to the railway company is principally in offering a convenience to the public, especially to its patrons, and the manager of the company, N. McD. Crawford, reports that so far there has been no drawback to the plan.

The system has proved most popular in Hartford, and has been well patronized. It was put in operation on a half-hourly schedule on April 1, when it was thought that only fourteen boxes were required to perform the service. F. P. Furlong, General Post Master of Hartford, who originated the idea, said recently to the STREET RAILWAY JOURNAL that during the first fifteen days of April there were received through this source 9310 letters; during the last fifteen days, 12,899; making a total for the month of 22,209 letters, which included quite a few special delivery letters.

For the postal department the system presents very many advantageous features. Much earlier connections are made with outgoing mails, by reason of the frequency of the service, and it relieves, in a measure, the congestion in the mailing division, by reason of bringing smaller quantities of mail into the office at frequent intervals.

Three Phase Transmission for Railway Service Near Philadelphia

The increase in the number and extent of suburban electric railways near Philadelphia has kept pace with that surrounding other large cities in this country, and Philadelphia is now connected electrically with Wilmington on the south and Westchester on the west, while the extension of roads to the north is being carried on rapidly. These roads make connections in the outskirts of the city with the system of the Union Traction Company of Philadelphia, but the suburban cars do not run into the center of the city, as in some instances, over the tracks of the city company.



INTERIOR OF MAIN POWER STATION—WESTCHESTER TRACTION COMPANY

Among the lines in operation that of the Philadelphia & Westchester Traction Company is, from an electrical standpoint, probably the most interesting, on account of the use of the three-phase current for power distribution. The line is 20 miles in length, and extends from the corner of Sixty-third and Market Streets, Philadelphia, in almost a direct line along the turnpike, which is controlled by the company, to the Borough of Westchester, which has a population of 15,000. The region traversed is a rich and rolling farming territory, and crosses a series of six ridges and valleys, with grades of from 4 to 6 per cent on each side, some of the grades being over 3500 ft. long. Eight miles of this line, or that from the eastern terminus to Newton Square, were built in 1894, but the old track has been completely reconstructed.

The track is rock ballasted for the entire length, and east of Newton Square is a 58-lb. T rail, furnished by William Wharton, Jr., & Co., with tongue switches, mates and frogs of manganese steel. The ties are 5 ins. x 7 ins. x 7 ft., laid 2-ft. centers. No. 0 trolley wire, with the General Electric overhead material is used. West of Newtown

Square 58-lb. Johnson T rails in 60-ft. lengths are used, laid on oak and chestnut ties of the size already mentioned. The trolley wire on this section is a No. 0000, and double for the entire distance, as no feeders are employed. The overhead material is of the General Electric and McCallum type. Within the Borough of Westchester a 9-in. Johnson girder rail in 6-ft. lengths is used, on 6-in. x 8-in. x 8-ft. oak ties. Mayer & Englund 0000 protected bonds are used throughout. The Ramsey block-signal system is used.

The main power station is at Llanarch, 2¼ miles from the eastern terminal. It is of red brick on rubble stone foundations, and measures 100 ft. x 52 ft. 5 ins. The roof trusses are of steel, supported by steel columns, which also carry the crane girders. The boiler room is 44 ft. x 51 ft., and 20 ft. high, and contains three Pierpont water-tube boilers of 200 h.p. each. These boilers are fed by two No. 10 Sellers injectors, and burn bituminous coal.

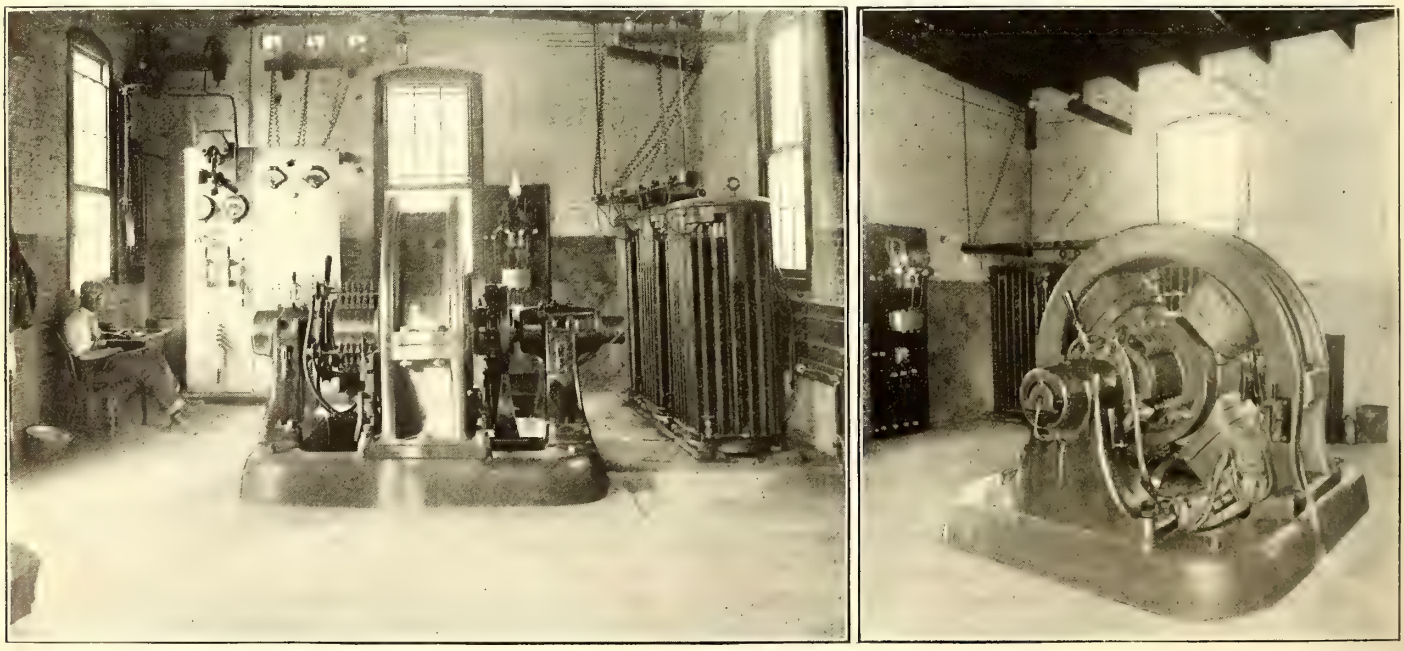
The engine room is 52 ft. 5 ins. x 51 ft., and contains two Harrisburg Ideal compound condensing engines, 17 ins. and 28 ins. x 42-in. stroke, each directly connected to a G. E. 400-kw. generator, with a speed of 100 r.p.m. In the basement each engine is connected with a single cylinder air pump and jet condenser, 12 ins. and 16 ins. x 18 ins., manufactured by the Snow Steam Pump Company, which also supplied the steam pump, which is 10 ins. x 5 ins. x 10 ins. In the engine room is also a 15-ton Sellers crane, operated from the main floor. The switchboard is of the standard type of the General Electric Company, with two generator and four feeder panels.

In addition to this machinery, which supplies current to the line from the eastern terminus to Newtown Square, there is also a 250-kw. General Electric rotary converter, taking current from the main bus bar. This converter is of the T C-4-250-750 type, supplying 380 volts on the alternating side and 550 volts on the direct current side, and is run inverted; that is, the direct current side is used as a motor, while current is taken from the alternating side at 25 cycles per second. In the station are also three 90-kw. step-up transformers of 380 volts primary and 6600 volts secondary current connected with the alternating current side of the inverted rotary.

The substation is located at Ridley Creek, is of brick, and measures 19 ft. 6 ins. x 32 ft. It is 10¾ miles from the power station, with which it is connected by three No. 4 wires carried on porcelain insulators. These were supplied by Mayer & Englund, manufactured by Fred M. Locke, and are carried on white pine cross-arms, on pins spaced 12 ins. apart. After passing the lightning arresters, which are of the G. E. A type, the current passes through aluminum fuses, thence to the oil switches on the switchboard, and thence to three oil-insulated 90-kw. transformers, by which it is reduced to 380 volts. At this



EXTERIOR OF ROTARY CONVERTER SUBSTATION

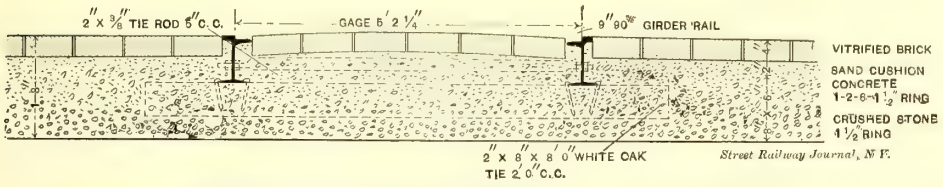


INTERIOR OF ROTARY CONVERTER SUBSTATION AT RIDLEY CREEK

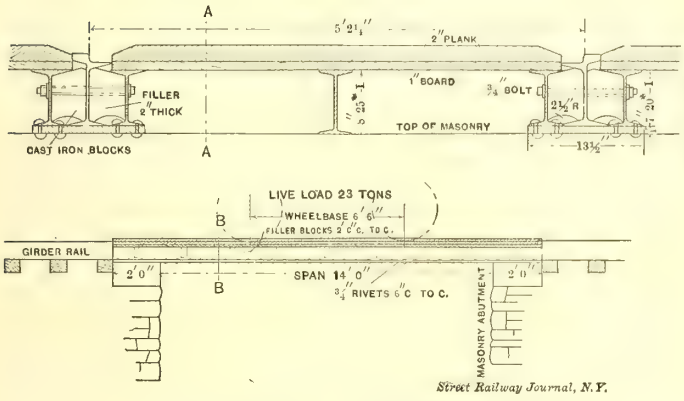
voltage it is taken to the alternating side of the rotary, while from the direct current side a current of 550 volts is supplied to the trolley wire.

Each rotary converter is supplied with a centrifugal governor operated from the extended shaft of the machines. This governor is set so as to throw the circuit breaker on the switchboard, in case the limiting speed, which is about 30 per cent above normal, is reached. The governor consists of two weights, which are thrown out as the speed increases, and when in operation make contact on two rings, which are connected to an auxiliary trip coil on the circuit breaker. On the other side of the machine is placed an end-play device which is in connection with a make and break circuit, which energizes coils and causes a magnetic pull on the armature, thus giving it a to and fro motion in the bearings. The motor for accomplishing this is of the induction class, 4-1/16-750-80 type.

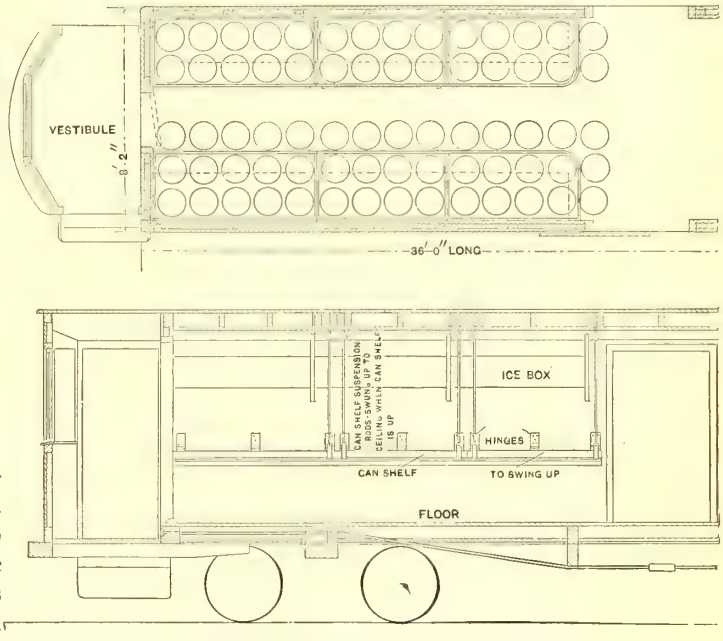
In starting the alternating current system, the rotary converter in the main station at Llanarch is first



SECTION OF TRACK CONSTRUCTION IN WESTCHESTER



14-FT. SPAN BRIDGE OVER PENNSYLVANIA R. R.



SECTION AND PLAN OF MILK CAR

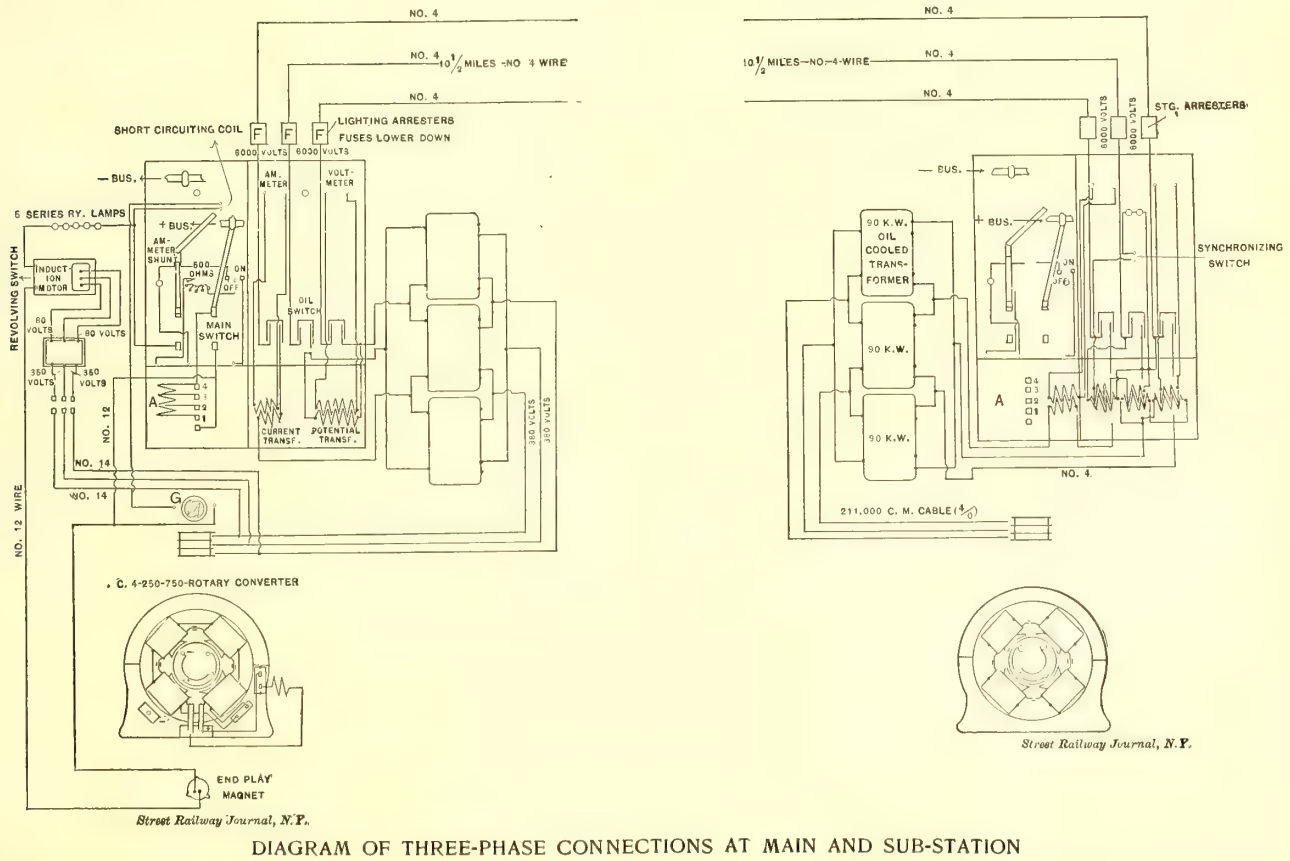


DIAGRAM OF THREE-PHASE CONNECTIONS AT MAIN AND SUB-STATION

run as an ordinary direct current motor, after which that in the substation is started as an alternating synchronous motor from the alternating side. The amount of current necessary to start this machine is about its full load. The voltage on the direct current side of the rotary converter in the substation is practically the same as that in the main station. This voltage rises, along with the compounding of the large 400-kw. generators, in the main station as the load goes on.

For its rolling stock the company has fifteen ten-bench open cars, made by the Lamokin Car Works, mounted on Brill 21 E trucks, and equipped with Westinghouse No. 38 motors; six small box-cars, built by Brill, and six long closed cars, with smoking compartment, built by Jackson & Sharp. These latter, the latest addition to the company's rolling stock, are 29 ft. 6 ins. in frame, 39 ft. over all and 40 ft. over bumpers. They measure 7 ft. 6 ins. wide over sills, and 8 ft. 2 ins. wide over belt rail, allowing 34-in. seats on each side of the aisle, giving a very wide aisle space.

The interior finish of the cars is quartered oak, with white birch veneer ceilings, handsomely decorated. Between the second and third windows is placed a bulkhead, or partition, dividing the car into two compartments. The main compartment, or passenger room, is fitted with Hale & Kilburn's walkover seats, upholstered in rattan. In the smoking-room end of the car side seats of slats of the usual type are placed, giving a seating capacity of four on each side, or eight in all, making the total seating capacity of the car forty passengers. The sashes are double and fitted with polished plate glass; the upper light is permanent. The lower sash is made to drop into the side of the car below the belt rail. The lights in the deck are bevel-edge with chipped center, and the glass in the end doors are also bevel-edge, of plate. The end doors of the cars are double, mounted on contra-twist door hangers. The curtains are fitted with Burrowes Climax fixtures. The cars are fitted with especially long platforms, being 5 ft. 3 ins. over all, detachable canopies and vestibule fronts. The outside is painted Tuscan red, and striped and numbered in gold leaf, and lettered in aluminum leaf, which give very handsome effect. The cars are mounted on Peckham 14 A trucks, and are equipped with Westinghouse No. 49 motors and Christensen air brakes. The cars are equipped with New Haven registers and Johns heaters.

A large proportion of the company's business is the carrying of freight and merchandise, of which the transportation of milk forms a considerable item. To accommodate this service the company has recently put on a new milk car of the form illustrated on the preceding page.

The line is especially built for high speed, and it is the intention of the company to run the 20 miles in one hour and fifteen minutes. There is no direct steam railroad connection between the terminals of the electric road, and it is thought that considerable through business can be secured, as well as a considerable excursion business in the summer. To encourage the regular passenger business, especially on rainy and cold days, the company will build waiting stations at regular points along the line, and they will be lighted and heated by electricity.



VIEW ALONG LINE





INTERIOR VIEWS OF DOUBLE TRUCK CAR

The officers of the Philadelphia & West Chester Traction Company are: President, A. Merritt Taylor; secretary, C. Russell Hinchman; treasurer, Nathan Sellers; electrical engineer, Joseph W. Silliman; superintendent, J. H. Gibson.

The general contractors were Pepper & Register.

For making inspection and running repairs such as should be made in car-houses, it is a safe rule to have one man to seven cars. From paper at the Boston Convention, 1898.

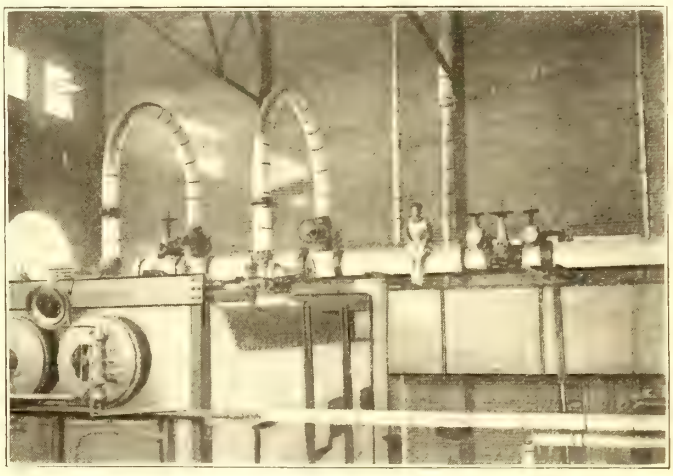
An Interesting Cross Country Electric Road

The Dayton & Western Traction Company, of Dayton, Ohio, in which some of the principal stockholders of the City Railway Company, of Dayton, are interested, is operating an important electric railway extending from Dayton to Eaton, a distance of 25 miles. The line extends through a thickly settled region, chiefly devoted to farming, and containing a number of small villages and towns, notably New Lebanon, Johnsville and West Alexandria. The Dayton terminus is at the Post Office. After leaving the Dayton city line it follows the National Pike all the way to Eaton, and in a distance of 22 miles after leaving the city tracks it has only one slight curve, near the Soldiers' Home. The subgrade of the track, wherever possible, was kept about on a grade with the highway, thus keeping the track high and dry. The maximum grade on the line is 4 per cent, coming out of Dayton. There is also a long grade about 6 miles in length, of 3.85 per cent for 2600 ft. and 3.5 per cent for 1700 ft.

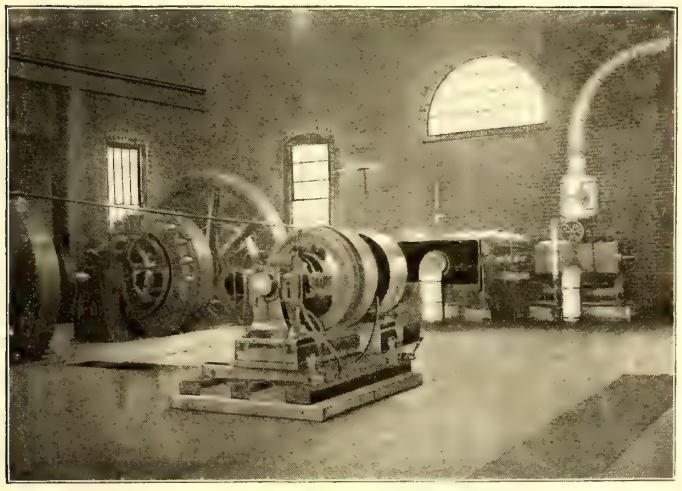
There are nineteen steel bridges on the line, of various lengths, from 10 ft. to 154 ft. They are all built alongside



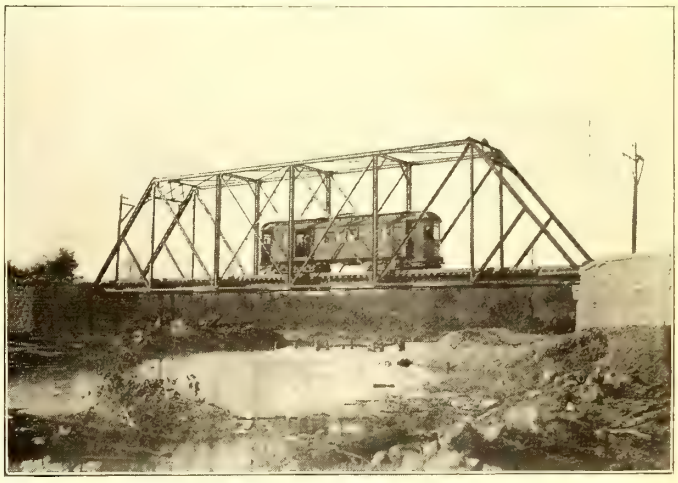
EXTERIOR OF POWER STATION



VIEW OVER BOILERS



INTERIOR OF STATION



120-FT. SPAN TRUSS BRIDGE AT BANTA'S CREEK



WOODEN TRUSS BRIDGE



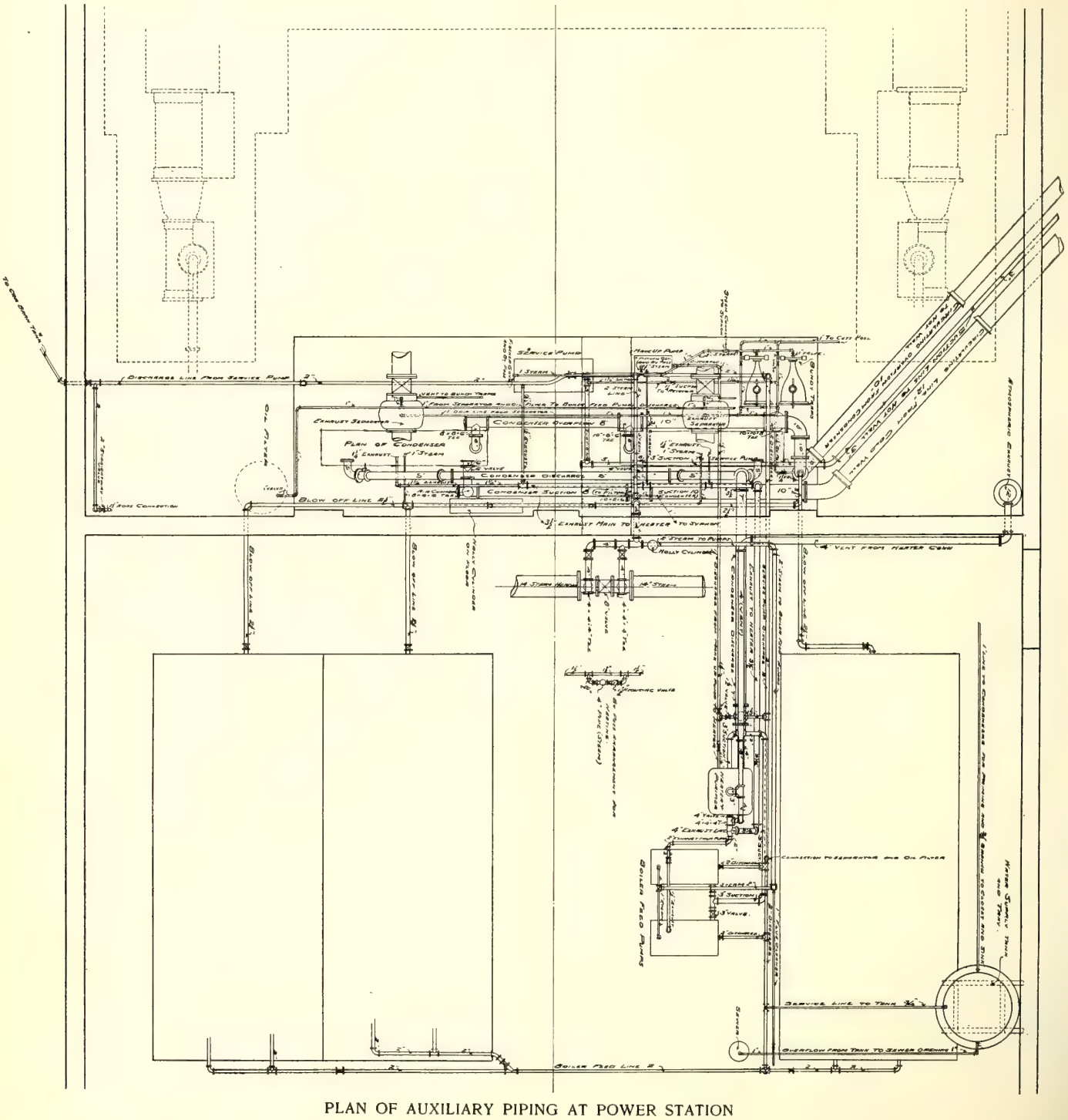
PLATE GIRDER BRIDGE

of the county highway bridges, and have independent abutments. They are all of the deck girder construction, with the exception of one through truss span over Banta's Forks, 118 ft. span. The bridges were furnished and erected by the King Bridge Company, Cleveland.

The ties are principally of white oak, with about 20 per cent chestnut, and were 5 ins. x 7 ins. x 7 ft. 6 ins. The rails are the A. S. C. E. standard, 70-lb. T, 60-ft. lengths, furnished by the Johnson Company. Seven-inch rails are six 300,000 cir. m. feeders of bare wire. There is also a complete telephone system, with boxes at numerous intervals along the road, and telephones in the power house and office and on the cars.

The road has no competition, there being no direct steam road communication between Dayton and any point on the traction line.

The company is at present operating four passenger cars and two combination cars, and transports both freight



PLAN OF AUXILIARY PIPING AT POWER STATION

were used in West Alexandria, and 6-in. girder in Eaton. The track is ballasted throughout with 6 ins. of gravel underneath the ties, sloping 12 ins. outside the ties. The switches are 200 ft. in the clear, and these, with all other special work, were furnished by the Cleveland Frog & Crossing Company. The line crosses the Cincinnati & Northern at West Alexandria, and the Panhandle at Eaton. Derailers are provided at both crossings.

The trolley wire consists of two No. 00 wires, and there and passengers. The fare for the entire trip is 45 cents, or 75 cents for the round trip. The charges for freight are 25 cents minimum for packages, with the regular charge of 10 cents per 100 lbs. for light freight, but special rates are given for bulky loads, such as household goods, and the line is enjoying a very liberal patronage in both the freight and passenger departments. Long eight-wheel cars, with cross seats, are employed. The cars were built by the G. C. Kuhlman Company, of Cleveland, and are

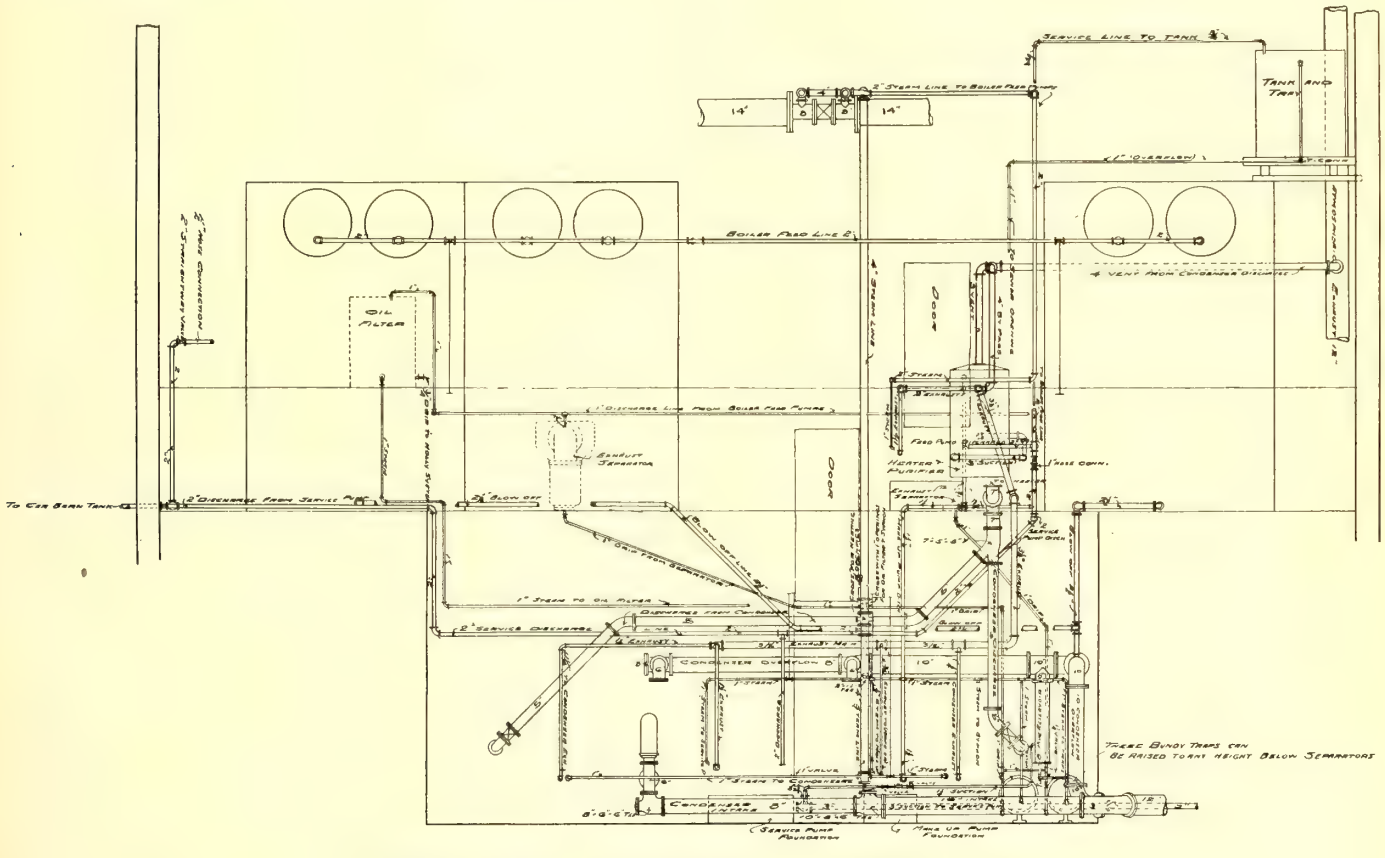
mounted on extra strong Peckham trucks, with two General Electric motors, and with electrical brakes of the General Electric type.

The station was located at West Alexandria, 17 miles from the eastern terminus. This site was selected because it was the only point between the termini where the line crossed a steam railroad, and where coal could be obtained without hauling it over the electric road. It was also the best site for water, as there was no location toward the middle of the road where water was obtainable. It was also thought probable that at some time there might be an extension or addition to the western portion of the line, in which case the power house would be at the center of gravity of the system.

The station building is of brick and is located on the top of a bluff about 1200 ft. from Twin Creek, and about 32 ft. above the level of the creek. The bottom land lying between the creek and the foot of the bluff rises gradually toward the bluff until at the power house it is about 18 ft.



PASSENGER AND COMBINATION CAR



SIDE ELEVATION OF AUXILIARY PIPING AT POWER STATION



VIEW AT TOP OF 3.8 PER CENT GRADE 2600 FT. LONG

below the top of the bluff. Underlying the soil on the bottomland is a bed of gravel, and sufficient water to operate the condensing plant is obtained without the expense of a large pipe line to the creek by driving two wells, about 16 ft. in diameter and 18 ft. deep.

The power equipment consists of two 250-h.p. Buckeye engines, each of which is directly coupled to a Siemens & Halske 250-kw. generator. The engines are tandem compounds, with cylinders 15 ins. and 28 ins. x 30 ins. The units are placed parallel to each other, and the shafts of the generators are extended and coupled with friction clutch with a belt pulley. From this pulley is run a booster, which is placed on a line with the engines, so that it can be driven when one or both of the generators are in service. The booster is rated at 75 kw., and raises the voltage from 600 to 800 volts. It is connected to the line 8 miles from the station. The engine room is provided with an overhead traveling crane, which was manufactured

by the Cleveland Punch & Shear Company, of Cleveland, Ohio.

The steam is generated in two Babcock & Wilcox boilers of 250 h.p. each, and the auxiliary equipment consists of Wheeler condensers and air pump. The coal is delivered directly into the boiler room from freight cars by sidings that connect with the neighboring railroad lines. The operating office of the company is located in one corner of the car house, which adjoins the power station.

The entire engineering for the system was done by E. P. Roberts & Co. and the Osborn Company. In addition to the inspection on the ground, the structural steel was inspected at the mills for the tracks, bridges and structural work in the power house and for the boilers. The contractors for the line were the Chase Construction Company, for the overhead material the Ohio Brass Company, and the line arresters the Garton Company. The engravings for the article are from photographs taken by J. B. Crankshaw, electrical engineer of the road.



VIEW ON DAYTON & WESTERN RAILWAY

The officers of the company are: President, J. E. Lowes; secretary and superintendent, J. E. Feight; treasurer, Oscar Sheppard; general manager, Valentine Winters, and electrical engineer, J. B. Crankshaw.

Labor Saving Devices in Cincinnati Repair Shops

About a year ago the extensive new repair shops of the Cincinnati Street Railway Company were described in the Street Railway Journal. They have been found amply adequate for the purposes for which they were designed, as well as most conveniently arranged. During a recent visit to these shops of a representative of this paper a number of labor saving devices and other interesting features were noticed.

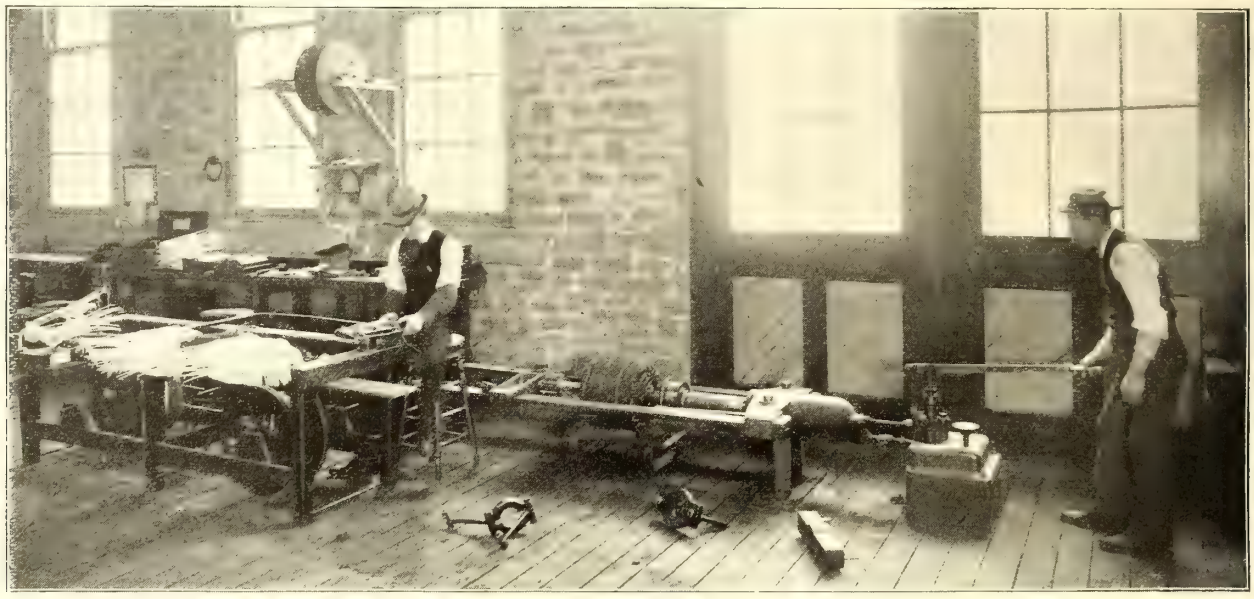


FIG. 1.—MAKING COILS AND PRESSING ON COMMUTATORS, CINCINNATI



FIG. 2.—COIL TAPING MACHINE

In the motor repair department five hands only are employed. These are mostly boys or young men, who work under the direction of an expert repair man, and it will

be noted that this is an exceedingly small force for a railway of the size of the Cincinnati Street Railway Company, especially since it is the practice of the company to wind and tape all its own coils and fields and make all its own commutators. The latter are cast in the brass foundry of the company, of pure copper from the scrap trolley wire that is melted up.

Fig. 1 illustrates some of the forms on which the armature coils are made. In this same engraving is shown a home-made hydraulic press, which is employed for pressing on or taking off the commutators from the armature shaft. This press is operated by a hand lever, as shown in the illustration.

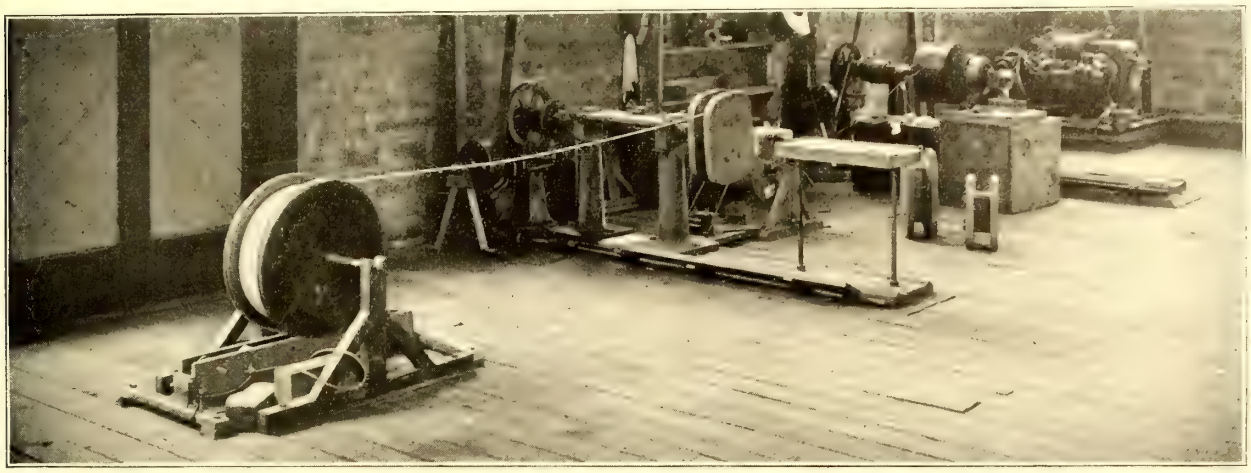


FIG. 3.—LATHES FOR WINDING FIELD COILS AND PLACING BINDING WIRE ON ARMATURES

Fig. 2 shows the coil taping machine, by means of which armature coils are taped very rapidly. This consists of two rings, one operated outside the other by means of a belt which is actuated by foot power, and which causes the ring carrying the spool of tape to revolve. Both the inner, or stationary, ring and the revolving ring are provided with slots which, when brought into conjunction, admit of placing one side of the coil within the ring. As the ring revolves the tape is paid out from the reel which carries it, and which has a governing spring that adjusts the tension. By this device coils can be taped very much faster than by hand. The shops are provided with two of these machines, and a large number of coils are taped up in advance, ready for service, and are stored in the stock room.

Fig. 3 illustrates the method of winding the field coils, which is done on a wooden form. In the same figure is shown a similar device for placing the binding wire on the armatures. These are each operated by power from a belt connecting with an overhead shaft, and the mandril is revolved through the medium of a friction clutch and a worm gear. The clutch is thrown in or out of operation by means of a lever operated by a long pedal, as shown. By this means the mechanism may be started or stopped at the will of the operator. These devices, as well as other shop tools, are operated by power from an electric motor, also shown in Fig. 3.

Four types of motors are employed on the cars of this system, according to the character of the grades and of the cars. They are the G. E. 800 type, the G. E. 1000, the G. E. 1200 and G. E. No. 58, and for testing the armatures of the four different types the device shown in Fig. 4 is used. It consists of a jack shaft driven by belt from a D 62 type of generator that has been transformed into a motor. It will be noted that the cases and fields of four different types of motors are geared to the jack shaft, and are kept in position, the armatures being placed in or removed by means of an overhead hand-hoist. In connection with this testing apparatus is a nest of incandescent lamps, which are cut in and out according to the tension of the current required in the testing.

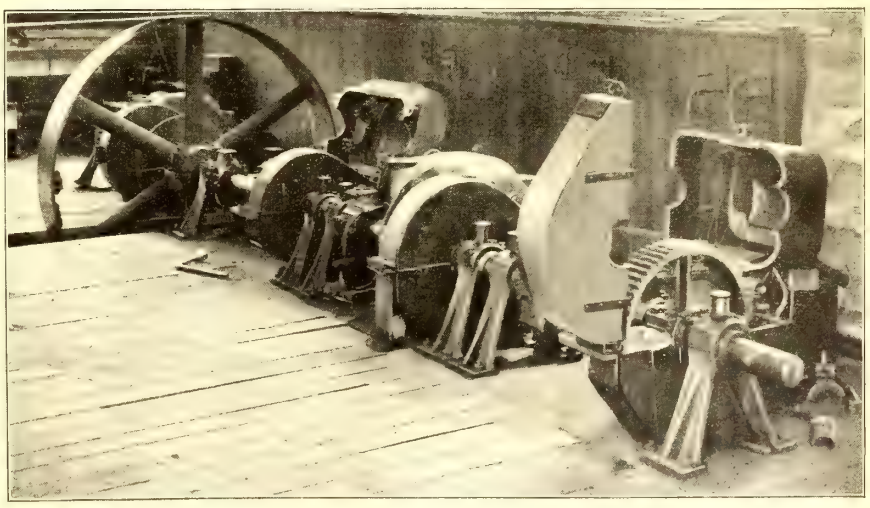


FIG. 4.—APPARATUS FOR TESTING ARMATURES

For treating field coils and armatures Monarch asphalt paint is employed. This paint, when properly baked, proves to be as durable and as satisfactory as to insulating properties as any of the materials that the company has tried.

It is the practice to provide two sets of carbon motor brushes for each car motor, and the same for the generators in the different stations. The brushes for the motors are put in service every other day in summer and every three days in winter, and as soon as removed are placed in a pan of sperm oil, in which they are kept until again put in use. The brushes are all numbered and lettered, and are used on the same commutators. By this practice a long life is gotten from the brushes, two sets lasting a year. The practice also adds 100 per cent to the life of the commutator, some of which run for three years. They never require to be sandpapered or touched, but always run smoothly, with a gloss on the surface.

Power for operating the different departments of the

repair shop is derived from motors which are made over from the old D 62 type of generators formerly employed. Quite a number of these are employed, and have proved very satisfactory. There are besides twenty small-power motors employed about the shops and the different car houses of the system.

The company manufactures its own trolley wheels, the blanks being cast in their own brass foundry. They are turned on a specially designed turret lathe, the cutting tool of which works automatically and turns the sides and grooves at one operation. The lathe is operated by an unskilled workman, who receives only $1 a day, but is able to turn up and finish 125 wheels a day. The wheels are cast from a mixture consisting of eight parts of copper to one of tin.

The company employs bronze bearings for armature journals in preference to babbitt, as it was found frequently that the babbitt would squeeze out from the shell and allow the armature to come down in contact with the fields, and in case of excessive heat would melt.

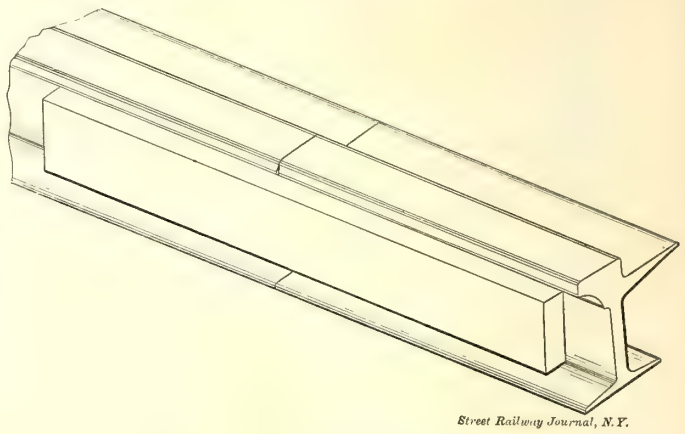
The Present Status of Electric Welding of Rails

BY H. F. A. KLEINSCHMIDT

It will be remembered that in the early welding of rails, as carried on by the Johnson Company, peculiar indications of a change in the nature of the steel were observed. These were attributed for a long time to the electric current. Until the nature of the apparent change could be understood, the company withdrew from the field and entered upon an exhaustive series of experiments. Various methods of heat treatment after the weld was made were tried and discarded. Finally the writer, in endeavoring to prevent the spread of heat after the weld is made, discovered a very simple process which entirely overcomes any change in structure of the steel, and produces a weld of the greatest toughness and strength. This process consists in making a weld from a boss on a bar, instead of from a flat bar. As the boss is the only portion of the bar which comes in contact with the rail, all the heat is concentrated at that point. As soon as a welding heat is reached the current is cut off, and, simultaneously, a heavy pressure is exerted directly over the weld and artificial means provided for hastening its cooling while under pressure. The comparatively cold portions of the bar surrounding the boss prevent the more plastic metal from spreading, and the heavy pressure so confines it that in cooling there is no chance of coarse crystallization. In other words, the effect is exactly the same as hammering or working the steel.

The results obtained experimentally by the Lorain Steel Company have been amply borne out by practice. Even with a strain of 350,000 lbs., we have never succeeded in shearing off a weld made in this way. On making a joint we use a bar 1 in. x 3 ins., having three bosses, as shown in the accompanying diagrams, and weld one bar to each side of the rail web. Bosses of an ovoid shape are used when old rails having punched holes are to be welded. The boss then covers the hole, welds it up completely, and thus removes the danger of old fractures at this point. Holes beyond the bars are reamed. The center weld is made first, then the end welds. The bars, when cooling, exert a powerful force to bring the rail ends together, making a perfectly tight joint.

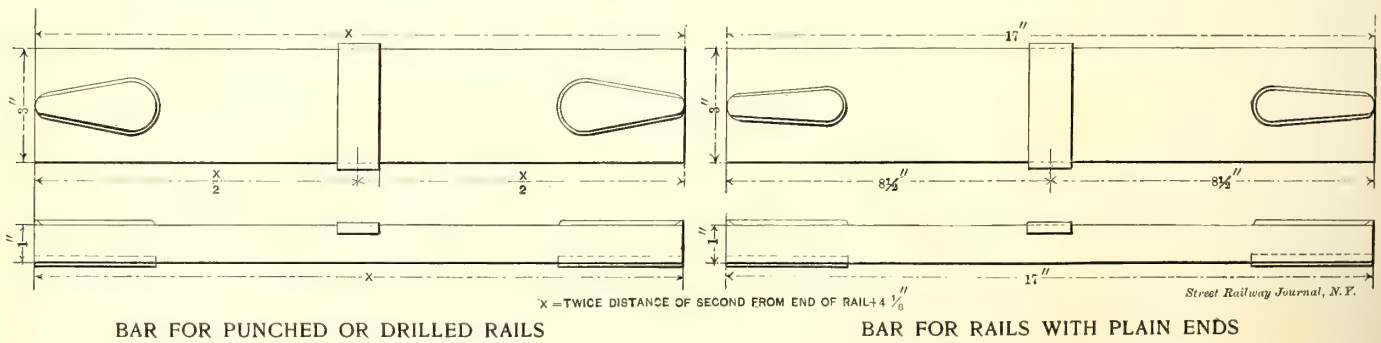
In 1897 a little over a mile of track was welded in Johnstown. After a severe cold spell during the first winter one break occurred through an old bolt hole beyond the



ISOMETRIC DIAGRAM OF JOINT

welded bars. No further breaks have occurred on this track. Last summer 10 miles of track were welded for the Nassau Electric Railway Company, at Brooklyn. Some of the joints had eight-hole splice bars, and others twelve-hole. In all cases the second hole on the top row was welded over by the end bosses, the bars being placed close under the head of the 9-in. rails. In the twelve-hole punching the holes beyond and directly under the end of the bars were reamed out, our experiments having shown that a punched rail, on account of minute fractures, is very much weaker than a drilled rail. Although the Brooklyn track was welded during the hottest weather, the number of breaks have only been one out of 180 joints, or a trifle over 0.5 per cent. In no case did a rail with the eight-hole punching break. The fractures all occurred through the holes beyond the bars, thus showing that the reaming had not removed all the fractures in every case. With new rails, having no holes, or rails in which the holes are drilled instead of punched, it is confidently believed a break will be an extremely rare occurrence. The fact that no fractures occurred until after severe cold weather set in proves conclusively that they were due entirely to the tensile strain to which the rails were subjected by contraction due to low temperature, and that the old trouble has been entirely overcome.

The experimental stage of the electrically welded rail joint is passed. In electric welded joints we are as sure



BAR FOR PUNCHED OR DRILLED RAILS

BAR FOR RAILS WITH PLAIN ENDS

of our product to-day as in any field of production. With a given size of bar we produce a joint of certain strength and a uniformity of product as perfect as can be obtained.

The ultimate success of the process is due to the indomitable perseverence of Mr. A. J. Moxham, and to his faith that this method offered advantages superior to any form of joint, and that the field to be occupied has hitherto been unfilled.

For electric roads using their rails as a ground return it has manifest advantages. The cost, especially for the 9-in. girder rails which are now coming into almost universal use, is less than for any other form of so-called welded joint. As a bond it offers the only perfect method of reducing electrolysis to a minimum. The intimate union of steel to steel, and the increased carrying capacity due to the bars at the joints, make the joint the place of least resistance. An electrically welded track is of lower resistance than the rail itself.

There is no obstruction to paving, as the flat bar offers as good a surface for paving against as the rail web itself. Ties are not disturbed, as it is not necessary to go below the rail flange in making the joint. A continuous rail joint should last as long as the rail itself, and its wearing qualities should be the same. By our process the head of the rail is heated but slightly, thus avoiding the danger of annealing the rail head and softening it, which is apt to be the case where the whole rail is raised to a red heat when forming the joint.

In the apparatus used at present in this work we have made very few changes. A 75-kw. booster has been added, which permits good welding, even with a voltage as low as 300, and a sand blast apparatus has replaced the old method of cleaning the rails.

The Lorain Steel Company has started upon the electric welding of 50 miles of track in Buffalo, upon the system outlined above. Of this length about 25 miles will be of 60-ft. 9-in. rails, with ends left blank for the style of joint adopted.

Speed Tests on the Cleveland-Lorain Railway

In the last issue of the STREET RAILWAY JOURNAL some results secured in the power station of the Cleveland-Lorain Railway Company were published, under the heading "Analysis of the Operation of an Interurban Railway." Through the courtesy of E. P. Roberts & Co., engineers of that line, the STREET RAILWAY JOURNAL is able to give in this issue some additional statistics upon the speeds secured during trial runs and in regular service. The figures are particularly interesting, from the fact that the line is a high-speed electric road, with practically no grades and few curves. The cars with which the tests were made, the results of which are given, were equipped with four G. E. 57 motors, with gear ratio 1 to 5.7. Each car was mounted on two Brill No. 27 trucks, equipped with 33-in. wheels.

Table I. shows the result of four acceleration tests made in the same direction, with the same car, from the same point, and with the same motorman. The car weighed 23 tons, and the speed per hour given is the average speed between the 10-sec. readings.

Table II. shows four tests with three cars differently

TABLE I.—SPEED TEST WITH SPECIAL CAR.

No. of Car.	Weight of Train in Net Tons.	Grade, Per Cent.	10 Seconds.		20 Seconds.		30 Seconds.		40 Seconds		50 Seconds.		60 Seconds.	
			Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour,	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.
1.....	23	1 2	9.1	133	20.0	426	20.8	877	37.7	1,430	43.2	2,064	44.0	2,724
1.....	23	"	9.5	138	21.8	455	....	....	...	1,520	42.4	2,146	46.7	2,830
1.....	23	"	10.1	148	21.0	457	31.7	922	35.3	1,449	39.9	2,034	....	....
1.....	23	"	10.1	149	23.5	493	32.9	976	38.1	1,535	43.0	2,165	43.4	2,802

All readings taken in same direction and from same point and same motorman. Could obtain test in only one direction as only one controller on car. No load.

TABLE II.—SPEED TEST WITH REGULAR PASSENGER CAR.

Car.	No. of Cars.	Weight of Train in Net Tons.	Grade, Per Cent.	10 Seconds.		20 Seconds.		30 Seconds.		40 Seconds.		50 Seconds.		60 Seconds.	
				Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.
Car 15—22 pass., west.....	1	24	1 2	9.7	142	26.6	532	34.8	1,042	39.6	1,622	40.8	2,221	47.2	2,913
Car 15—14 pass., east.....	1	24	"	7.0	102	17.8	363	27.9	772	36.1	1,293	47.4	1,888	43.1	2,520
Car 14—25 pass., east.....	1	24	"	9.3	136	19.0	415	28.4	831	34.2	1,333	40.4	1,925	41.1	2,528
Car 13—12 pass., east.....	1	24	"	8.8	129	18.9	406	25.0	772	32.2	1,744	37.4	1,793	40.0	2,380

No wind of account. Different cars and motormen. Same section of track as in table 1.

TABLE III.—TEST WITH REGULAR PASSENGER CAR.

Car.	No. of Cars.	Weight of Train in Net Tons.	Grade, Per Cent.	10 Seconds.		20 Seconds.		30 Seconds.		40 Seconds.		50 Seconds.		60 Seconds.	
				Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed. Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.
Car 17—23 pas., west	1	24	1 2	9.5	139	18.6	412	28.0	822	32.7	1,302	40.7	1,898	41.7	2,509
Car 56—13 pas., new car east	1	24	"	10.2	150	....	....	....	833	20.5	1,280	38.0	1,837	40.4	2,429
Car 10—25 pas., east.....	1	24	"	8.5	124	18.7	399	29.3	829	35.9	1,355	40.2	1,945	43.9	2,589
Car 10—west	1	24	"	9.3	136	20.0	430	28.9	854	34.1	1,354	41.0	1,955	42.8	2,582
Car 13—12 pass., west.....	1	24	"	10.2	149	18.8	423	29.9	861	34.6	1,368	37.8	1,923	43.0	2,553

Wind was from east to west and 10 to 15 miles per hour variable. Tests 3 and 4 were made over same section of track with same motorman, but different cars and in opposite direction.

loaded, but with the same equipment as in Table I. As with Table I., there was practically no wind at the time of the test.

Table III. shows five tests in different directions, with wind blowing from east to west at from 10 to 15 miles per hour. The track is almost exactly east and west.

Table IV. gives the voltmeter and ammeter readings, with feet, for every ten seconds, corresponding to the last run in Table I., *i. e.*, 1-5 per cent down grade, 23-ton car, with four G. E. 57 motors, etc.

Table IV.—Acceleration Data.

Seconds.	Amps.	Volts.	Feet.	Total Distance.
10	485	500	149	149
20	350	520	344	493
30	275	550	483	976
40	225	570	559	1,535
50	195	575	630	2,165
60	180	580	637	2,802

Table V. gives a selection of readings taken under most favorable conditions at two points along the line. As will be seen, the averages are respectively 31.75 lbs. and 32.53 lbs. friction.

Table V.—Traction Data.

Selections of readings obtained under most favorable conditions. Track practically level and straight.

Place No. 1.

Car.	Bound.	Passengers.	Amps.	Volts.	Speeds.	Wind.
15	West.	0	150	595	45	6 m. per h. East.
15	East.	13	145	575	47	6 " "
15	West.	20	150	570	46	6 " "
11	East.	8	155	580	45	5 " "
13	East.	8	140	535	49	30 to 35 East.
13	West.	14	160	570	40	" "

Average gives 31.75 lbs. friction.

Place No. 2.

15	West.	0	155	615	48	6 m. per h. East.
15	East.	13	145	610	50	6 " "
15	West.	17	155	610	48	6 " "
11	East.	8	155	615	48	5 " "
13	East.	8	135	620	51	30 to 35 East.
13	West.	14	180	600	39	" "

Average gives 32.53 lbs. per ton friction.

The wind is usually from West to East, and on the day readings for car 13, run obtained was quite high and variable as to velocity.

Average of both places gives 32.14 lbs. per ton friction.

Table VI.—Traction Data.

Car No. 15.

	Bound.	Passengers.	Amperes.	Volts.	Speed.
Practically Same Point.	East.	13	145	610	50
	West.	17	155	610	48
	West.	0	155	615	42
Practically Same Point.	East.	13	150	600	47
	West.	20	150	580	48
	West.	0	155	600	45
Practically Same Point.	East.	13	145	575	47
	West.	20	150	570	46
	West.	0	150	590	45
Practically Same Point.	East.	15	145	605	48
	West.	22	150	600	47
Practically Same Point.	East.	17	140	535	44
	West.	24	140	420	37
Practically Same Point.	East.	17	140	505	45
	West.	24	160	550	42
Practically Same Point.	East.	17	145	505	..
	West.	24	165	510	..

Wind about 6 miles per hour west to east. Average gives 30.8 lbs. per ton friction.

Table VII.—Traction Data.

Car No. 11.

	Bound.	Passengers.	Amperes.	Volts.	Speed.
	East.	8	155	580	45
	East.	8	150	595	48
	East.	8	165	610	47
	East.	8	155	615	48
Same Point.	East.	9	175	600	40
	West.	14	155	605	45
Same Point.	East.	9	152	605	45
	West.	14	150	610	50
	East.	9	165	615	48
Same Point.	East.	9	175	595	40
	West.	15	175	590	43
	East.	10	162	535	37
	East.	10	155	525	48

Average gives 34.6 lbs. per ton friction.

Wind about 5 miles per hour. This car seemed to me heavier than others, this was noticeable from rapidity of retardation when power was thrown off.

The results in Table VI. were obtained to determine the effect of wind resistance on speed. All readings are on the same car, and were taken in some cases while the car was running easterly, and in other cases in a westerly direction. The loading, necessarily, was different, however, as the car was in regular service. Tables VII. and VIII. are made up in the same way, except that other cars were under observation, and the velocity of the wind was different. In each case the equipment of the car was the same, viz., four G. E. 57 three-turn motors on Brill No. 27 truck, 33-in. wheels and 1:5.7 reduction.

Table VIII.—Traction Data.

Car No. 13.

Bound.	Passengers.	Amperes.	Volts.	Speed.
East.	10	140	535	..
West.	14	160	570	40
East.	10	150	600	..
West.	14	175	590	43
East.	10	135	620	51
West.	14	180	600	39
East.	10	145	610	40
West.	8	160	600	40
East.	10	145	550	45
West.	8	160	550	40
East.	10	165	535	48
West.	8	155	530	40
East.	10	145	560	45
West.	8	165	500	38
East.	10	140	525	45
West.	8	150	525	38

Average gives 32.6 lbs. per ton friction.

Wind high 30 to 35 miles per hour, West to East, and variable velocity. Very fair tests, as had few stops having mostly through passengers.

Carrying Mail in Germany

The carrying of mail pouches has been a part of the street railway business in Germany for some time. The manner in which this has been done is that a postal clerk, by paying the full or partial fare, traveled as a passenger and guarded the bags, or if but one or two pieces had to be transported at a time, the bags were placed on a certain car at a definite time by a postal clerk, and there were guarded by the motorman until the car reached its destination, where the matter was delivered to another postal clerk by the motorman.

Up to now these have been the only methods employed. Recently, however, special agreements have been made between the imperial postal service and the larger street railway lines, such as that in Berlin, to the effect that the companies will operate, for a certain compensation, specially constructed mail cars over their lines. Already most of the roads which are subject to the Prussian laws governing street railway lines have been obliged to have such a clause inserted in their original franchise; they would gladly have consented, however, without such compulsion, to transport merchandise—although originally the lines were intended for passenger traffic only—as considerable profit can be derived from such service.

With the transportation of mail, however, the exclusive use of the lines for passenger traffic has become changed, and there is a growing demand in a number of cases to introduce a parcel express service. In the granting of new franchises the municipalities have insisted in several cases that the roads for a certain consideration will transport corpses, the city's building material, such as paving stones, etc., as well as convey refuse matter; and at Hamburg they are even compelled of late to transport cattle to the slaughter houses.

LETTERS AND HINTS FROM PRACTICAL MEN

Notes on the Standard Rules and Regulations as Reported by the A. S. R. A. Committee, V

Schenectady Railway Company.

Schenectady, N. Y., May 19, 1899.

Editors Street Railway Journal:

Concluding the comparison and analysis of the "Standard Rules and Regulations" of the A. S. R. A. committee, we wish to know:

12. Are they free from unnecessary repetitions, either within themselves or with one another? Rule No. 8 for Motormen is an exact duplicate of the first part of Rule No. 17 for Motormen and Conductors, and Rule No. 12 for Motormen is an exact duplicate of the last part of this rule. The latter part of Rule No. 18 for Conductors and Motormen is a repetition in idea—though not in phrase—of the latter part of this same Rule No. 17 and its duplicate, No. 12, thus triplicating a rule. The second paragraph of Rule No. 14 for Conductors repeats the same ideas as Rule No. 23 for Conductors and Motormen. These are specific instances of repetitions and duplications where the language and ideas are identical, and there are several other cases where the idea or general meaning is repeated. Now, it is true that the above repeated rules are important "safety rules," and neglect of them has probably caused serious loss to many companies, but they are not so important as *some* of the safety rules, and not a bit more important than some of the others that have not been repeated in either ideas or language. If the idea of the committee has been to make repetition act as emphasis to particularize important rules, their ideas of the relative value of rules are, to say the least, peculiar.

The value of any particular rule or rules is, with the exception of possibly one—that relating to accidents—very hard to fix—in the rule book. It is a difficult task to impress on a new employee by anything in the rule book the true value or importance of even the rules that the employer considers most important; it may be possible to impress him with one or two, which show their value on their face, but anything beyond that tends to bewilder him and give him false ideas. The true—and the relative—importance of a rule, or rules, must be mainly learned in his practice of them, and for this reason it is best in the rule book to emphasize only *one* of them—the one treating of the management and reporting of accidents, and to emphasize this one in some other way than by repetition. Any other rules may have their salient points emphasized by italics, capitals, etc., but in no other case should any one rule be emphasized as a whole. The sense of the value of the rules and of care and responsibility must be impressed on the new employee by the palpable clearness, completeness and logicality of the rules, by the care inculcated in their use, by the precepts and practice of his superior officials, by the example of his fellow employees, by the rewards and punishments meted out by his employer, and *not* by the inane repetitions of certain rules, ideas, or phrases.

13. Are they free from unnecessary, irrelevant, or axiomatic remarks and directions? Unhappily they are not! This point has been gone over in another article, but something still needs to be said on the subject. Rules are virtually specific "instructions," and as such should be as formally concise as is possible, everything necessary to the subject *must* be included, everything unnecessary *must* be excluded, therefore such remarks as "It is your duty to do so-and-so," "you will be held responsible for not doing such-and-such," "never do" such a thing, should not be placed in the rules—they are unnecessary, besides being senseless.

Other unnecessary remarks and directions are those which treat the new employee as an uncivilized savage, a hardened tough, or an idiotic imbecile, by pelting him with orders not to do some one or more of a hundred things that no sane civilized person would think of doing in the street railway service at present, especially if, as should be the case, the example of his superior officials and of his co-employees shows him at once that such things would not be tolerated for an instant. If the street railway industry were an absolutely new one, and the committee were making the rules for the very first street railway in existence, such orders and remarks might be tolerated, but with the developments of the last few years and the higher class of men now employed as conductors and motormen, the "usages" of the street railway have reached a higher plane, and these usages—the "*lex non scripta*" of the profession—can be safely trusted, in a set of general rules, to take the place of such remarks as have been instanced and spoken of.

14. Are they unnecessarily peremptory in tone? Do they use "must" and "shall" and "never do this and that" more than is needful? They certainly do! Now, while this is not a vital point, it is one of the minor ones that is worth considering as going to make perfect discipline, *not* the stiff-starchedness of military discipline, where the supreme authority and the power of life and death are behind the "orders;" *not* the dread of strict authority and the *letter* of the rules; *not* the fear of fines, suspensions and dismissal; but the heart-whole, cheerful, willing and intelligent obedience that makes a unit of the employees in their employer's interests; *that* is the true discipline of a street railway service, and to conserve which it is not necessary to use peremptory terms except as a means of emphasis in special cases, or—as in the case of the "qualification rules," where a standard is set to which all employees of a certain class must conform. To state in a rule that an employee "will" do such and such a thing is to make him feel that he does it voluntarily, or is *led* to do it; to state that he "must" or "shall" do it, is to make him feel that he is being *driven*.

15. Are they addressed to the second person, "you," or do they address the employees impersonally as "he," or "they," the latter preferably, for reasons given in a previous article? They do both; they mix these "persons" up in a way that would make the average employee wonder who he was. This is another point that is not vital; it is one of the "little things," but it only takes a little care in composition, and if strictly carried out adds to the force and appearance of the rules—unluckily it adds also to the elegance of their phraseology!

16. Do they threaten? No; the rules themselves are free from this defect, but—following Rule 23 for Motormen is a section entitled "Penalties," which invites criticism, both from its location—which may have been an inadvertence on the part of the committee—and for its contents. In its first paragraph is given a list of offenses that "are considered good grounds for dismissal from service," and among these are included dishonesty, lying, drunkenness, reckless running and—smoking and reading newspapers! This reminds one of the "good old days" when a person was hung for murder—and also for stealing a pig! Had the committee left out proven insubordination, dishonesty, lying, drunkenness and recklessness, which are *crimes* in any service, and therefore "dismiss" of themselves, and said "while on duty, the following, if repeated

or persisted in, will be good grounds for dismissal," there would have been some reason in the statement, although it is—in the writer's experience—bad policy to explicitly and formally specify dismissal for anything except the five "crimes" mentioned above. To all the other offenses and faults there are often found, on close and impartial examination, so many mitigating circumstances that a rigid application of a dismissal rule for such minor offenses as are given among those specified by the committee would be unjust and unwise.

The old quotation, "a little learning is a dangerous thing," is aptly illustrated in the case of new conductors and motormen. Knowing their own complete ignorance at the start, they are then very teachable, but when first "turned in" and put on "extra," or "regular extra" runs they will, despite previous good training, get the "big head" and run amuck among the rules. This is recognized by all who have the training of men as the first "critical period," and it is at this period that the disciplinary power of the official is shown. If it is of the "Medes and Persian" order, the employer will lose many good men—much potentially good material. If it is of the jelly-fish order, the employer will gain many poor men—much potentially bad material.

If, however, the discipline is of the kind that reckons on the "human element" among the employees, if it does not expect wings to sprout on their shoulders as soon as they enter the service, if the employer has the three "knows"—knows his business, knows his men, knows *himself*—then at this "hour of trial" to both the employer and the employee, cast-iron rules will not prevail as regards minor offenses, and the employer will be the gainer by so many "ripened" employees, men who have learned through hard experience that they "don't know it all"—the most valuable lesson that can be learned, and one that can only be learned by experience—the experience of failures—and for which the committee would recommend unlimited dismissal!

The second paragraph of this section recommends two punishments "for other offenses not meriting dismissal," although after the sweeping list just preceding, it would be a little hard to tell just what these "other offenses" could possibly consist of! Suspension without pay is damned without a hearing, which is unwise. *Indiscriminate* suspension without pay *is* unwise, but the writer has seen cases where the suspension without pay gave lasting good effects when other measures failed, and it did not "encourage dishonesty, hatred and discontent." "Punishment" is, as a rule, to be avoided if possible, but "it takes all kinds of men to make a world" (likewise a street railway), and, as we have been assured for ages "that one man's meat is another man's poison," it is as unwise to avoid all punishments, or to limit their number and kind, as it is to accord dismissal for pretty nearly every possible offense. The "Mikado's" practice "to make the punishment fit the crime," while a novelty in law, was hardly one in discipline, as many a successful superintendent and manager will testify.

To conclude: The members of the committee have asked for criticism—it is due them, for the report, if left unquestioned and uncriticized, might have had influence with those unfamiliar with the subject, and have done considerable harm.

In view of the fact that the Railroad or Street Railway Commissioners of some States are suggesting the promulgation by themselves of a set of rules—or at least of a set of *safety* rules—the use of which is to be enforced on the roads under their jurisdiction, it behooves the street railways of any State having such a Commission to see that such rules are those which *their* experience shows to be good and proper, and that they are put in, at least, *usable* shape. It also behooves the A. S. R. A., in its capacity as a *national* organization, to see that these rules as they are promulgated in one State after another, are as nearly uniform as possible, so that such inconsistencies as are manifested in such State laws as those in regard to—for instance—bankruptcy and divorce, do not occur in rules which may have the force of laws, and which—under the increase of interstate operation and ownership—may affect many corporations and employees. For this reason it is the province of the A. S. R. A. to set a committee of its own the task of preparing a set of *general* rules to be submitted to the various *State* Street Railway Associations for criticism and suggestion, with a view to making them *uniform* and *standard* for the whole United States, or for such of them as now have Railroad or Street Railway Commissioners, or legislative bodies or committees of like character and powers. If such action is not *promptly* taken by the A. S. R. A., and carried out thoroughly and effectively, we may within the next few years see a heterogeneous mass of conflicting and inefficient rules in adjacent States—beside which the present divorce laws and the rules suggested by the committee will seem good, clear, equitable and consistent.

H. S. Cooper.

Power House Operation

Cleveland, Ohio, May 18, 1899.

Editors Street Railway Journal:

An explanation should be made of the power house report at the top of page 267 of the last issue, in which the kw. hours per car mile are given as 3.4 and the lbs. of coal per car mile as 21.8. This to a certain extent is misleading as to the economy of the plant, as this figure includes the electric heating and lighting load, as well as the steam used to heat the large pavilion. No devices are installed for measuring these separate items, so that an estimate must be made of the amount of power consumed by each, in order to reduce the figures to the net kw. hours and net pounds of coal required to produce a car mile.

During the week referred to the pavilion required heat during a large part of each day, making an average of one-half of the total heating surface for 16 hours per day, or 112 hours per week. There are 7000 sq. ft. of radiation, and at 130 sq. ft. per h.p., this requires 54 boiler h.p. One-half of this, or 27 h.p., at 4.5 lbs. of coal per boiler h.p., gives a total of 13,552 lbs. of coal used per week for heating. Call this 13,500 lbs. 121,465 lbs. — 13,500 lbs. = 107,965 lbs. coal used for the week in running the road, including heaters, light and machine shop motor. 107,965 ÷ 22,451 = 4.81 lbs. coal per kw. hour.

Taking up now the electric heating, there are two cars on the line for 21 hours each day, and generally one in the station, all using current in the heaters. The machine shop motor and lights also take current, making the average steady load, exclusive of that taken by the car motors, about 40 amps. for the 21 hours. This is exceeded when the machine shop motor is running with the car lighting, but drops below when the lights are turned off, and also when the motor is stopped. 40 (amps) × 700 (volts) × 21 (hours) = 588 kw. hours per day, or 4116 kw. hours per week. Deducting this from the total for the week given results as follows: 22,451 — 4116 = 18,335 kw. hours per week, or 2,619 per day, and this, with the average of 823 car miles per day, gives 3.18 kw. hours per car mile, instead of 3.9. 3.18 kw. hours per car mile at 4.81 lbs. coal per kw. hour gives 15.3 lbs. coal per car mile, instead of

the 21.5. These results more nearly agree with the results obtained during the week ending May 14, 1899, during which there was little or no heating, and but little lighting; *i. e.*, total kw. hours per week, 20,798; average coal per kw. hour, 5.5; deducting for the machine shop motor, 10 (amps.) × 700 (volts) × 10 (hours) × 6 (days) = 420 kw. hours per week. This gives 20,378 kw. hours per day. There were 8,795 car miles, which makes the averages 2.31 kw. hours per car mile and 12.7 lbs. coal per car mile. No records are kept of the time which the service pump runs, so that no allowances are made for same.

Referring to the decreased coal consumption per h.p. and per kw. hour, this is very well shown by the record for the two consecutive weeks ending April 30 and May 7, 1899. The first week was run under regular one-hour schedule, and beginning with the second week cars were added to make one-half-hour schedule between 7.15 A. M. and 9.45 P. M.

	Week Ending April 30,	May 7, 1899.
Total kw. hours	15,273	19,741
Total coal	101,145 lbs.	107,245 lbs.
Average kw.-hours per day	2,181	2,820
Average kw. per hour	103	134
Average coal per kw.-hour	6.6 lbs.	5.4 lbs.
Average coal per h.p.	4.9 lbs.	4.0 lbs.

Yours truly, E. P. ROBERTS & CO.

An Argument Against Rear Grab Handles

DENVER, May 3, 1899.

EDITORS STREET RAILWAY JOURNAL:

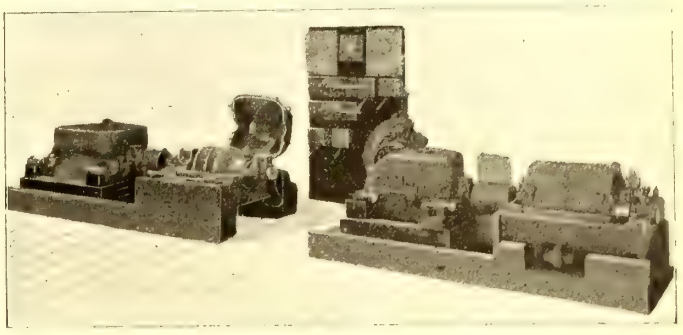
A large percentage of the accidents which occur on street railways is caused by ladies, and others unacquainted with traveling, stepping from the cars (before they have stopped) and facing in the direction other than that in which the car is going. My impression is that this practice is caused because they are not accustomed to use their left hand. If this opinion is correct, many accidents might be averted if the rear grab handles were dispensed with. I make this suggestion in hope that the cause, whatever it may be, is learned and efficient preventatives applied.

JNO. C. HENRY.

Testing Armatures in Repair Shops

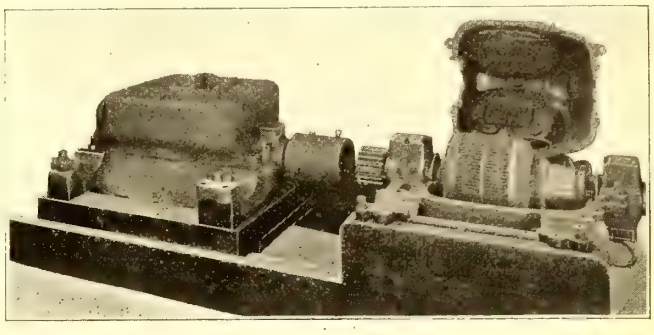
It is most desirable to thoroughly test all apparatus repaired in the shops, rather than run the risk of its breaking down on the road, but the trouble of putting armatures into the motor fields and giving them a practical test under load has sometimes induced superintendents to remain content with the ordinary magneto tests. An ingenious arrangement for testing armatures quickly, however, has recently been devised by Mr. Adams, master mechanic of the North Jersey Street Railway Company of Jersey City and Newark. This device has been in use in that company's repair shops on the Plank Road for some time with excellent results.

Mr. Adams has mounted a G. E. 1000 field rigidly in a wooden frame, and next to it a G. E. 1200 field, arranged so that it can be slid in a direction parallel to its armature shaft. In mounting these motors armature shafts are kept in line. The upper halves of the fields are arranged so that they can be lifted back without unscrewing any bolts, the place of the bolts being taken by taper keys. When a G. E. 800 and 1200 armature have been repaired in the shops they are carried to the motors on a traveling hoist and lowered into their places, the pinions coming opposite each other. The 1200 motor is then slid along its ways until the pinions touch, and the two are connected together by a sleeve, which surrounds the pinions and is fitted with six set screws which fit between the teeth. One motor is then run from the railway current, operating the other as a generator, the current for the second motor being taken



TESTING RACKS FOR ARMATURES

up by a water rheostat. A switchboard, located near the testing device, gives the amount of current used and generated. After having run in this way about seven and one-half minutes, the connections are changed by a double-throw switch, so that the former generator becomes a motor and the former motor a generator, thoroughly testing both machines. Adjoining this is another testing rack of a smaller type, made up of a Westinghouse No. 3 motor and a G. E. 800 motor.



RACK WITH ARMATURES DRAWN APART

In front of the motors is a large frame for holding the armatures to be tested. Every armature which leaves the shops is taken directly to this place to be tested, independent of the extent of the repair, even if it is only the replacing of the canvas on the end of the armature.

The entire system is very simple, and it takes only a few minutes to change the armatures on both machines, and the entire process can be carried on by one man and helper.

Municipal Regulations in Germany

An instance of the minuteness of the German municipal regulations in regard to street railways is shown by a recent ruling of the Police Department, that it is dangerous for a conductor to pass along the steps of open horse cars which have transverse seats. The railway company has therefore been obliged to cut a passage through the seats and end partitions of some cars that it has been operating. As the width of the cars in Germany is restricted to 2 meters (6 ft. 6¾ ins.) outside, this ruling reduces the carrying capacity 25 per cent, so tht a six-bench car will seat but eighteen people. Standing inside is prohibited on all German roads, but a limited number may stand on the platforms; this limit, however, which is plainly posted, is strictly enforced.

STREET RAILWAY JOURNAL

JUNE, 1899.

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, BEARD BUILDING, 120 LIBERTY STREET.

BRANCH OFFICES:

CHICAGO.....Monadnock Block.
PHILADELPHIA.....929 Chestnut Street.
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ST. PETERSBURG.....Alexander L. Lineff, Ligovka, 67-22.

Long Distance Telephone, "New York, 4044 Cortlandt."
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / 25/ / 31 fr
Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

NOTICE.

Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, accounting, finance and invention.

Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

Address all communications to

The Street Railway Publishing Co.,
Beard Building, 120 Liberty Street, New York.

A most valuable aid to the work of a building engineer on electric railways is a portable camera by which he can retain views of the construction of a power station or roadbed while in progress of completion. These views may often prove of value after the construction has been finished to show how certain portions of it were installed, as well as form an interesting souvenir. Important records, also, can often be made with a camera on operating roads by the superintendent or other officials.

Punctuality in running times is one of the best methods of securing and retaining business, particularly where cars are run on long headway and a person desiring transportation has to wait for a considerable time if he misses a car. This is so well recognized as to be almost a truism, but the best of care in timing cars at the termini of lines or at widely distant points on long distance lines does not prevent the motorman from departing from his schedule sometimes, especially if no particular system of checking this feature is adopted. It would not seem a difficult thing to do to establish frequent points along the line of a railway, such as by numbering certain poles, and the employee would then know whether he were behind or ahead of his schedule by comparing the time at which he passed these poles, as indicated by a watch carried on the dash, with the proper moment as given in his time card. Inspectors could be instructed to check up the crew, if necessary, by boarding the cars at different points and comparing the attained time with the schedule.

The ability to study each problem separately and suggest the remedy which is best suited to the conditions, is as important in electric railway work as in any other industry. There are so many factors involved in economical operation that it is not safe to assume that the same solution will do in every case. An instance of this occurred upon a railway recently where it was found that adding 4000 lbs. to the weight of a car cut down the watt output. This anomalous condition was caused by the topography of the road. It was in the form of a single track loop, with a comparatively steep grade near the power station, and a gentle descending grade for the rest of the line. The lightly loaded cars would not descend this grade without using current, but the heavily loaded cars required the use of motors only at starting. The result found was that when the line losses and motor losses for the lightly loaded cars, while on the loop, were compared with those of the heavily loaded cars when mounting the grade near the station, the former were found to be in excess.

Governor Roosevelt, in a recent speech made in Buffalo, said, in referring to the subject of taxing franchises:

"On the one hand we have the perfectly simple savage who believes that you should tax franchises to the extent of confiscating them, and that it is the duty of all railroad corporations to carry everybody free and give him a chromo. On the other, we have the scarcely less primitive mortal who believes that there is something sacred in a franchise, and that there is no reason why it should pay its share of the burdens at all."

In this enumeration, the Governor omitted to mention a third variety of political economists, whose teachings are equally fallacious and far more dangerous to the public than either of the two described. This is the *soi-disant* reformer, who thinks he takes a middle course between the other two views when he advocates franchise taxation and lower fare bills or the absorption of quasi-public corporations by the municipality without any knowledge of or investigation into the real conditions under which these companies operate. It is comparatively easy to protect property against the believer of direct confiscation. It is the person who advocates indirect confiscation under the plea that because in other countries and other conditions street railways do so-and-so, that is the most dangerous to the community.

The electric system has monopolized the attention of street railway engineers for so many years, and its advan-

tages have been so thoroughly demonstrated, that the claims of other powers during the last decade have received scant attention. The latest claimant for a hearing to demonstrate its ability to compete with the electric system, however, is compressed air—latest, not because trials in this power were not made before or concurrently with the electric system, but because the use of compressed air under high pressures as now being tried in this country is entirely new in the history of its application to railway service. Mechanically, the air power motor has been most carefully designed and it is our opinion that if the system should become a successful competitor of the electric for street railway use, it will be upon the general lines described elsewhere in this issue. It is needless to say, however, that some time must yet elapse before absolute figures as to the cost of operation in regular conditions of service on a large enough scale to make this comparable with electric railway service, can be secured. In many respects the system is an attractive one, but it remains to be seen whether there may not be troubles which are not now apparent, but which may militate strongly against its employment.

Elsewhere in this issue a description is published of the use of the three-phase system for current distribution upon a long interurban line. The small percentage drop secured by the use of high tension currents makes the system an attractive one; a number of these lines have been built during the last year or two, and a much larger number is now being installed. While much economy can often be secured in reducing loss of power on the line and in first cost by this method as compared with the several methods of boosting direct current, there are certain disadvantages connected with the three-phase system for small roads which ought not to be overlooked, and while local conditions do vary the problem greatly, it is a question whether electrical engineers are not rather prone to install the three-phase system for railway work when the same, or a slightly greater investment in copper would not secure more satisfactory results. The installation in a power station of both continuous and alternating current machinery, with the use of a substation with converting machinery, adds considerably to the variety of types of spare parts which must constantly be kept on hand to avoid a shut-down through accident. This is a more important consideration for a small than for a large road. Again, the depreciation upon this machinery must be equated against the capital investment and compared as well with that on copper wire, which is practically nothing. We, therefore, recommend designers to go carefully over their estimates on the cost of current distribution apparatus, before selecting any particular methods.

It is a well-known fact that the success of an electric railway company depends largely upon the motormen and conductors, and the ability and faithfulness with which they discharge their respective duties. The conductors are the employees most closely brought in contact with the general public, and the opinions formed by the latter of the company are drawn very largely from the treatment received from the men who collect the fares. The motorman, on the other hand, is the engineer of the car, and, especially in crowded streets or where high speeds are attained, his duties require a skill and discretion which are not found in every man of intelligence; in fact, the opinion is growing more and more pronounced that too much care can hardly be expended in selecting the proper men for this important position, or in training them for the proper discharge of the peculiar duties which they have to perform. Emergencies may often arise in a crowded street at any moment which demand the exercise of a high degree of coolness, judgment and a complete knowledge of the operation of the apparatus in their charge, and any defect in one of these qualifications may mean a serious loss to the operating company. While the possession of these qualities is to a certain extent innate, it can also be acquired, and no motorman should consider himself as competent unless he understands exactly the use of the apparatus under his control. By this it is not meant that he should necessarily understand all the electrical connections, or the principles of motor operation, but that he should know, *instinctively*, the exact distance, for example, in which he can stop his car at different speeds by the application of the brakes, the acceleration secured at different positions of the controller handle, the effect of a short circuit, etc. We note with considerable interest that a number of companies have established schools for instructing motormen on the special points on which a good knowledge is desirable. The Metropolitan Street Railway Company of New York, for instance, has fitted up one large room with eighteen or twenty brake-stands, as well as a complete motor truck, fully equipped with controller, brake, sand box, etc., all raised a short distance from the floor, so that the wheels can be revolved and the brakes applied, as in actual service. Around the walls of the room are hung photographs showing the right and wrong ways of applying the brakes, etc., diagrams of the motor connections, and other information which are useful on the road. Regular lectures and talks on the subject of car operation are given by the head of the instruction department, who also explains the proper procedure in case of emergency.

The most admirable thing about the Milwaukee street railway system, which we fully describe and illustrate in this issue, is its conservative financial scheme in which amortization of franchises, depreciation, uninsured losses by fire, accidents, and other contingencies are cared for by special reserve funds to which are passed each month from earnings, predetermined sums. Whenever a company's franchises are limited in tenure, particularly as in the case of Milwaukee, when they expire in so short a time as from twenty-five to thirty years, it is not safe to proceed upon the assumption that they will doubtless be renewed to the present company at the end of the franchise period, but the possible losses to stockholders which may be realized at that time, should be provided for years beforehand by such a reserve fund as that which the Milwaukee Company has wisely established. Depreciation, to which the happy-go-lucky manager shuts his eyes, inevitably forces itself upon his attention, usually at some particularly inconvenient time, by urgent demand for new track, new cars or new motors. The car house, with all its contents, burns down and has to be replaced at a cost twenty-five per cent greater than the insurance money obtained. Is this twenty-five per cent to be taken out of capital, or are the

earnings of the year properly chargeable with it? The theory of these reserves for contingent losses is that the first duty of the manager of any enterprise is to return to those who have invested money in it the principal of their investment, and his last duty is to declare the profits, and these profits should not fluctuate within wide limits from year to year.

The Ford Franchise Bill, even in its amended form, is an example of crude and ill-considered legislation, which is not an honorable part of the record of the State of New York or a credit to Governor Roosevelt, good as his intentions undoubtedly are. To tax as "real estate" that particularly unreal and intangible thing called a "franchise" —a thing whose value is changed every day by the whim of legislatures or councils, by the autocratic decrees of city department heads and tax assessors, by the judicial decisions of the courts, and by the will of the public affecting earning power—is a self-evident absurdity. But this is not the worst error of judgment. The Ford bill is capable of a thousand interpretations and can be put into effect only by the selection of some one method of arriving at the value of franchises from a host of those which may be suggested. The power of making the selection is, by the amendments to the bill just passed at the special session of the legislature called for the purpose, placed in the hands of a state tax commission whose judgment is final, subject only to revision by the courts in equity proceedings. Why was not the method of arriving at the value of these franchises specified in the bill itself and made a part of the statutes? The answer is that neither Governor Roosevelt nor the New York Legislature cared to take the responsibility of suggesting a practicable plan or could do so in the limited time allowed. They, therefore, leave this responsibility with the newly created tax commission without providing, as is usual in such cases, that the commission shall report its plan back to the legislature for final action, but they put in the hands of these few men the right to determine the value of thousands of millions of property. Such a power is far too great and is not in line with our institutions or traditions. By far the safer plan in dealing with interests so large, would be to carry out what is reported to have been Governor Roosevelt's first intention, namely, to refer the whole matter of taxation to a commission formed of the best legal and expert talent in the state and to have guided legislation by their report. As it is, the Ford bill, even in its amended form, is quite likely to be declared unconstitutional, in whole or in part, and the heavy expense to the state of the extra session will be lost, to say nothing of the harm caused by the unsettling of values meanwhile. We have been surprised to see that in the whole course of the discussion in the Legislature and Executive Chamber at Albany so little attention has been paid to the excellent, public spirited work done by the special commision appointed by the Governor of Massachusetts some three or four years ago to investigate the subject of street railway taxation. The plan determined upon by this commission, after a year or more of research, was in most respects sound, legitimate and consistent, far more so than this mongrel legislation fathered by Senator Ford and Governor Roosevelt, which will surely be a thorn in the flesh until amended or repealed.

Financial Analysis of the Brooklyn Rapid Transit System

In view of the many important consolidations which have lately taken place in the street railway system of Brooklyn and vicinity, an accurate statement of the new financial conditions and the possibilities of future development will be of general interest. The following analysis has been made from information furnished by the officers of the Brooklyn Rapid Transit Company for publication in "American Street Railway Investments," the financial supplement to the Street Railway Journal, and is correct to date:

The Brooklyn Rapid Transit Company was chartered in 1896, under the laws of the State of New York, as a successor to the Long Island Traction Company, whose assets were purchased under foreclosure of the collateral trust deed and transferred to the new company. The latter's control of the street railway properties of Brooklyn is through ownership of stock, and the operating agency of the system is the Brooklyn Heights Railroad Company, all of whose stock is in the treasury of the Brooklyn Rapid Transit Company, and to which are leased nearly all the properties originally and recently acquired by the Brooklyn Rapid Transit Company.

The nucleus, and by far the most valuable part of the system is the property of the Brooklyn City Railroad Company, which was leased to the Brooklyn Heights Company, in February, 1893, for a rental equivalent to fixed charges and a dividend of 10 per cent per annum on its capital stock of $12,000,000. About 217 miles, or nearly one-half of the mileage of the entire system, including that in the business district near the East River, most of the approaches to Brooklyn Bridge, the ferries, etc., belong to the Brooklyn City Company. The next largest property in point of mileage (136) is that of the Nassau Electric Railway Company, nearly all of whose stock is now in the treasury of the Brooklyn Rapid Transit Company, and which has just been leased to the Brooklyn Heights Railroad Company. The Brooklyn, Queens County & Suburban Railroad Company, which is a consolidation of three companies previously in independent operation, is owned in its entirety by the Brooklyn Rapid Transit Company, and was leased to the Brooklyn Heights Railroad Company last July. Control of the Brooklyn Union Elevated Railway Company, which is also a consolidation of several other companies, and which has had a somewhat checkered career financially, was acquired in March and April, 1899, and has also been leased to the Brooklyn Heights Railroad Company, and control of the Kings County Elevated Railway Company, the only other elevated railroad property in the city, is now being acquired by the Brooklyn Rapid Transit Company through exchange of stock.

The Brooklyn Rapid Transit Company owns the following securities:

Entire capital stock Brooklyn Heights R. R. Co., which includes equity in 999 year lease of Brooklyn City R. R. Co. to Brooklyn Heights R. R. Co., par value	$200,000
All right, title and interest of the Brooklyn Heights R. R. Co., in the construction account against the Brooklyn City R. R. Co., for extensions and improvements on leased lines, amounting Jan. 31, 1899, to	4,528,503
Entire capital stock, Brooklyn, Queens County & Suburban R. R. Co., par value	2,000,000
Entire capital stock, Sea Beach Ry. Co., par value	650,000
Entire capital stock, Sea View R. R. Co., par value	190,753
First mortgage 6 per cent bonds, Sea View R. R. Co., par value	52,500

84,997.16 shares out of total 85,000 shares of the common stock of the Nassau Electric R. R. Co., par value	8,499,716
60,520 shares out of total 65,000 shares of the 4 per cent cumulative preferred stock of the Nassau Electric R. R. Co., par value	6,052,000
34,713 shares out of total 38,302 shares of the 5 per cent non-cumulative preferred stock of the Brooklyn Union Elevated R. R. Co., par value	3,471,300
109,974 shares out of 129,267 shares of the common stock of the Brooklyn Union Elevated R. R. Co., par value	10,997,400
Entire capital stock of Coney Island & Gravesend Ry. Co. outstanding, par value	35,400
First mortgage 5 per cent bonds, Brooklyn, Queens County & Suburban R. R. Co., par value	*2,000,000
First mortgage 5 per cent bonds, Brooklyn City R. R. Co., par value	*1,627,000
Total	$40,304,571

*Composing guarantee fund for performance of Brooklyn City R. R. Co.'s lease.

The Brooklyn Rapid Transit Company has also acquired through one of its constituent companies, all the property of the former Brooklyn & Brighton Beach Railroad, and has contracted with the Long Island Railroad Company to lease for a period of 999 years certain portions of its line between Brooklyn proper and Coney Island, which can be used to advantage in the new system now being welded together.

The only street railway properties not included in the Brooklyn Rapid Transit system, are the Coney Island & Brooklyn Railroad Company, the Brooklyn City & Newtown Railroad Company, and the Van Brunt Street & Erie Basin Railroad Company. The two first named are valuable properties which may be brought into the system later. They are capitalized at about $5,700,000, and are earning about $960,000 per annum. The last is a small horse railway, 3 miles in length, earning about $30,000 per annum only.

The principal financial characteristics of the consolidated system are shown in the accompanying table in which appears the capital stock and funded debt outstanding and in the hands of the public, excluding that in the treasury of the Brooklyn Rapid Transit Company, which is represented, of course, by its own capitalization, together with the mileage and fixed charges of each company and the gross and net earnings of all the operating companies for the calendar year, 1898. The foot note explains slight inaccuracies in certain of the figures which have, however, no material effect upon results.

It is seen by this table that the entire outstanding capital stock of the system amounts to $59,739,484, equivalent to $121,495 per mile of track, and the funded debt to $48,787,000, equivalent to $99,221 per mile of track; the total capital, therefore, being equivalent to $220,716 per mile of track.

The total earnings of the system from operating and other sources amounted in 1898 to $10,832,642. After paying operating expenses only, excluding taxes, the earnings from operation, applicable to the payment of taxes, guaranteed rentals, fixed charges and dividends on the stock of the Brooklyn Rapid Transit Company, amounted to $3,603,037.

The interest upon the outstanding bonds of the entire system amounts at present to $2,166,730, and the guaranteed rental upon outstanding capital stock of the Brooklyn City Railroad Company to $1,200,000, to which should, strictly speaking, be added a small sum for the pro rata proportion, due upon the small amount of outstanding stocks of the Nassau Electric Railroad Company, and the Brooklyn Union Elevated Railroad Company, for the rental to be paid those companies. The taxes paid in 1898 amount to $379,123. It appears, therefore, that the gross and net earnings for 1898 were not quite sufficient to pay the interest, rentals and taxes of the system, the deficit being $142,816, and nothing was left for the stock of the Brooklyn Rapid Transit Company.

This statement, however, taken by itself, would be grossly unfair to the Brooklyn Rapid Transit system, inasmuch as few of the benefits of consolidation were realized in 1898, and it is also true that they will not come to anything like full fruition until 1900 or 1901. Every effort is being made to get the system into condition to handle a far larger amount of Coney Island traffic than usual this summer, and no doubt the plans are being perfected on a broad and comprehensive scale for the joint operation of the elevated and surface lines to the best advantage of the system in earning capacity. Nevertheless, the electrical equipment of the elevated lines can hardly be fully completed short of two years and the power stations must be given larger capacity for handling increased surface railway traffic as well as elevated. Consequently, as before stated, the full benefits arising from the consolidations of the past eighteen months cannot be realized for two or three years yet to come.

Let us see now what earning power will be necessary in order to make fixed charges and return a 5 per cent dividend upon the Brooklyn Rapid Transit Company's stock. It will not be far out of the way to assume that in 1901 the interest, guaranteed rentals and taxes combined will amount to, at least, $4,000,000, instead of $3,745,853, as at present, since further investment for equipment pur-

CAPITALIZATION (JUNE, 1899) AND EARNING POWER (YEAR ENDING DEC. 31, 1898) OF THE BROOKLYN RAPID TRANSIT SYSTEM.

NAME OF COMPANY.	Track Mileage.	Capital Stock Outstanding. *b*	Funded Debt Outstanding.	Gross Earnings, All Sources.	Earnings from Operation.	Fixed Charges.			
						Interest on Bonds.	Rental.	Taxes. *e*	Total.
Brooklyn Rapid Transit Co.	....	*a* 45,000,000	6,625,000	....	.....	331,250	.....	.....	331,250
Brooklyn Heights R. R. Co.	1.3	.....	250,000	*f* 6,322,993	*f* 2,488,312	12,500	.....	147,505	160,005
Brooklyn City R. R. Co	217.0	12,000,000	*b* 5,298,000	.....	.....	*c* 267,150	1,200,000	.....	1,467,150
Brooklyn, Queens County & Suburban R. R. Co.	45.0	.....	*b* 4,574,000	.....	.....	*c* 228,700	.....	28,375	257,075
Nassau Electric R. R. Co.	136.1	451,284	13,500,000	2,214,901	521,412	585,530	(*d*)	72,000	657,530
Brooklyn Union Elevated R.R.Co.	36.9	2,288,200	12,890,000	1,658,131	525,259	515,600	(*d*)	107,289	622,889
Sea Beach Ry. Co.	13.5	.....	650,000	.....	.....	26,000	.....	33	26,033
Sea View Ry. Co.	2.3	.....	.....	.....	.....	.....	.....	362	362
Kings County Elevated Ry. Co.	*i* 39.6	.....	5,000,000	636,617	68,054	200,000	.....	23,559	223,559
Totals	491.7	59,739,484	48,787,000	*g* 10,832,642	3,603,037	2,166,730	*d* 1,200,000	*h* 379,123	3,745,853

a Including $2,000,000, soon to be issued in exchange for stock of the Kings County Elevated Railway Co. *b* Excluding holdings of Brooklyn Rapid Transit Co. *c* Excluding interest on holdings of Brooklyn Rapid Transit Co. *d* Excluding nominal rental due on outstanding stock. *e* For year ending June 30, 1898. *f* Including earnings from certain other small properties not then (Dec. 31, 1898) leased to Brooklyn Heights R. R. Co. *g* Excluding earnings of portion of Brooklyn & Brighton Beach R. R. Co. and Prospect Park & Coney Island R. R. Co. with allied lines. *h* Excluding taxes Brooklyn & Brighton Beach R. R. Co. and Prospect Park & Coney Island R. R. Co. with allied lines. *i* Including Brooklyn & Brighton Beach R. R. Co.

poses will doubtless be necessary, and there is a strong probability that the item of taxes will be increased. Adding to these fixed charges a 5 per cent dividend on the $45,000,000 of capital stock, we have $6,250,000 as the required dividend and fixed charge fund of the system. If now we may assume that the system can be operated for 50 per cent of its gross receipts (a far better result, of course, than can be shown at present) the gross receipts must be $12,500,000, while if 55 per cent of the gross receipts be required for operating expenses, the gross receipts must be nearly $14,000,000.

What are the prospects that such a gross earning power can be realized in 1901? The development of traffic in Brooklyn during the past four years will throw some light upon this question. Combining the gross passenger earnings from all sources and the track mileage of all the companies now forming the Brooklyn Rapid Transit system for the years ending June 30, 1895 to 1898 inclusive, we have the result shown in table on page 371.

It will be seen that the percentage increase in earnings from year to year is getting much larger, and that for the year ending Dec. 31, 1898, it is more than 10 per cent larger than for the year ending June 30, 1898. Whether this large proportional increase can be kept up in the next two or three years remains to be seen, but it seems not impossible to hope that this may be the case, and that unless some serious set back occurs, the Brooklyn Rapid Transit system may be earning 4 or 5 per cent on its capital stock in 1901 through the bettering of service, and possibly rates, and the lowering of the percentage of operating expenses to gross receipts.

Year Ending	Track Mileage.	Gross Passenger Receipts.	Per Cent. Increase.	Receipts pe Mile Track
June 30, 1895....	395.2	$8,428,699	..	$21,327
" 1896....	444.4	9,104,887	8.0	20,489
" 1897....	471.4	9,214,592	1.2	19,547
" 1898....	491.7	9,752,571	5.8	19,834
Dec. 31, 1898....	491.7	10,832,642	11.1	22,031

Class Distinctions Cause Trouble

It is a well-known fact that upon many of the tramways of Europe the cars are divided into two compartments, one for first-class passengers and the other for second-class passengers, the rates of fare in the latter case being from two-thirds to one-half of that in the former. In some cases the second-class passengers have no seats provided for them, but stand on the platforms; in other cases, where double-decked cars are used, the upper deck is reserved for the second-class passengers and the lower deck for the first-class; on still other roads the motor car transports the first-class passengers, and is handsomely fitted up, while the trail car carries the second-class passengers, and its decorations are not so elaborate as in the motor car.

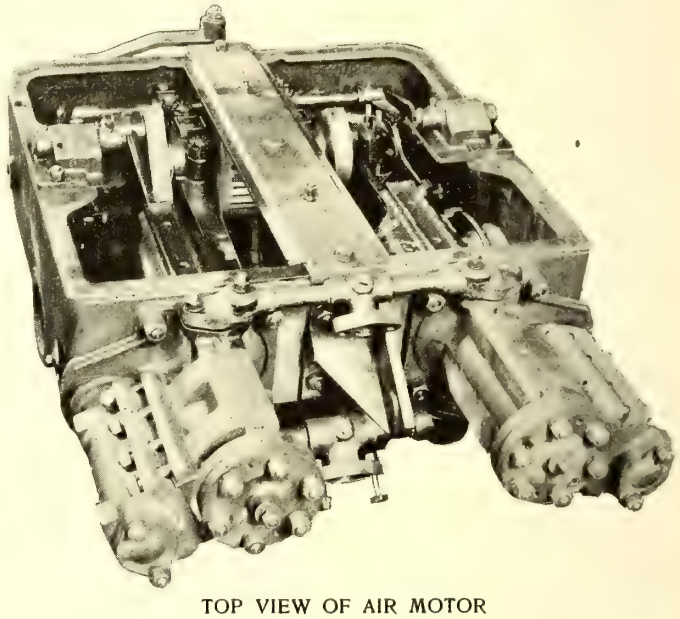
A curious effect of this division of passengers occurred recently upon one of the roads in France. In the early morning and late evening hours, when the majority of passengers prefer to ride as second-class, the trail cars became crowded, while the motor cars were so lightly loaded that the latter could not get sufficient traction to draw their loads, and as a result the trains became stalled. After a careful consideration of the problem no remedy could be suggested except that the second-class passengers should be admitted to the motor cars during those hours in which they supplied such a large proportion of persons desiring transportation. This was done, and the difficulty disappeared.

The Consolidated Traction Company, Pittsburgh, Pa., is about to put into regular service an automobile emergency wagon.

Compressed Air Motors in New York

It is well known that compressed air motors are in use abroad on several railways, and in the last issue of the Street Railway Journal some particulars were given of the cost per car mile during 1898 of the motor cars of the Mekarski Compressed Air system upon the line of the General Omnibus Company at Paris. Owing to the development of the trolley system in this country, but little effort has been made up to the present time to give the compressed air system a thorough trial in this country, although a few cars on the Mekarski system were operated several years ago in Toledo, Westfield and other cities.

The possibility of developing some system which would operate without overhead wires, however, induced certain prominent capitalists interested in the street railways of New York to look into compressed air as a motive power about three years ago, and to determine whether it might be



TOP VIEW OF AIR MOTOR

made a substitute for the underground conduit electric system and trolley. The preliminary steps taken by this syndicate, which resulted in the construction of an air motor equipment for street cars upon lines entirely different from those which had been followed abroad, are familiar to the readers of the Street Railway Journal, through an article published in these columns in August, 1897, which described the system as then constructed and in use on the Lenox Avenue and Columbus Avenue divisions of the Metropolitan Street Railway Company. Since the publication of that article, the American Air Power Company has been organized, and has acquired all the stock, patents and property of the General Compressed Air Company, the American Air Power Company, of New Jersey, and the Compressed Air Company of New York. This company has been organized with A. A. McLeod as president, Henry A. Humley as secretary and treasurer, and W. H. Knight, engineer, and the following board of directors: A. A. McLeod, W. L. Elkins, Thomas Dolan, Thomas F. Ryan and J. H. Hoadley.

In the meantime, also, important improvements have been introduced in the mechanical features of the system, so that now the company claims an economy of operation closely approximating, if not less than that of the overhead trolley. To determine the actual operating expenses, however, the American Air Power Company has made arrangements with the Metropolitan Street Railway Company to introduce the system on an extensive scale in the

equipment of the Twenty-eighth and Twenty-ninth Street lines of the latter company. These lines are now being relaid with 9-in. girder rail to afford substantial construction for the cars.

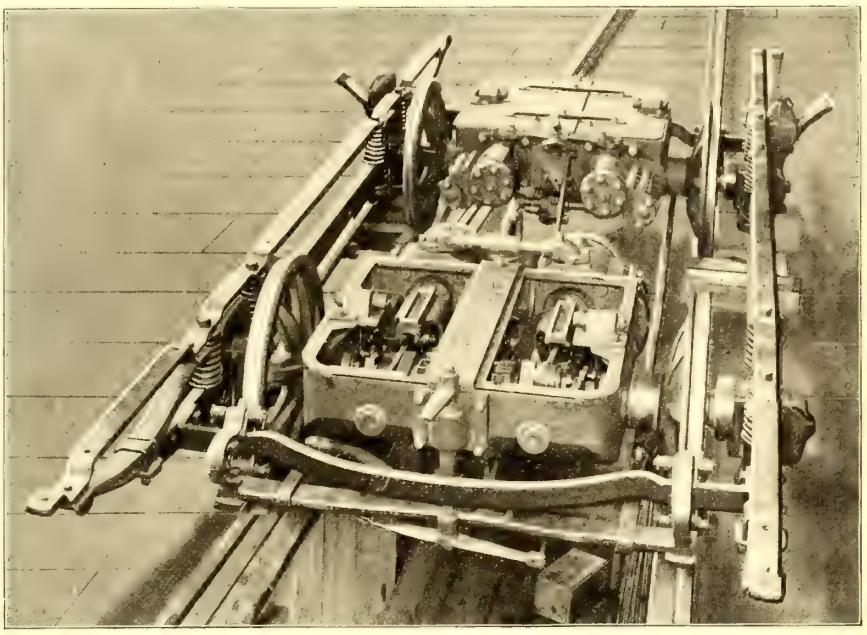
In the meantime, the company has built an extensive compressing plant at the western terminal of the Twenty-eighth and Twenty-ninth Streets lines at West Twenty-fourth Street and Twelfth Avenue, containing a 1000 h.p. direct driven, four-stage compressor, with charging outfit and car house to accommodate the equipment necessary for the operation of the Twenty-eighth and Twenty-ninth Streets lines. The capacity of this compressor is eighty cars, and it will operate the Thirty-fourth Street and other cross-town lines as far down town as Bleecker Street. During the completion of the large compressor ten air power cars are performing night service on the Twenty-third Street crosstown line in regular passenger service.

The cars do not differ in exterior appearance in any way from the ordinary underground conduit cars in use on that line. The car body is the same in every particular, and is mounted on a 21 E Brill truck, which carries the air motors. The latter are completely enclosed in a dust-proof case, in which they revolve in oil, lubricating themselves continuously without the attention of an operator. The use of side rods is completely dispensed with, as each axle is driven independently, one by two high-pressure motors, the other by two low-pressure motors. In fact, the principle closely followed in the design of the equipment was to follow the general standard street railway practice as developed on electric roads, the purpose being to retain the use of the standard wheels, axles, trucks and car bodies, as it was thought that these have now reached a form where the expense of maintenance was a minimum.

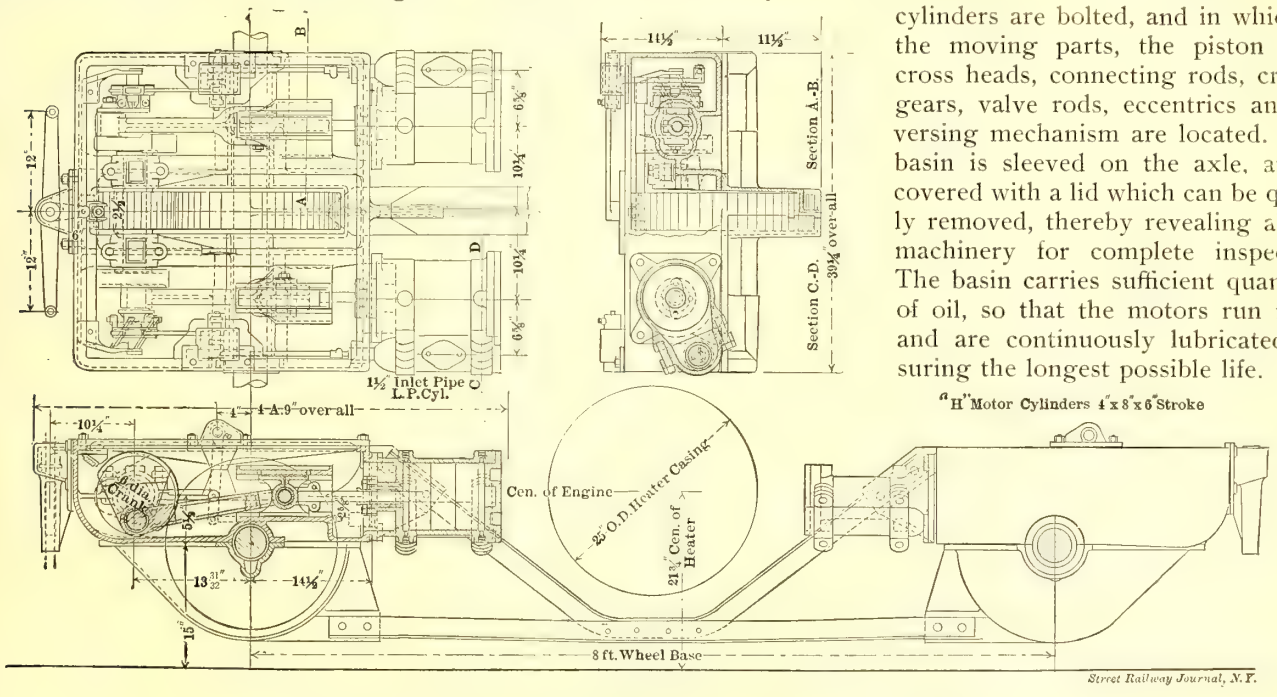
The controller is designed with two handles, one for direction, the other for speed, with duplicate controllers at each end of the car, making it easy for a motorman familiar with an electric power to operate one propelled by compressed air.

The air power system as in use now in New York may be described in detail as follows:

On each axle is mounted an iron clad motor having two cylinders and cranks at right angles. One motor has two high pressure cylinders 4 ins. in diameter and 6-in. stroke. The other motor has two low pressure cylinders 8 ins. in diameter and 6-in. stroke. Upon the crank shaft of these motors is a pinion about 9¼ ins. in diameter, meshing into a 21-in. gear wheel mounted on the middle of the axle. The axle is straight as used for electric motor cars, and the wheels are ordinary street car wheels. The motor consists essentially of a cast iron case or basin, to which the two cylinders are bolted, and in which all the moving parts, the piston rods, cross heads, connecting rods, cranks, gears, valve rods, eccentrics and reversing mechanism are located. The basin is sleeved on the axle, and is covered with a lid which can be quickly removed, thereby revealing all the machinery for complete inspection. The basin carries sufficient quantities of oil, so that the motors run in oil and are continuously lubricated, insuring the longest possible life.



VIEW OF AIR MOTOR TRUCK

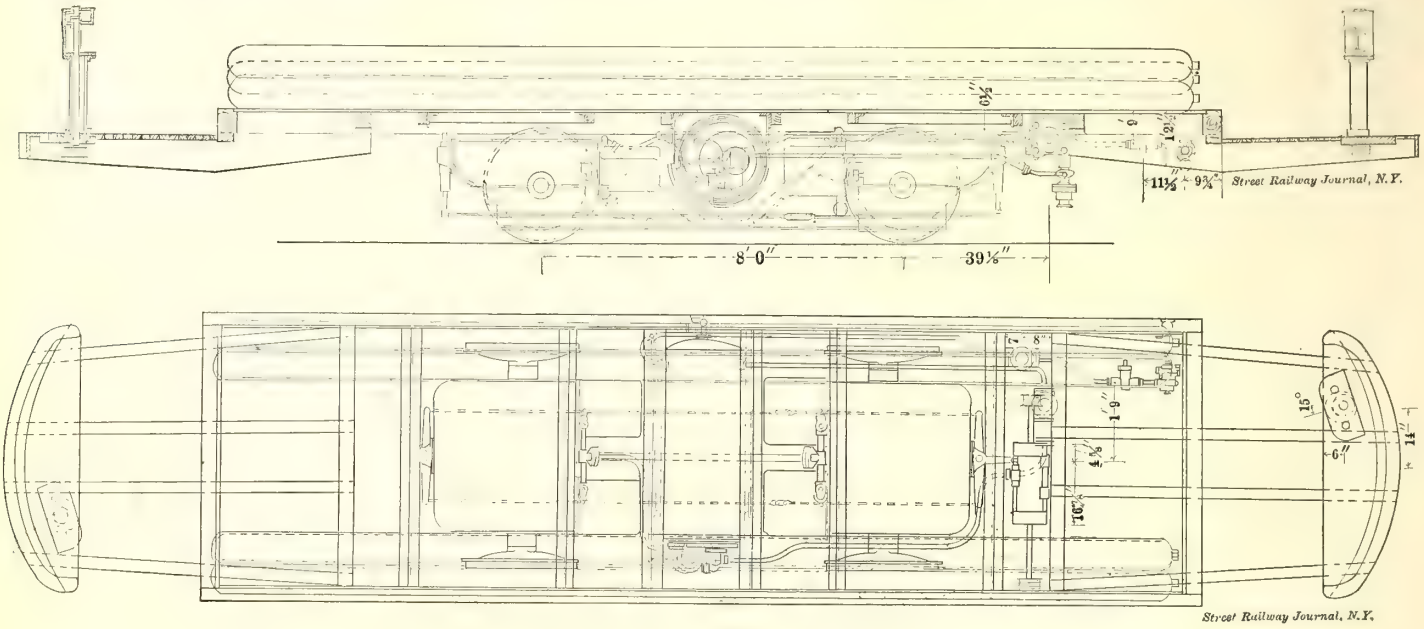


PLAN AND CROSS AND LONGITUDINAL SECTIONS OF AIR MOTOR

The air reservoirs, which are seamless steel bottles, are carried under the seats. These flasks measure 21 ft. 6 ins. in length and 2 ft. 5 ins. in circumference outside. There are six on each car. They weigh about 700 lbs. each, and are 9 millimeters thick, and are tested to three times the

pressure they are intended to carry. From these pipes a 1 in. pipe leads to a reducing valve, which reduces the storage pressure to the working pressure. Before reaching the reducing valve, the pipe passes for about 2½ ft. from its length through the heater, so that it can receive sufficient heat to prevent the subsequent freezing of any moisture which may be in it.

The heater consists of a wrought iron reservoir, that is supported on the cross pieces which connect the two motors, and is charged with hot water under a pressure of about 210 lbs., which corresponds to a temperature of 400 degs. The capacity of the heater is about 60 cu. ft.



PLAN AND SIDE ELEVATION OF EQUIPMENT

After passing through the heater, where it takes up heat, as described, the air enters the reducing valve, which is of the ordinary type, where its pressure is reduced from 2400 lbs., which is that in the reservoirs, to 320 lbs. From the reducing valve it branches and flows to the throttle valves, one at each end of the car. From the throttle valves it passes to the injector, shown on page 375, where a certain amount of moisture is given to the air. This injector is fed from the heater, and consequently the water is at the same temperature as that in the heater, viz., 400 degs. The moisture not taken up by the air falls to the bottom of the injector chamber, and is led back to the heater. From the injector the air passes through a spiral coil in the heater, consisting of a 1-in. pipe having a linear length of about 50 ft. In this passage it is brought up to the temperature in the heater, so that in the next step, when it is admitted to the high-pressure cylinder, it has a temperature of 400 degs. After exhausting from the high-pressure cylinder, it is carried through a connection underneath the heater to the low-pressure cylinder, and is then exhausted into the atmosphere on the lower side of the low-pressure cylinder through a muffler. By having one motor high pressure and the other low pressure, undue slipping of the wheels is prevented, as when the high-pressure wheels slip the low-pressure motor gets more air and more pressure. On the other hand, when the low-pressure slips its wheel it draws down the pressure in the exhaust of the high-pressure cylinder, correspondingly increasing the strength of the high-pressure motor.

The direction of the flow of the air is shown diagrammatically in the cut below, in which *A* is the charging valve through which the air passes through the head *B* to the bottles, and *B* to the reducing valve *D*. The throttle valves are shown at *E*, the injector at *F*, the connection to the high pressure cylinders at *G* and the connection to the low pressure cylinder at *O*.

In its use of a heater, the practice of the American Air Power Company is similar to that of practically all the other manufacturers of air motors, but, as will be seen, the form of heater adopted is quite different from that which has been used elsewhere. The object of imparting moisture to the air is two-fold; first, it assists in packing the joints, thereby reducing the leakage, as the air would be excessively dry owing to the high temperature to which it is brought. Another advantage of adding the moisture is that during the expansion in the cylinders the water keeps flashing into steam all along the passage as the piston advances beyond the point of cut off. This keeps up the pressure toward the end of the stroke and gives an almost isothermal expansion instead of adiabatic expansion.

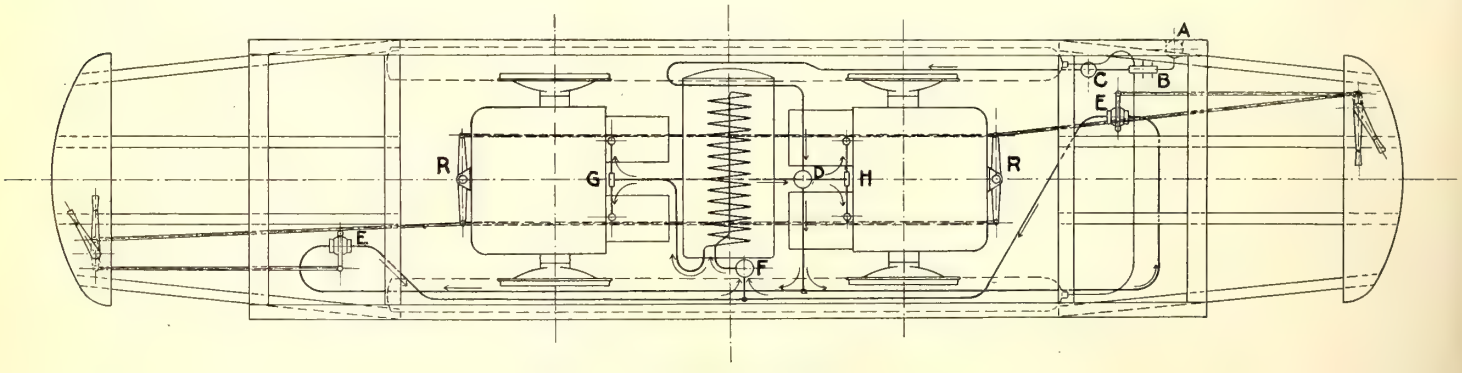
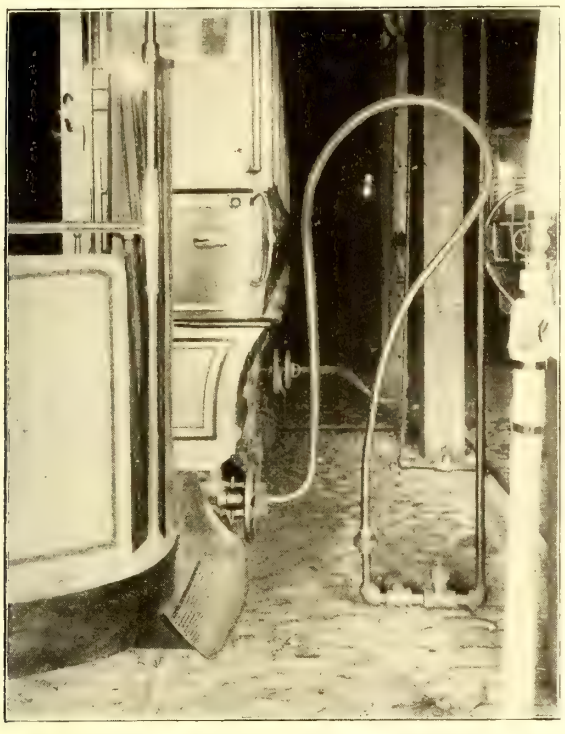
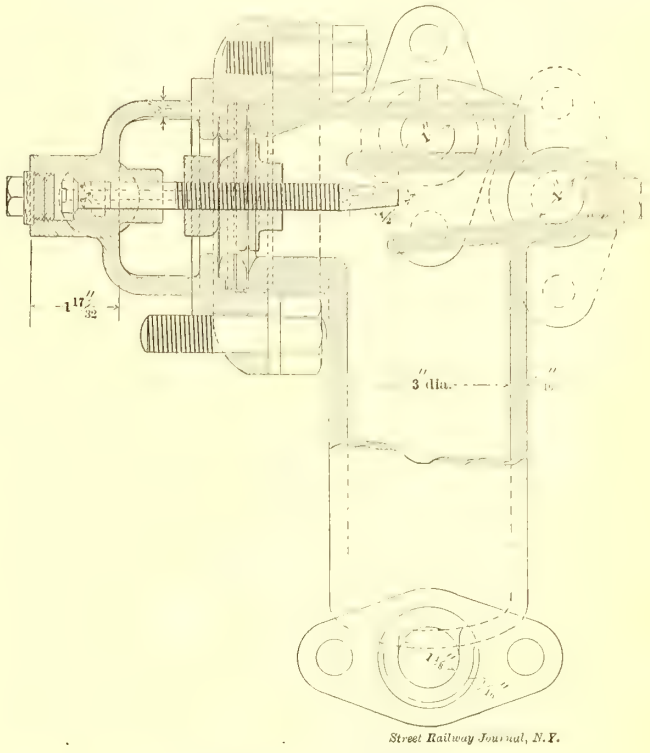


DIAGRAM SHOWING DIRECTION OF AIR

In the heater used on the Mekarski system, to which reference has already been made, the air is made to pass through the hot water; this system was not adopted, first, because the experimental tests conducted with it seemed to indicate that its use was liable to bring excessive quanti-



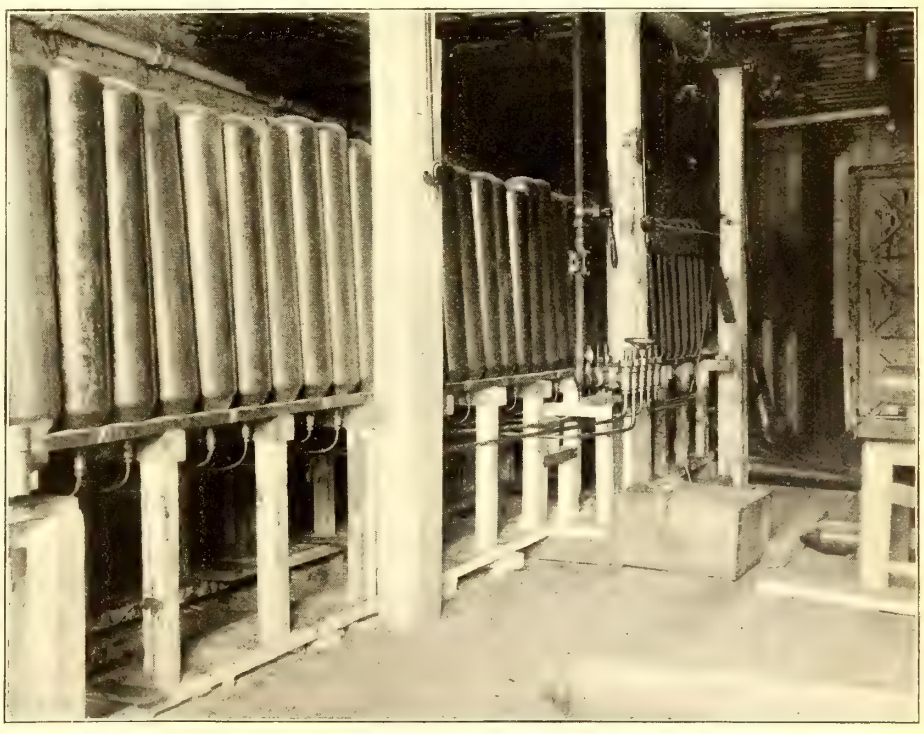
METHOD OF CHARGING CARS



SECTION OF INJECTOR

ties of water over into the motors, and secondly, to reduce the pressure in the heater from that of the air to the 210 lbs. required to maintain the temperature of the water at 400 degs. As will be seen from the sectional view of the injector, the amount of moisture injected into the air can be regulated, while the necessary amount of heat is imparted to the air through its dry passage through the heater.

Two methods of control are adopted, one by varying the cut off, and the other by the use of a throttle. Both methods of control are operated from the platform, which is equipped with a double handle controller, the upper handle being that moving the throttle and the lower that adjusting the cut off. The latter handle has four notches, corresponding to stop, and three degrees of speed. On the first notch the valve is set to cut off at one-quarter stroke, the second stop at one-third stroke, and the third notch at five-eighths the length of the stroke. At the neutral position the air pressure is entirely cut off, and as the motor cylinders are fitted with check valves, the car can coast without creating any back pressure or vacuum. The usual position of the cut off when the car is in operation is that of the first, or one-quarter, notch, which is, of course, the most economical point of running. The speed is then controlled by the throttle. Should the motorman desire more power or higher speed than can be given with the throttle open, the cut off can be advanced to one-third or five-eighths point, and to avoid accident the motors can be reversed if necessary, by throwing the cut off controlling handle around to the reversing position without touching the throttle, although this brings a strain upon the motors similar to that experienced by electric motors when suddenly reversed. No special notches are provided on the reversing side of the cut off controller disc, as they would be little used. When the car reaches the terminal of its route, the two controller handles are lifted off the spindles and carried to the other end of the car, as with electric operation.



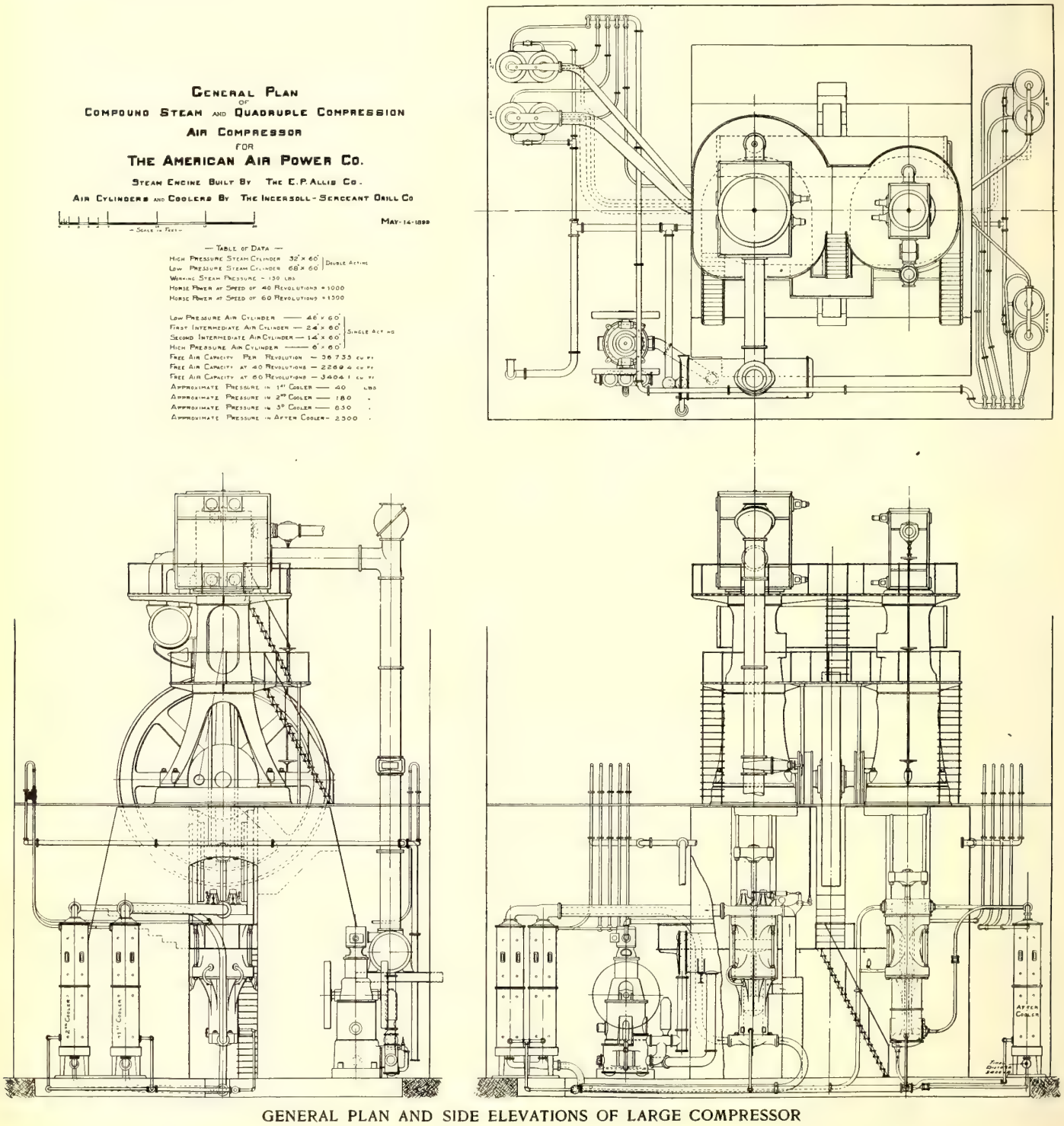
VIEW IN STORAGE ROOM

The results secured during the past two years have dem-

onstrated that the motors are highly efficient and exceedingly durable, all the original parts being still in use. The manufacturers estimate that making a liberal allowance for the wear which must occur, and which, in the case of the more rapidly wearing parts has been measured, the maintenance per car mile will compare favorably with that of an electrical equipment.

ble of slipping the wheels on a dry rail under a weight of 30,000 lbs., corresponding to that of a powerful electric motor equipment, with which, as will be seen, it does not differ materially in weight.

Several sample indicator diagrams, taken from the high and low pressure cylinders, are given on page 378. As will be noticed, they are similar to locomotive diagrams,



GENERAL PLAN AND SIDE ELEVATIONS OF LARGE COMPRESSOR

The weight of the standard car as in use on the Twenty-eighth and Twenty-ninth Streets lines is as follows:

Car body	6000 lbs.
Trucks	4500 "
Air reservoirs	4200 "
Heater	700 "
Motors (each 1400 lbs.)	2800 "
Controlling apparatus and other fittings	400 "
Piping	150 "
Total	18,750 lbs.

The motors upon which this estimate is based are capa-

and have the characteristics of diagrams taken from cylinders with link type of cut off.

Reviewing briefly now the motor equipment, it will be seen that the system differs in many respects from that used abroad, notably (*a*), in the form of motors employed, (*b*) in the method of heating, and (*c*) in the high pressure used. The adoption of a pressure of 2400 lbs. in the reservoirs was to increase their capacity. As at present designed, the cars can run 15 miles on a trip with a charge that is restricted to a space under the seats, and this can be increased to 20, 30 or 40 miles by crowding in all the

flasks that the space would allow, or by increasing the pressure, as the company is now preparing to do. As the reservoirs have a capacity for withstanding three times the pressure used in them, it will be readily seen that the element of danger is practically eliminated. There is no deteriorating influence on the reservoirs incident to the use of this pressure, nor has there been any explosion with any of the flasks by air except when premeditated, and only then with the greatest difficulty and with apparatus specially constructed to bring the required force into play.

The cars operate noticably without noise, and start noticeably without jar and with a cushioned effect which is extremely easy for passengers.

The method of charging is another feature to which the engineers of the company have devoted a great deal of attention, and which is now accomplished in a minimum space of time. A general view of the main charging room is shown on page 375. The main charging reservoir consists of a large number of the same type of flasks as used on the car, but carried in a rack and piped to a manifold, from which the air from the compressor is switched into any bank of reservoirs desired. From this point the air under pressure is piped to the charging room, where are located the charging nozzles. The latter are carried upon a flexible goose neck so arranged that the nozzles can be readily fitted to the charging valve. Adjoining the air charging nozzle, but located in such a position that it will come opposite to the heater, is the hot water charging nozzle, which is similar in general appearance to that used for charging the air reservoirs. This device has a double set of pipes, one for introducing the hot water into the reservoir, and the other to allow the discharge of the water which may be in the heater after a run. The process of charging the air reservoir, hot water reservoir and removing the cooled water can be accomplished simultaneously and in a short space of time.

The compressor plant, which has just been completed at the corner of Twelfth Avenue and Twenty-fourth Street, by the Ingersoll-Sergent Drill Company, is unusual in almost all of its features, but especially in two points, its great power and the high pressure obtained. High pressures with smaller machines are common, but pressures of 2400 lbs. to the square inch in 1000-h.p. machines are essentially unique.

In general the machine consists of a vertical cross compound engine, built by the E. P. Allis Company, of Milwaukee, which has cylinders 32 ins. and 68 ins. x 60 ins. stroke, and is provided with Reynolds Corliss valve gear.

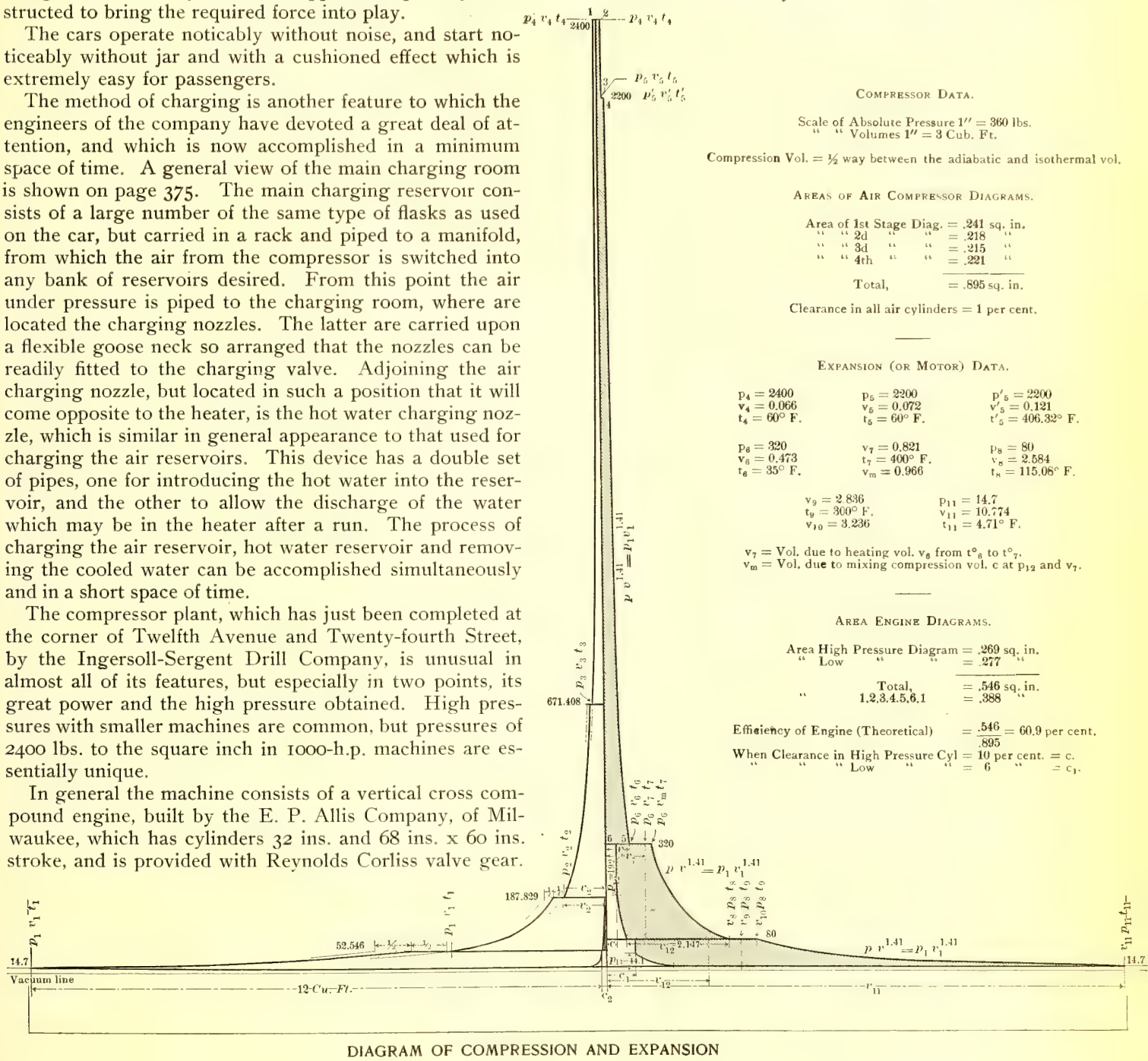


DIAGRAM OF COMPRESSION AND EXPANSION

With steam pressure of 150 lbs., furnished by Babcock & Wilcox boilers, 40 r.p.m., and most economical point of cut off, the horse power is 1000. The shaft is of hammered iron 22 ins. in diameter outside of the journals and 20 ins. diameter in the bearings which are 36 ins. long. The fly wheel, placed between the cylinders, is 22 ft. in diameter and weighs 60 tons. The engine is mounted upon brick piers, and directly underneath it is placed the air compressor.

This machine is of the four-cylinder type, the low pressure cylinder being 46 ins., the first intermediate 24 ins., the second intermediate 14 ins., and the high pressure cylinder 6 ins. in diameter. The stroke being common with that of the engine is 60 ins. All of these cylinders are single acting and are water-jacketed. The free air capacity per revolution is 56.735 cu. ft.; capacity at 40 r.p.m., 2269.4 cu. ft., and the free air capacity at 60 r.p.m. is 3404.1 cu. ft. The approximate pressures in the different coolers are given in the large diagram showing cycle of operation.

The compressor pistons are arranged in pairs vertically in line beneath the steam cylinders as is shown in side and end elevations. The initial and first intermediate air cylinder being below the low pressure steam cylinder, while the second intermediate and high pressure air cylinders are below the high pressure steam cylinder. Motion is transmitted from the steam engine cross heads through distance rods, one pair for each crosshead, to a crosshead attached to the air cylinder piston rods.

The intercoolers employed are of two different designs. The two for the lower pressures consist each of a shell inclosing a nest of vertically arranged cooling pipes, through which the air passes going from one cylinder to the other. The coolers for the higher pressures consist each of a shell

inclosing a pipe coil. The former construction was adopted for the lower pressures because great cooling surface was required on account of the large volume of air, but in dealing with the higher pressures coils were substituted so as to dispense with as many joints as possible. The coolers are arranged so that in case of leakage of air from the cooling pipes into the shell or casing this air will rise with the circulating water up to the operating floor of the engine room and discharge through a slight discharge pipe under the immediate care of the engineer. All the piping from the first air cylinder and through the entire compressing plant is of copper.

What may be called an auxiliary governor controlled by air pressure is provided to act upon the governor of the steam engine. This consists of a weighted lever which is operated upon by a small piston, which in turn is actuated by the air pressure. If for any reason the pressure should become excessive, the lever is lifted. This opens a valve admitting air to a device on the governor, so designed as to reduce the steam supply and for all practical purposes, to throttle the engine.

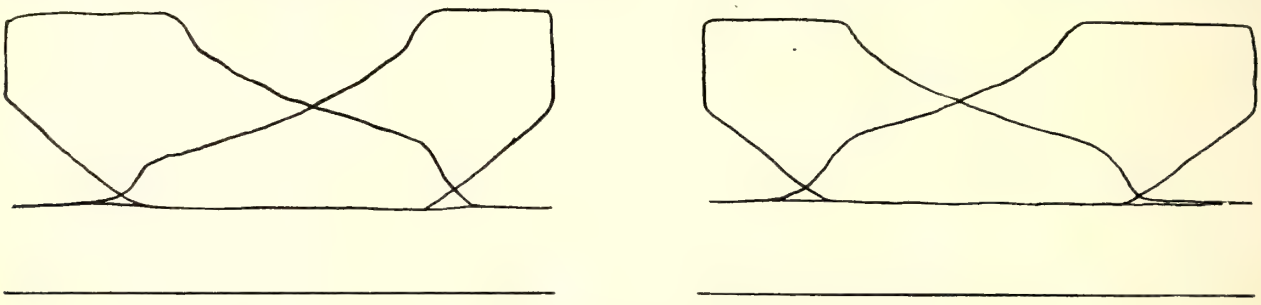
Some idea of the massiveness of the machine may be obtained from the bare statement that it is 60 ft. in height. It will be employed exclusively for supplying air to the air motor cars on the street railway cars.

The water used for cooling the air in the intercoolers is taken from the North River, which is a few hundred feet from the station, through a 16 in. water main. After passing through the intercoolers this water is discharged into the river through a second 16-in. main.

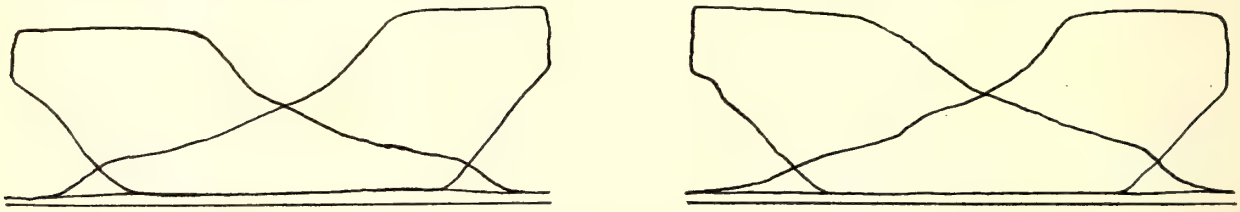
Referring now particularly to the diagram given on the previous page, showing the cycle of compression and expansion, this diagram is drawn to scale, the abscissæ representing volumes, and the ordinates pressures. The left hand side of the diagram shows the compression curve, and the right hand side the expansion curve. Twelve cubic feet of air is taken as a basis, the scale of pressures being 1 in. to 3 cu. ft. The curve of actual compression in each cylinder of the compressor is considered to be half way between the theoretical adiabatic and isothermal curves on account of the water jacketing, and at the end of each stage of compression the air is brought back to the corresponding point on the isothermal curve through the cooling of the air in the intercoolers. Short arcs of the true isothermal and adiabatic curves are given on the diagram at the end of each stage of compression.

The portion of the curve to the right hand of the center line shows the pressures and volumes at each stage of expansion. The actual values of pressure, volume and temperature at the end of each stage are shown by $p_4\ v_4\ t_4$, $p_5\ v_5\ t_5 \ldots p_{11}\ v_{11}\ t_{11}$. The effect of heating the air is shown in the differences between $v_5\ t_5$ and $v'_5\ t'_5$, and again between $v_6\ t_6$ and $v_7\ t_7$. The effect of the injection of moisture is shown in the difference between v_7 and v_m.

The theoretical efficiency of the entire mechanical cycle can, of course, be obtained by dividing that portion of the area of the right hand curve, which represents work performed, i. e., that of the high pressure and low pressure diagrams, by the entire area of the left hand curve. According to these figures, the theoretical efficiency of the cycle is 60.9 per cent. This figure, however, is, of course, slightly in excess of the true efficiency of the entire system on account of the addition of heat from the hot water heater. The effect of subtracting this, however, will not materially affect the total efficiency, as given above.



SAMPLE INDICATOR DIAGRAMS FROM HIGH PRESSURE CYLINDER OF MOTOR



SAMPLE INDICATOR DIAGRAMS FROM LOW PRESSURE CYLINDER OF MOTOR

The question of air consumption and cost is, of course, an important one. Upon this point the company hopes to be able to contribute some important data soon. From tests already made, however, Mr. Knight, chief engineer of the company, states that the average consumption per car mile has been 450 cu. ft. of air, and the cost per car mile has been about $.025.

The writer has found the following system of repainting cars to be quite satisfactory: First remove all old paint by softening it with a blow-pot just enough to allow it to be scraped off with a broad putty knife, not allowing the flame from the blow-torch to strike the bare wood at any time. Then sand off the surface well with block and sand paper. Where any new work has been put in, it should be first primed with a coat of boiled oil and a little lead and allowed to stand for not less than four days. Dashes and all iron-work should be thoroughly cleaned with strong alkali and primed with a coat of linseed oil, put on boiling hot and allowed to thoroughly harden, giving one coat of oil and lead before color. If the surface is rough, plaster with lead on this coat. Then allow it to thoroughly harden, and sand with block; then lay on two coats of flat lead, two coats of color, color varnish, stripe and ornament, finish with one coat of rubbing varnish and one coat of finishing varnish. From paper at the Boston Convention, 1898.

Street Railway Parks

MIDDLETOWN, CONN.

The Middletown Street Railway Company serves an elaborate park located 2½ miles from the center of that city, which has a population of about 15,000, the total population served by the street railway system being about 20,000. The park contains about 20 acres of land, one-half of which is well covered with shade trees. It has been left in its original state as much as possible, and this fact contributes very largely to its popularity among lovers of rustic beauty. A deep ravine, over which a rustic bridge has been constructed, runs through the grounds. Although the natural features of the place have been carefully preserved, a large amount of money has been expended in improvements and in providing the usual attrac-



VIEWS IN PARK AT MIDDLETOWN, CONN.

tions for resorts of this kind. A rustic theater, having a stage 30 ft. x 50 ft., and situated at the foot of a hill, which is covered with a hemlock grove, is one of the most popular institutions. The stage was made extra large to enable it to be used for dancing after the shows are over, but dancing accommodations have not been found profitable. In front of the stage and on the slope of the hill are located some 400 seats, for which a charge of five and ten cents is made during the performances. The ten-cent seats are quite comfortable; the five-cent ones being ordinary chairs fastened together.

A large lake in the park adds greatly to its popularity. One section of the grounds, well shaded, is reserved for the use of picnic parties, so that churches and societies can have exclusive privileges for their outings, at the same time being able to avail themselves of all the advantages of the park. A small-sized restaurant building and a flying-horse merry-go-round are among the most recent attractions installed.

E. W. Goss, superintendent of the Middletown Street Railway Company, has the following to say in regard to street railway parks: "As far as our experience with running a park is concerned, as we have only had one year in which to judge, it is hard to form an opinion. Last season, after we commenced running the park, we handled heavy crowds, a large number of which were pleasure-seekers exclusively. We did not make any charge for admission to the grounds, depending for our remuneration upon the increased traffic on our cars and upon the money spent by visitors in seeing the entertainments. We think it would cost more to collect an admission charge at the gates from non-patrons of the cars than we would take in by so doing. We do not allow bicycles or teams on the grounds, wheels being checked at a small building near the entrance, and posts being provided outside the park for hitching horses. The park will be opened on June 19, and the theater entertainments will consist of the usual vaudeville attractions."

PADUCAH, KY.

Paducah has a population of 25,000, and there are no public parks, so that the park of the Paducah Street Railway Company forms the only outing grounds for the people. These grounds contain 75 acres, of which about 20 acres are now used for park purposes. The resort is located some 2 miles from the center of the town.

The value of the park is placed at about $50,000, and nearly $17,500 have been expended in improvements, as follows: Erecting a handsome brick building, which is occupied by the park keeper, who boards the actors in summer, $5,000; constructing summer theater, $2,500; total for improvements on grounds, $10,000. The park contains a lake covering about 5 acres, and supplied from the city water mains. Here bathing house, boats, etc., are provided.

George C. Wallace, general manager of the Paducah Street Railway Company, writes as follows:

"In our theater we have tried both stock companies and vaudeville shows, but find that a good stock company, with specialties once a week, and a good band are the best drawing cards. We also give balloon ascensions, fireworks and lake displays, for which we charge admission to the park. At other times admission to the grounds is free, and a small charge of five or ten cents is made for seats in the theater. We also keep a few animals, such as bears, monkeys, etc. We now lease the amusement features for a nominal sum. We have from 500 to 1000 people in attendance each night, and from 2000 to 5000 at the other attractions.

"Our season opens May 15 and closes Sept. 15. On account of our long, hot summer we find the park quite a paying investment."

SCHENECTADY, N. Y.

H. S. Cooper, superintendent of the Schenectady Railway Company, in reply to an inquiry regarding the recent improvements made in the pleasure park of his company, writes as follows:

"We still run our pleasure park as an 'assembly ground,' and find no reason as yet to change its character to an 'amusement park,' and do not believe that we could at the present time make it pay as such.

"We have already booked nearly every Saturday of the season, together with several other days, for picnics, 'field days,' etc., of the various societies and organizations of the city. The revenue from these, together with the returns from the sale of privileges, admittance to evening dances, hiring of boats, swings, etc., will go well towards paying fixed charges and operating expenses, leaving the extra traffic engendered by the park as nearly clean profit.

"We have made no large improvements, but are all the time adding any small thing that will increase the park's comfort, beauty and convenience.

"We will, this winter, try skating, hockey and curling rinks, so as to see if we can lessen the 'dead time' of the park, and add a little to our winter traffic. We shall try it carefully and conservatively, but thoroughly, and hope to be able to report a success.

"Specifically answering your question as to the value of parks, we can say that it has been our experience that our park has been a profitable enterprise to the railway company. It has been made so by fully studying our people here, their needs and desires, and by cautiously catering to them in all things that were profitable, and not by blindly following the lead of 'any old place,' and rushing into expensive and unremunerative 'attractions.' We may come to 'attractions' later on, when we find that our present course shows signs of failing to pay, or be popular; and we will then have the experience of others to aid us in knowing what NOT to do, and with our park in its present course shows signs of failing to pay or be popustart anything we may wish, and without the extraordinary initial expenses and mistakes of an absolutely new and untried enterprise."

Summer Park Theaters

BY J. W. GORMAN

Park amusements in connection with street railway pleasure resorts have now developed to such proportions as traffic producers, as to warrant the most careful consideration of managers and directors everywhere. The progressive and up-to-date management of any corporation or institution is the one, of course, that is constantly studying out new methods of increasing and extending the business and revenue earning capacity of the plants under their control, and in no case does this apply with greater force than in the matter of adding summer parks and amusement features to already well equipped street railway systems for the purpose of adding to the regular, necessary and business patronage a purely pleasure traffic. Two features predominate in the life of every city, viz., business and pleasure, otherwise there would be but bare walls and business structures, grim stores, banks and markets, instead of, as now, attractive shops and windows, handsome residences, amusement halls and brightness in all things, as an expression of the tastes, likes and wishes of the dwellers. The far-seeing and progressive street railway manager takes advantage of these two characteristics, and while paying strict attention to the regular and what may be called the legitimate traffic on his road—at the same time increases his earnings by catering to the love for pleasure and recreation among the people his system serves.

A properly conducted park situated from 3 to 10 miles from a city and provided with proper amusement attractions, gives the incentive for a ride on the electric cars—the ride in itself bringing relaxation from the day's business cares, while the attraction to be witnessed acts as an additional inducement.

The writer, as the result of careful observation and inquiry, estimates that during the average weeks of summer, a traffic equal to the entire population of the city can be induced by a properly conducted amusement adjunct to a traction company. In illustration the following remark is given, made by the progressive and successful manager of a once non-paying and "run down road," who had revised all former methods, and added a handsome park. In conversation with a prominent manager of summer attractions, this gentleman said: "Mr. ——, our road paid you last week $400 for your amusement company, and we carried 45,000 paid fares to our park during the week. The population of our city is 48,000, so undoubtedly many witnessed the performance more than once. We do not hesitate to tell you this, * * * and your contract with us is a fixed one." The writer relates another instance in which a manager stated that during the entire amusement season his road had averaged 20,000 paid fares per week from the park travel, the city having a population of but 22,000 people.

The manager of a traction company who sends out letters and circulars or makes efforts to induce circuses or menageries to visit his city and to locate their places of exhibition on his line, is another example of up-to-date management.

The prevailing error that is being made by roads with handsome and suitable parks is in giving the cheap and mediocre entertainments easily obtainable, arguing that, "it is all free and the quality does not matter." Here lies the error of otherwise shrewd business men in catering to the masses. Now, is the show free? Does the public not pay for the exhibition? To convince any traction company, it need but to thoroughly advertise that its cars will start at a certain hour and day for such a park with no performance mentioned. There will be no unusual life, interest or fares taken. Announce as thoroughly that there will be presented a known and desirable attraction that has a reputation and drawing power at the local city Opera House in the regular season, and that there will be no charge for the performance, and the capacity of the cars will be crowded to the utmost. Do not the riders pay for the show? Certainly they do, and the fares are collected not for the ride alone, but in conjunction with the attraction.

The performance must be good and well conducted. The talent must be of merit to win the praise of intelligent people, and adapted to the wants and wishes of each city for the best results. This selection must come from experience. An evening's time to citizens is too valuable to be thrown away that some irresponsible talent may be presented, and some irresponsible "hawker" of amusement wares and goods may make a handling commission or profit. The right men can be found to provide desirable and worthy entertainments in line with good taste, and morality acceptable to church attending patrons, as well as to the general public. Nor should traction companies limit their amusements amount to such a low figure that good talent cannot be employed. Many a park that loses money at a small figure for attractions would make large profits if double the amount was expended for attractions of drawing power and of sterling merit and reputation.

The traction companies in the East have developed much beyond those in the West and Middle States, in availing themselves of the great revenue that comes from the pleasure seeking public, but there is little doubt that at no distant day, nearly every progressive street railway system in the country will have its summer park and open air theater presenting meritorious attractions as established adjuncts to its general business.

The Electrical Installation Company, Monadnock Block, Chicago, has just closed a contract for the complete rehabilitation of the Vicksburg (Miss.) electric lighting system. Work will be started immediately, and rushed to completion within ninety days.

LEGAL NOTES AND COMMENTS*

Edited by J. Aspinwall Hodge Jr., and Robert Ernest, of the New York Bar

Taxation of Franchises

The last few weeks have been prolific in the discussion of this topic in New York, owing to the introduction and passage, as the result of an emergency message of the Governor, presented to the Legislature last March, of what is known as the Ford Franchise bill, and as we go to press an extra session called by the Governor has passed amendments which he deems necessary. The original bill consisted of less than a dozen lines to be inserted in subdivision 3 of section 2 of the Tax Law of the State, which section defined the terms "land," "real estate," and "real property" as used in that chapter. The tax law provided that real estate should include, among other things, all surface, underground and elevated railroads, and also the pipes laid in and above any public or private street for the purpose of conveying water, oil and other substances or products, and the Ford bill inserted after the words "railroads" and "pipes" the words "the value of all franchises, rights, authority or permission to construct, maintain or operate the same" through streets, highways and public places.

This bill was held by some, and notably by two of the leading morning papers, as a radical measure of great importance, making an epoch in the history of taxation in the State and imposing upon corporations their just proportion of the burden of taxation which heretofore, it is asserted, they had not borne.

Another portion of the public, who found representation in another of the leading morning papers, talked and wrote against it in the strongest terms, alleging that it imposed double taxation upon corporations and was a socialistic attack upon wealth.

A third view was taken and seems still to be held by many to the effect that the law is of little importance, and that it practically imposes no new burden; that the amount of tax to be derived from it, instead of being very large, will be very small; and that, as a matter of fact, it is merely declaratory of the present law.

The laymen and, we have suspicion also, the Governor himself (certainly when the law was first drafted and passed), have had confused notions and inadequate ideas of the scope of the act and its effect.

This effect can only be determined by a careful examination of the decisions of last resort of our own State, with some side light thrown upon the matter by the decisions of the courts of other States where similar enactments have been pased. These decisions will only afford light when one has clear and definite ideas of what a franchise is, or of what taxes are already laid upon franchises in New York. Without quoting authorities, it is manifest that the franchise referred to is not what is often called a "corporate franchise," which is the right of several individuals to be and become a corporation, but it is that right possessed by a corporation or by an individual (for, as a matter of fact, the Ford bill applies to individuals who have such rights, as well as to corporations) to maintain and operate mains, pipes, conduits or wires for transporting certain products or substances, including electricity, or to maintain and operate railroads through streets and highways.

Were it not for some decisions in the State, it might be contended with some show of reason that the Ford amendments do not change the tax law, for manifestly if the assessor is to determine under the old law the value of a gas pipe in a street, it would be contendable, if not reasonable, to hold that in determining the value of the pipe laid below the surface of the street, the right to have it there should be included. Its value as a pipe, without the right to leave it where it is and to put gas through it, would be its value as old iron; or certainly not more than the cost of putting it there. One might even go so far as to hold that it is worth less than nothing since, without the right to leave it in the street, it would cost more to take it away than the value of the pipe.

But if the assessor places the value upon the pipe as a usable article in the street, in other words, adds to the value of the pipe, the value to use it (without which few articles would have real value at all), then manifestly the original Ford bill would not change the law one iota, nor would the amendments presented by the Governor in his message calling a special session of the Legislature, except so far as those amendments placed the assessing of the value in the hands of the State, instead of the local authorities, and make some provision against double taxation.

The impossibility of separating the value of the pipe and the value of its use is evidenced by the fact that in the amendments proposed, these two are included in one item, and by particular definition are dubbed a "special franchise," the value of which is to be ascertained by the State Board of Assessors.

But the original Ford bill does change the law, because the courts have construed the tax law as it was before the passage of the bill to mean that the mains and pipes of the gas company may be taxed, but not the privilege granted by the local authorities to use them. (*People ex rel. Keystone Gas Co. vs. Martin, 48 Hun, 193*). The decisions of the court maintaining this proposition, the Ford bill necessarily makes as a change in the law:

All corporations, under other provisions of the tax law, are taxed upon their capital stock to an amount determined by its value, arbitrary values being fixed upon stock paying specified dividends. This tax is often called a franchise tax. If this is a tax upon the mere right to be a corporation, graded by the size and the success of the corporation, then it is a tax upon a privilege which can scarcely be said to be property, for, as is asserted by the Supreme Court of the United States as late as last April, the Michigan Mileage Law case, the taking away of this right does not take away *property*, but leaves the company's assets intact. The fact that there are certain privileges given to corporations, such as operating a railroad, which are not given to individuals, adds to the value of many corporate franchises, because it makes them necessities in those particular lines of business.

A great variety of opinion has also emerged from the discussion of Mr. Ford's statement as to the simplicity of determining the value of a franchise such as he proposes to tax. He would take the market value of the stock, plus the market value of the bonded and other indebtedness of the company as being equivalent to the total value of all the assets tangible and intangible. Under the present law, it being the duty of the assessors to appraise the tangible assets, we have, according to Mr. Ford, only to take the value of those tangible assets as found by them and deduct it from the total market price of the securities of the company and we have the value of that intangible asset, which is to be called a "local" or "special franchise."

Many of the comments upon this method of arriving at the valuation have held it up to ridicule, and we think very justly so if it is taken as a rule which can be applied generally; and this, notwithstanding the fact (which seems to

* Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

have been overlooked) that this very rule has been applied in particular instances in Massachusetts and Illinois by the highest courts of those States and in the Supreme Court of the United States. *(Com. vs. Hamilton Mfg. Co., 12 Allen, 312; Aff., 6 Wallace, U. S., 632; Porter vs. Rockford, etc., Co., 76 Ill., 561; Illinois Railroad Tax Cases, 92 U. S., 575).*

This method, happily, is not embodied in the Ford bill, and the local authorities (or according to the amended bill, the State Assessors), will, under the decisions and subject to the review of the courts, be compelled to formulate a general rule or else a rule for each particular case. The latter method, we venture to predict, relying upon the general trend of the decisions of the Court of Appeals in tax cases, will be insisted upon by the courts.

If Mr. Ford's rule was applied to some cases, it would necessarily result in the greatest injustice. For example, a large proportion of a company's debt, represented, perhaps, by an issue or part of an issue of bonds or other securities, may arise out of bad management or peculation. This is especially possible in the small companies; but these bonds for which the company has nothing to show in tangible assets would increase the estimated value of the franchise, according to Mr. Ford's method, by an amount equal to their full value. *Very many things besides the franchise may make up the difference between the Stock Exchange value of the total capital stock and the issue of bonds on the one hand and the estimated value of the tangible assets on the other hand.*

Some effort has been made in the amendments to the bill to partially avoid double taxation, but they are not in the form that they undoubtedly would be had this matter been taken up with that deliberation which legislation of this character demands, rather than with that snap and push and energy which is more commendable on the battlefield and, even, in the strictly executive functions exercised by a Governor, than it is in the enactment of legislation—especially, legislation dealing with so supreme and complicated a subject as taxation.

Manifestly, the bill has been improved by the amendments, but there must be very grave doubts, in the minds of every one, as to whether it would not have been better to have had a measure like this discussed more fully, and there seems to be a reasonable certainty that the other amendments may have to be passed, even if the law is not radically altered at the next session of the Legislature.

If a company in one town or village pays a fixed sum annually to local authorities for rights in public streets, and another company pays for similar rights by paving the street and agreeing to keep it in repair, why should one company have a deduction made from its "special franchise" tax and the other company have no deduction? This is what the amendment to the Ford bill does.

The chief problem involved is not the question as to whether these intangible assets shall be taxed, but how the tax asssessors are to arrive at the value of the intangible assets for the purpose of taxation. This matter has vexed the Legislatures and courts of all the States, and much can be learned from their experience; and no one should attempt to frame a bill or advise the passage of one dealing with the subject until after an exhaustive study by skilled counsellors of that experience as it appears in the statutes and in the decisions of the courts of the various States.

Among the many ways other than that adopted by the Ford bill by which a franchise tax can be measured are the following: By dividends, by the gross receipts, by the net earnings, by the amount of the capital stock at its market value, by the market value of the shares and other securities less the value of the real and personal property (which is Mr. Ford's method, but not necessarily the method to be adopted by the State Assessors); and, finally, by a careful consideration of each case on its merits, giving weight to many, if not all, of the various indicia of value, instead of founding an estimate upon only one of them.

H.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

ILLINOIS.—Mandamus to Street Railroad—Use of Streets—Control of Fares—Estoppel—Contracts—Ultra Vires—Procedure.

1. Where a corporation accepts a public franchise, imposing certain duties to the public in return for rights conferred, the performance of such duties may be compelled by mandamus.

2. The State's power to attach conditions beneficial to the public to the charter of a quasi public corporation may be exercised by a municipality, as within its delegated power to permit the use of streets and public places by the corporation.

3. Const. art. 11, sec. 12, authorizes the general assembly to enact laws to prevent extortion and unjust discrimination by street railways in the transportation of passengers. Held, that though the Legislature had enacted no laws to carry out the provisions, it was, notwithstanding, a declaration of the sovereign power over a street railway's duties to the public to demand only reasonable rates, without unjust discrimination.

4. An ordinance of R., authorizing defendant to enter and use its streets for the operation of a street suburban railroad to Chicago, provided that the fare between any point in R. and the city of Chicago should not exceed the fare charged from any point in the town of C., etc., to the same point, or return. Held, that by the acceptance of the ordinance, defendant was estopped to deny that the exaction of a greater sum from R. to Chicago than from C. was an unreasonable and unjust discrimination against the public.

5. The fact that a city ordinance imposing conditions on a quasi public corporation, in consideration of the privileges granted, required the corporation to accept it, does not render it a mere license, or such ordinance a mere private contract.

6. Since the street railway company has no power to use the streets of a city, in the absence of an ordinance permitting it, the granting of such privilege is a sufficient consideration for obligations imposed and assumed by the acceptance of the ordinance.

7. Where a street railway has enjoyed the benefits of an ordinance requiring performance of certain conditions and obligations by it, it cannot escape performance on the ground that the ordinance and duties imposed were ultra vires to both the city and the company.

8. An obligation imposed on a street railway company by a city ordinance, to demand no greater rates between certain points than between certain other points, is a provision for the protection of the public against unjust discrimination; and hence any citizen is entitled to maintain mandamus for its enforcement.

9. In mandamus begun in the Supreme Court, that court may alow an issue of fact to be made after submission of the case and demurrer to the petition, or not, in its discretion.—(People ex rel., Jackson vs. Suburban R. Co., 53 N. E. Rep., 349.)

ILLINOIS.—Appeal—Reversal — Amendment — Eminent Domain—Necessity.

1. Where the judgment in a petition for condemnation is reversed, and the cause remanded, on the ground that the petition should have stated facts showing the necessity for appropriating the lands in question, the Circuit Court properly allowed an amendment to the petition stating such necessity, and admitted evidence of the facts alleged.

2. Under Rev. St., chap. 66, relating to horse and dummy railroads, and the eminent domain act (Id., chap. 47), allowing the condemnation of property when "necessary" for the construction or operation of such roads, the necessity is not an absolute physical necessity, but one created by expediency or reasonable convenience.

3. A street railway approached a public crossing at an elevation where there were six tracks of a steam railway company, with trains passing and repassing every fifteen minutes. The street railway would have to cross these tracks and the center of the yard of the railroad, if it kept its tracks within the highway. Held, that a necessity arose, within Rev. St., chap. 66, in relation to horse and dummy railroads, and the eminent domain act (Id., chap. 47), so as to authorize a condemnation of private property to avoid the obstacles in ascending and descending a hill near such tracks, and the danger of the grade crossing.—(Aurora & G. Ry. Co. vs. Harvey, et al., 53 N. E. Rep., 331.)

MINNESOTA.—Taxation—Equality—Irregularities—Statutes—Partial Invalidity—Corporations.

1. Gen. St., 1894, sec. 1530, was designed to constitute the ex-

clusive method of listing and assessing for taxation the franchises and other intangible property of corporations and associations falling within its purview. The method there provided for reaching such intangible property for taxation is by listing and assessing the entire capital stock at its market or actual value, less certain specified deductions.

2. The personal property referred to in item 7 is the tangible property specifically listed and assessed, and does not include "franchises." Item 14 of section 1524, Gen. St., 1894, providing for listing "franchises" as a separate and distinct class of personal property, applies only to private persons, or others not falling within the provisions of section 1530. The provision in section 1530 for deducting the total amount of the indebtedness of a corporation or association from the value of its stock is unconstitutional, because resulting in inequality of taxation. But the invalidity of this provision does not render the remainder of the section invalid.

3. Certain irregularities of the county board and county auditor in increasing the assessed value of items 18 and 27 of personal property, and in extending it on the assessment rolls. Held, not to have prejudiced the defendants; it not appearing that, as thus increased, either item was overvalued. Gen St., 1894, sec. 1669, providing for the taxation of railroad companies by requiring them to pay a percentage on their gross earnings, does not apply to street railroads.

4. Held, that upon the facts the Duluth Street Railway Company is not a "railroad company," within the meaning of section 1669, Gen. St., 1894.—(State vs. Duluth G. & W. Co., et al., 78 N. W. Rep., 1032.)

MISSOURI.—Municipal Corporations—Jurisdiction of the Circuit Court—Use of Tracks—Compensation.

1. Under Const. art. 6, sec. 22, giving the Circuit Court Appellate jurisdiction from inferior tribunals as may be provided by law, and under the charter of St. Louis, the city may, by ordinance of its assembly, confer on the Circuit Court jurisdiction to review the award of commissioners appointed to fix the just compensation to be paid by one street railway company for the use of another's tracks.

2. Under the charter of St. Louis, which allows one street railway to use another's tracks on payment of a just compensation, and Ordinance No. 12,562, sec. 3, requiring the commissioners appointed to ascertain the just compensation to hear proofs as to such damages as they may deem just, where the company whose tracks are used did not have an exclusive franchise to use the street, but had agreed to permit any other road to use its tracks, it is not entitled, as part of the compensation, to loss of profits from competition of the other company.

3. Where a street railway company has abandoned its cable line, filled up its conduit, and is operating an electric line, the value of the road at the time another company seeks to use its tracks, and not the original cost of constructing the cable line, is the proper basis of the annual interest to be paid by the second company as part of the just compensation for use of the former's tracks.

4. Where one street railway company uses part of another's tracks, it should not be required, as part of the just compensation therefore, to pay any proportion of the latter company's special franchise tax, payment of half the annual property tax on the tracks used being sufficient.

5. Where one street railway company using another's tracks is required to make and maintain connections and pay switchmen, it is properly allowed to select and employ such switchmen.—(Grand Ave. Ry. Co. vs. Citizens Ry. Co., 50 S. W. Rep., 305.)

MISSOURI.—Municipal Corporations—Jurisdiction of Circuit Court—Use of Tracks.

1. Const. art. 12, sec. 20, prohibits the general assembly from granting the right to construct and operate a street railroad within a municipality without first acquiring the consent of the local authorities. The freeholders' charter of St. Louis, which, under Const. art. 9, sec. 25, is the organic law of the city, by article 10 gives the municipal assembly power by ordinance to determine all questions with regard to street railways, section 6 giving any such company the right to use another company's tracks on payment of just compensation, under such regulations as may be prescribed by ordinance. Ordinance No. 12,652 provides that such compensation shall be determined by commissioners, to be appointed in a manner prescribed. Const. art. 6, sec. 22, gives the Circuit Court appellate jurisdiction from inferior tribunals, as may be provided by law. Held, that the municipal assembly might by ordinance confer on the Circuit Court jurisdiction to review the award of the commissioners.

2. Under an ordinance regulating the use by one street railway company of another's tracks, which provides that the former shall construct and keep the connections with the latter's tracks, the former has the right to select and control the persons employed to handle the switches whose wages it is required to pay.—(Grand Ave. Ry. Co. vs. Lindell Ry. Co., 50 S. W. Rep., 302.)

MONTANA.—Duty to Operate—Ordinance—Mandamus—An ordinance granting a street railway company the right to construct and operate lines in certain streets, and providing that, if the company shall not construct and operate a certain portion of the line within a certain time, the right shall be forfeited, as to the parts where the failure occurs, does not impose on the company the duty to continue the operation of any portion of the line; and mandamus cannot issue to compel it to do so.—(State ex rel., Knight, et al., vs. Helena Power & Light Co., 56 Pac. Rep., 685.)

NEW JERSEY.—Constitutional Law—Judicial and Legislative Functions—Equity Jurisdiction—Injunction—Forfeiture of Franchise.

1. Though a township ordinance granting powers and franchises to a street railway corporation provides that the township may adjudge a breach of duties and obligations and declare a forfeiture, an ordinance passed pursuant thereto, declaring a forfeiture and decreeing a sale of the corporate property, is judicial in its character, and equity has the same power to intervene and modify the proceeding as it would have to interfere in a proceeding in a court of law.

2. When a judicial act is in any particular contrary to the principles of equity, the fact that there may be a remedy at law on other grounds is not generally a sufficient reason to prevent equity from interposing its appropriate remedy on grounds not available at law.

3. Where a street railway corporation has expended large sums of money and exercised due diligence in building and operating its road, so as to comply with an ordinance of permission, but unforseen circumstances have caused a delay, which has occasioned no pecuniary injury to the township or its inhabitants, equity will interfere to restrain the adoption of an ordinance by the township declaring a forfeiture of the franchise of the corporation because it did not comply with the statute of permission, which provided that cars should be running at a certain headway, on a continuous line of double track, within a specified time.—(North Jersey St. Ry. Co. vs. Inhabitants of Township of South Orange, 43 Atl. Rep., 53.)

NEW YORK.—Carriers—Fares—Where a person boards an open street car, and then, because of a sudden change in the weather, leaves such car, and takes passage in a closed one, attached to the other, he becomes a new passenger, and liable for another fare.—(Lasker vs. Third Ave. R. Co., 57 N. Y. Suppl., 395.)

NEW YORK.—New York City Court—Removal of Causes.

1. Under Greater New York Charter, sec. 1366, providing that a defendant may apply to the justice holding court in the district in which the action is brought for its removal to the City Court of New York, an action is not removable on application of one of several defendants.

2. Mandamus—Remedy by Appeal—Mandamus will not lie on refusal of district court to remove case to City Court of New York, the remedy being by appeal.—(People ex rel., Metropolitan St. Ry. Co. vs. Roesch, 57 N. Y. Suppl., 295.)

NEW YORK.—Municipal Corporations—Construction—The power conferred upon the city of Buffalo (Laws 1870, chap. 519, title 3, sec. 19) to permit railroads to cross streets is not independent of, and free from, the limitations imposed by the general railroad act (Laws 1850, chap. 140, sec. 28, subd. 5). The railroad act confers the right to occupy the highway, upon a consent being given, and the charter prescribed by what vote the permission of the city authorities shall be expressed; and the right, when thus acquired by a railroad company, can be exercised only in the proper way, and with a due regard to the public convenience.—(Delaware, L. & W. R. Co. vs. City of Buffalo, et al., 53 N. E. Rep., 533.)

NEW YORK.—Corporations—Action by Stockholder—Pleading—Sufficiency—Relief in Equity.

1. A complaint, in an action by a stockholder to set aside a lease of corporate property, alleging that the scheme of leasing was unlawful, and that the intent of the stockholders approving the lease was to defraud the others, and setting forth the method of accomplishing the fraud, without a motion by defendants to make it more explicit, is sufficient for the introduction of every fact showing an intention of the stockholders approving the lease to defraud the others.

2. Where a stockholder brings an action to set aside a lease executed by the corporation, it is not for his benefit alone, but for the corporation; and his complaint must allege that the corporation was applied to, and refused, to prosecute the suit.

3. A complaint, in an action by a stockholder to set aside a lease by the corporation, alleging that complainant demanded his share of the proceeds of operating the property under the lease;

that he notified the directors that the lease injured the stockholders, and demanded a distribution of the profits arising from the operation, without regard to the lease; and that such distribution involved such action of the directors as would annul the lease, is sufficient to authorize the stockholder to maintain the suit, the allegations not being equivalent to an averment that the corporation was applied to, and refused, to sue to set aside the lease.

4. Where directors of a corporation execute a fraudulent contract with a third party on the express approval of a required number of stockholders, and the scheme will result in serious injury to them or to the corporation, equity will set aside the fraudulent transaction, and compel the delinquent parties to account.—(Flynn vs. Brooklyn City R. Co. et al., 53 N. E. Rep., 520.)

NEW YORK.—Appeal—Review—Findings—Eminent Domain—Elevated Railroads—Damages to Abutting Property—Evidence.

1. If findings prove irreconcilable, it is the duty of the Appellate Court to accept those most favorable to appellant, as he is entitled to rely on them in aid of his exceptions.

2. When fee value of property abutting on a street through which an elevated railroad is operated has steadily declined since the construction of the road, while property on the abutting streets in the immediate neighborhood, with no railroad in front of it, has steadily advanced, and the rents from the property during the period when the road was being built decreased $5000, and, though there was some increase after the road was completed, they have never come to within $4000 of what they were before, while rents on the side streets have rapidly increased, in the absence of any explanation, the inference is that the presence and operation of the road has kept the value of the abutting property down.

3. On appeal from a judgment of the general term of the Court of Common Pleas of the city and county of New York, the unanimous affirmance by that court does not have the effect of a unanimous affirmance by an Appellate Division; and hence a finding made without evidence to sustain it is a ruling on a question of law, which, when duly excepted to, it is the duty of the Court of Appeals to review.

4. Evidence that a station has been located two blocks away from hotel property that it is claimed has been damaged by the construction and operation of an elevated railroad, in the absence of evidence that people in large or small numbers used the station, or that any more people passed by or patronized the property in question after the construction of the road and the building of the station than before, or that the station was of any special benefit to the property, will not justify a finding that the property has been materially benefited by the construction and operation of the road.—(Israel vs. Metropolitan El. Ry. Co. et al., 53 N. E. Rep., 517.)

OREGON.—Receivers—Claims—An order appointing a receiver for a street railroad in forclosure proceedings, and directing him to pay "all current expenses incident to the administration of his trust, and to the condition and operation of said business, from time to time, as the same arises and accrues," does not require the receiver to pay any debt not entitled to preference over the mortgage creditors, or such as accrued prior to his appointment.—(McCornack vs. Salem Consol. St. Ry. Co. et al., 56 Pac. Rep., 1022.)

PATENT DECISIONS.

1.—Patents—Invention — Electric Railways — After dynamic-electric machines and electric motors were invented, sufficiently powerful and economical to operate a stret railway, there was no invention in combining them with a track and cars by a plan or system previously well known, and which had been unsuccessful solely because the electric machines then in use were defective.

2.—Same—The only combination shown in the specifications of a patent for an electric railway was one in which the electricity is carried by one insulated rail and the wheels on it to the motor, and back by the wheels and the other rail. There was a suggestion that independent conductors might be used, but no suggestion as to how contact therewith was to be maintained by the moving car; and at that time there was no practical device for maintaining contact with an overhead wire. Held, that the patent could not be pieced out, by reference to the art, so as to include in the combination an overhead wire and contact device.

3.—Same—The Green patents, Nos. 465,407 and 465,432, for an electric railway and means of operating the same, if valid at all in view of the previous state of the art, are confined to a combination in which the electricity is carried to the motor by one insulated rail and the car wheels, and back through the other wheels and rail or the ground, and is not infringed by the overhead wire and trolley-contact system.—(Kelly et al. vs. Springfield Ry. Co. et al., 92 Federal Rep., 614.)

LIABILITY FOR NEGLIGENCE.

ILLINOIS.—Cable Cars—Carriers—Passengers—Standing on Platform—It is not contributory negligence, per se, for a passenger on a cable car to ride on the rear platform, where others do it without objection, and there is no rule against so doing.—(North Chicago St. R. Co., 53 N. E. Rep., 568.)

INDIANA.—Master and Servant—Injuries to Servant—Action—Complaint—Special Verdict—Assumption of Risk—Negligence—Proximate Cause—Ordinance.

1. Under a complaint by an employee of a street railway company, merely alleging that the injuries resulted from the negligence of the company in running its cars, the employee cannot prove that they resulted from the failure of the employer to provide a safe place to work, and safe machinery, or that the injuries were willful.

2. One employed by a street railway company to turn switches at the intersection of several lines was familiar with the surroundings, and there was room for him to stand safely between the tracks. Having turned a switch, a car passed him, immediately followed by another, drawn by horses, which were prancing about, and to avoid injury therefrom the employee stepped back toward the other track, and was struck by a car thereon, moving in an opposite direction at 8 or 10 miles an hour, contrary to an ordinance limiting the speed to 6 miles. Held, that the appearance of the horses was the proximate cause of the accident, and not the speed of the car which struck the employee.

3. One employed by a street railway company to turn switches at the intersection of several lines assumed the risk of accidents caused by the switching of the cars.

4. A special verdict that the place of the accident, which was a curve on a street railway track, was rendered unsafe by the sway of the car, was not a finding that the improper speed of the car caused it to sway.

5. Where it is sought to make an ordinance, entitled one to authorize the operation of certain passenger railways on the city's streets, applicable to a company operating nearly twenty years after its passage, it should be shown that such company was existing when the ordinance was passed, and was one of the railways therein designated.—(Thompson vs. Citizens' St. R. Co., 53 N. E. Rep., 462.)

KENTUCKY.—Carriers—Negligence as to Passenger on Street Car—When Relation Ceases—Speed of Car as Negligence—Omission of signals.

1. Either the rapid speed of a street car at a public crossing in a populous city in the evening, or the failure to give a signal of the approach of the car to the crossing, is negligence, as to a passenger attempting to cross the track after alighting from another car of the same company moving in the opposite direction on a parallel track.

2. A passenger upon alighting from a street car does not cease to be a passenger, but is entitled to protection against the negligent management of cars by the same company on a parallel track.

3. Defendant having elicited from plaintiff, on his cross-examination as a witness, the fact that he had served a term in the workhouse, it was not error to permit an explanation by the witness of the offense for which he was convicted.—(South Covington & C. St. Ry. Co. vs. Beatty, 50 S. W. Rep., 239.)

MICHIGAN.—Trial—Province of Jury—Contributory Negligence—Witnesses—Interest.

1. Where the evidence is open to a construction that renders it conflicting, it is not error to refuse to withdraw the case from the jury.

2. It is not negligence for a passenger to ride on the running board of a street car, where the car is full, and he cannot get inside.

3. Where a witness testified, on cross-examination, that he went to defendant to see about a settlement for plaintiff's injuries, it is not error to sustain an objection to a question whether witness had told defendant the amount for which he would settle; his interest already appearing from his testimony.—Pomaski vs. Grant, 78 N. W. Rep., 892.)

MINNESOTA.—Costs—Rights of Prevailing Party—Witness Fees.

1. Actions were brought by different plaintiffs, husband and wife, against the same defendant, to recover for injuries received in the same accident. By consent of all parties, the cases were tried together, separate verdicts being rendered. Plaintiff's wife had a verdict on which her costs and disbursements were taxed and allowed, judgment entered, and paid. In the other action the verdict was in defendant's favor. Held, that under the provisions of Gen. St., 1894, sec. 5498, the defendant, prevailing party in the action brought by the husband, was entitled to recover $10 statutory costs, therein prescribed.

2. Held, further, that under section 5500, Gen. St., 1894, defendant, prevailing party in the action brought by the husband, was also entitled to recover disbursements paid or incurred as fees for witnesses who were subpœnaed and attended in that action, although it was admitted that the witnesses were as necessary and material in one case as in the other, and would have been produced and sworn in both, had there been separate trials.

3. It is not error to allow fees for travel and attendance of witnesses, who are not sworn at the trial, where the attendance of such witnesses is regularly proved. And fees of witnesses actually in attendance, though not called to testify, are properly taxed, where, if a certain state of facts had been shown by the other party, his opponent would have been compelled to call such witnesses.—(Schuler vs. Minneapolis St. Ry. Co., 78 N. W. Rep., 881.)

MISSOURI.—Injuries to Passenger—Negligence—Pleading—Evidence—Province of Jury.

1. Rev. St., 1889, sec. 2074, requires that in construing a pleading to determine its effect its allegations shall be liberally construed with a view to substantial justice. A petition alleged that a passenger on a street car requested the conductor to let her off at a certain street; that, on reaching there, it appeared that the car was not going to stop, and the passenger again indicated to the conductor her wish to get off there; that immediately, as if in response to her request, the car slowed down, until its motion was scarcely perceptible, when she attempted to alight; and that while doing so the car started suddenly, and she was thrown down. Held, after verdict, that it did not charge that the passenger specifically requested to be let off at an unusual place, but it implied that the car was stopped at her request, and that the conductor saw, or should have seen, her alighting; so that it was unnecessary to allege that the car started before she had time to alight.

2. Several blocks before reaching a crossing, a passenger on a street car told the conductor to let her off there, and, seeing that the car was about to pass that point, she again signaled him to let her off, and he nodded to her. Immediately the car slowed down until the motion was scarcely perceptible, when she attempted to alight, taking hold of the railing, and, when one foot was on the ground, the car suddenly started, throwing her. The company claimed that the car slowed up where it did, as was usual, to enable the motorman to see if there were any cars on an intersecting line on the next street, but the testimony did not show that the passenger knew this, or knew that it was unlawful to stop in the middle of a block to discharge passengers. She knew it was customary for the conductor to ring the bell to stop, but testified that she did not know whether he rang it this time or not, and that she did not see him after she signaled. Held, that the case was properly left to the jury to determine whether the passenger was justified in alighting.

3. The passenger and several witnesses testified that they did not notice whether the conductor rang the bell, but all the witnesses except one, who was on the sidewalk, were on the rear car. One witness testified that the conductor placed his hand on the bell rope. Held, that the evidence raised the question whether the car was stopped to let the passenger off.

4. The last witness also testified that, after the passenger had fallen, the conductor asked witness if he had seen that. Held, that the evidence raised the question whether the conductor saw the passenger attempting to alight.

5. While a street car was crossing a street, a passenger signaled the conductor to stop, and the car slowed up, coming nearly to a standstill, between such street and the next one. The passenger attempted to alight, and was thrown by the sudden starting of the car. The company claimed that the car was slackened, as was customary, to enable the motorman to ascertain whether there were any cars on an intersecting line on the next street, and that the conductor understood the passenger's signal as one to stop at such street. Held, that a very high degree of care was required of the conductor in regard to the signal.—(Cobb vs. Lindell Ry. Co., 50 S. W. Rep., 310.)

NEW JERSEY.—Contributory Negligence—A boy, nine and one-half years of age, while playing in the street, ran in front of a trolley car which he saw approaching, and was struck by the further corner of the fender. Held, that there was no element of danger which he did not perceive or which a boy of his years was not capable of fully appreciating, and that, therefore, he took the risk of failing in the attempt which he designedly made.—(Brady vs. Consolidated Traction Co., 42 Atl. Rep., 1054.)

NEW JERSEY.—Negligence—Obstruction in Street—New Trial—Newly Discovered Evidence.

1. While a street car company has the right to place a pile of car track rails upon the street, temporarily, for its use in reconstructing or repairing its car track, yet it is bound to the duty to exercise reasonable care to guard the public using the street against the danger arising from the rails so placed upon the street, and in the night-time to place a guard or signal of warning to persons using the street; and this duty exists whether the pile of rails be placed in the gutter of the street or in some other portion thereof.

2. Where the plaintiff, in the night-time, had come from a house on the street, and was endeavoring to cross over the curb and street to board a street car, and in doing so stumbled and fell upon a pile of street car rails placed in the gutter or alongside the street over which he was crossing in order to take the car, the pile of rails extending a few inches above the curb, there being no signal of danger or guard placed there to warn the plaintiff of the existence of the pile of rails at that place, and the street lamps or lights being at some distance away up and down and across the street, and, under the evidence, it being a matter of fair controversy whether the rails could be seen by the plaintiff in the exercise of ordinary care in passing over the gutter or side of the street, a case is presented which calls, as matter of fact, for a determination by the jury whether the defendant company, which placed the pile of rails in the gutter, had exercised reasonable care to protect the plaintiff from the injury arising to him by reason of his fall, and also whether the plaintiff himself had exercised reasonable or ordinary care in passing over the street to reach the car.

3. Newly discovered evidence in behalf of the defendant, tending to show the existence of lights in the vicinity, as bearing upon the question of the negligence of the defendant and the contributory negligence of the plaintiff, in order to be considered on a rule to show cause why the verdict should not be set aside, must be such as is not merely cumulative, and such as could not have been produced at the trial by the exercise of ordinary diligence on the part of the defendant.—(Thomas vs. Consolidated Traction Co., 42 Atl. Rep., 1061.)

NEW JERSEY.—Collision With Vehicle—The driver of a vehicle upon a road used by the public at large, which crosses the track of an electric railway, must exercise reasonable care to avoid collision, and the same duty rests upon the motorman of a trolley car in approaching the crossing of such a road, whether the crossing is in the country or in a town; and, in case of accident, the question whether either or both of said parties failed in such duty is one to be determined by the jury, when the proofs on the subject of negligence leave that question in doubt. Neither party at such a crossing has a paramount right of way.—(Atlantic Coast Elec. R. Co. vs. Rennard & Wilson, 42 Atl. Rep., 1041.)

NEW YORK.—Personal Injuries—Complaint—Specificness.

1. A complaint in a personal injury case, alleging that the occurrence inflicted severe injuries on plaintiff from which he has not recovered and will not recover, and that by reason of the injuries he has been unable to follow his usual occupation or do any work, and that he has suffered great pain, is sufficiently specific to warrant evidence as to any effects of the injuries received, in the absence of a motion to make the complaint more definite or for a bill of particulars.

2. Appeal—Matters Not in Record—Where the record does not contain a bill of particulars, the Appellate Court cannot consider its alleged contents.

3. Trial—Examination of Witnesses by the Judge—The action of the trial judge, in practically conducting plaintiff's case by examining plaintiff and his witnesses while on the stand, as to points not yet touched on by the counsel, by asking them questions which would have been incompetent if asked by plaintiff's counsel, and which were leading and suggestive, warrants a reversal.—(Bolte vs. Third Ave. R. Co., 56 N. Y. Suppl., 1038.)

NEW YORK.—Injury to Pedestrian—Evidence—A verdict against a street railway company for injury to a child four years old, struck by a horse car, is properly set aside as against evidence, the proof being that the car was 73 ft. away when the child and her older sister were at the first rail of the track, and it being apparent that the jury failed to consider the gross improbability of the car proceeding that distance while they were walking only part of the distance across the track.—(Gordon vs. Second Ave. R. Co., 57 N. Y. Suppl., 298.)

NEW YORK.—Injury on Crossing—Question for Jury—A building at the intersection of a private driveway leading from a public resort, and a street railway, obstructed the view of an approaching car. The building was only a few feet from the track. Plaintiff, who was proceeding along the driveway at night, without listening for a car, went upon the crossing and was struck. The car was running at a high rate, and did not slacken its speed. No gong was sounded nor other signal given. At that time of the evening many people were accustomed to leave such resort by the driveway. Held, sufficient to justify a submission of the case to the jury.—(Duncan vs. Union Ry. Co. of N. Y. City, 57 N. Y. Suppl., 326.)

NEW YORK.—Accident to Passenger—Evidence—Testimony of plaintiff that, after defendant's car had stopped, she was alight-

ing from the rear platform, with her right hand on the rail of the dashboard, and one foot in the air, ready to step off, when the car started, throwing her "forward," is not necessarily untrue.—(Bosting vs. Brooklyn Heights R. Co., 57 N. Y. Suppl., 119.)

NEW YORK.—Collision—Contributory Negligence—One who, seeing an electric car only part of a block away, coming very fast on a down grade, starts to cross the track diagonally for a cross street, passing close to a pillar of an elevated railroad, against which he is driven by the car, is prevented by contributory negligence from recovering therefor.—(May vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 277.)

NEW YORK.—Collision—Contributory Negligence—Contributory negligence is a question for the jury, where the plaintiff, driving along a street, and coming first to the track on the avenue on which the up-bound street cars run, had to turn the heads of his horses slightly to avoid a collision with such a car, and then, getting on such track, saw a car half a block away coming down on the other track, and, the crossing being clear, proceeded at a fast walk, and was struck by such car after the horses and front wheels of his wagon had got over the second track.—(Reilly vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 278.)

NEW YORK.—Collision—Contributory Negligence—One who, seeing a cable car coming, half a block away, very fast—at the full speed of the cable—gets into his wagon, covered at the sides, and, without looking further, starts to cross the track, is prevented by contributory negligence from recovering for injuries received.—(Lang vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 249.)

NEW YORK.—Negligence—Sufficiency of Evidence.

1. In an action for negligence, where plaintiff's evidence is not corroborated, and a defense is made out by disinterested witnesses, a verdict for plaintiff is against the weight of the evidence.

2. Damages—Personal Injuries—Pleading—Evidence—In an action for personal injuries, evidence of bodily ills, not complained of in the pleadings, is inadmissible.—(Hess vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 222.)

OHIO.—Wrongful Death—Recovery Limited to Pecuniary Loss for Mental Suffering—Competency of Evidence—Injury to Railway Employee.

1. While, in the trial of a case for causing death by wrongful act, neglect, or default, under sections 6134, 6135, Rev. St., the recovery is limited to the pecuniary injury resulting from such death to the beneficiaries, and nothing can be allowed on account of bereavement, mental suffering, or punitive damages, yet any evidence which tends to show the amount of such pecuniary injuries sustained by such beneficiaries, or which tends to show that such beneficiaries received financial aid from the deceased during his lifetime, and that they would likely have continued to receive such aid had he lived, is competent; and for the purpose of showing that such beneficiaries needed, and would likely have received, such aid from the deceased, the circumstances, age, health and means of support of the beneficiary, if a parent or next of kin of the deceased, as well as the age, health, disposition and thrift of the deceased, may be shown.

2. Rules adopted by a street railway company for the government of its employees in operating such railway are competent evidence, when relevant, in the trial of a cause for damages for personal injury caused by the negligence of the servants of such company.—(Cincinnati St. Ry. Co. vs. Altemeier, 53 N. E. Rep., 300.)

Legal Book Notices

NEGLIGENCE CASES*

In the December number of the Journal we had occasion to review the excellent work of Mr. Hamilton, entitled "New York Negligence Cases, Classified." It gives us pleasure to note the prompt publication of the supplement to that work, which contains all the cases "classified according to the facts," for the year 1898. The supplement follows the plan of the original work, with this important and useful addition, that in each case the disposition of the case in the first instance (including the amount of the verdict, if for the plaintiff) and the decision on appeal has been added to the brief statement of facts.

Mr. Hamilton's preface contains the interesting information that of the cases reported, with opinions, in the last twelve volumes of the Appellate Reports of New York, over 18 per cent were negligence cases, and about 13 per cent of those in the last four volumes of the Court of Appeal Reports.

These, with the negligence cases, covering the same period in the Miscellaneous Reports (about 7 per cent of the cases there reported) contain over 350 opinions on Negligence Law.

VALUABLE COLLECTION OF ELECTRICAL CASES†

This important and compendious work in six volumes has just been issued from the press of Matthew Bender. We know of no single work which contains as much of value, at first hand, for use in the legal department of electric and street railway companies as this. It contains full reports of between 2000 and 3000 cases, covering a period of twenty-four years. These reports are annotated by the head notes of, and references to, other cases decided during the same period. At the end of each volume is an admirable index which greatly increases the value of the work and makes it a time saver. Of course, an index or digest covering all the volumes under a single alphabet would still further add to its value. The cases in each volume seem to be arranged as far as is practicable, under different subjects, and perhaps the easiest way to give an idea of the value and extent of the work is to indicate the subjects treated of in the last volume, which covers the years 1895 to 1897.

Some fifteen cases are devoted to the powers of municipal corporations over the use by electric companies of streets and highways; of the right of the municipalities to impose license fees, and generally of the rights of electric companies in the streets, excepting those cases which involve the rights of abutting property owners.

The next eight cases treat of the rights of abutting property owners. Then, two cases are reviewed under each of the following topics: Cutting trees; the rights of the telegraph along a steam railroad; the crossing of electrical and steam railroads, and the inference by different companies in the use of the same street.

The next six topics relate to various phases of the law of negligence, and there are from five to thirty-six cases reviewed under each subject: Injuries caused by electric shock, negligence in the use of electrical appliances, negligence causing injuries to employees, the duties of street railway companies to passengers, and the duties of street railway companies to travelers in the street.

Six cases are reported which deal with the taxation of telegraph and other electric companies and their property. One or two cases are devoted to each of the following subjects: The rights of municipalities to supply electric light, discrimination practiced by telephone companies as common carriers, the relation existing by contract and otherwise between the United States, the Union Pacific Railroad and Western Union Telegraph Company.

Finally, nineteen fully reported cases deal with the negligence of telegraph companies in sending and delivering messages. The valuable note to these cases contains head notes of some fifty-six additional cases upon the same subject.

Perhaps in no department of the law is a work of this sort so useful. Ordinarily, especially in the older States of the Union, the practitioner finds precedents at hand in his own library from the courts of his own State, and can quickly advise the officers of the legal department of the corporation for which he is counsel, either out of his own knowledge or from the bookshelves of his own library; but where he is dealing with the legal rules that have to be applied to so new an element of modern commerce as electricity, very many questions arise in the conduct of a company using it which require the application of old principles to an entirely novel state of facts. Precedents have to be looked for not only in the home State of the corporation, but outside of it. It frequently happens that a question has only been decided in one or two States and has not been passed upon by the local courts at all.

This set of volumes is the best work we know of to supply the obvious need which exists in the library, both of the counsel and of the legal department of the corporation who deal with electrical questions. The arrangement of the volumes in chronological order is especially to be commended in a work of this sort, where the law is growing from year to year. For example, the question as to whether it is negligence for a street car company to run electrical cars without fenders is a question which is necessarily much affected by the date of the accident or decision. In 1895 the Supreme Court of Massachusetts decided that in the year 1893, at which time there was but one electric road in Massachusetts using a fender, the absence of a fender was not negligence. Mullen vs. R. R., 6 Am. Electl. Cas., 492. Subsequent volumes of this series will undoubtedly show an advance upon this decision growing out of the general adoption of this safety appliance.

* Supplement to Hamilton's New York Negligence Cases, classified according to the facts, by T. F. Hamilton. Matthew Bender, Albany, N. Y., 1899.

† American Electrical Cases. A collection of all the important cases (excepting patent cases) in the State and Federal Courts from 1873 to 1897, on subjects relating to the telegraph, the telephone, electric light and power, electric railway and all other practical uses of electricity, with annotations. Edited by William W. Morrill. Matthew Bender. Albany, N. Y., 1897.

Electrical Exhibition at Madison Square Garden

The second annual electrical exhibition was held at Madison Square Garden, New York, from May 8 to June 3, under the auspices of the National Electric Light Association. The show was opened on the evening of May 8, at 8.30, by Senator Chauncey M. Depew, who was assisted by A. M. Young, president of the National Electric Light Association, C. O. Baker, Jr., and Marcus Nathan, of the Electrical Exhibition Company. Telegrams of congratulation were received from President McKinley and from Governor Roosevelt.

The exhibition aroused considerable interest and enthusiasm in matters electrical, not only among the trade, but also among the every-day citizens of Greater New York, and it was well attended each afternoon and evening.

The occasion was taken by a number of electrical and technical societies in the vicinity of New York to hold regular and special meetings at the Garden during the exhibition, and in addition to these the National Electric Light Association met in regular convention in the lecture room of the Garden from May 23 to 25, inclusive.

On the evening of May 13 the New York Electrical Society held its 198th meeting, and celebrated the centennial of the discovery of the electric battery by Volta with special exercises. The meeting was held in the concert hall, and was attended by four or five hundred persons, including representatives of several Italian societies.

SOME OF THE EXHIBITS

The main floor of the Garden was filled with well-arranged exhibits of the heavier machinery, apparatus, etc., employed in the generation and distribution of electricity and in allied industries, and in the gallery running around the entire building were placed the lighter exhibits, such as historical and experimental instruments and relics, wireless telegraphy apparatus, etc. Among the exhibits the following may be briefly mentioned:

An attractive display of electrical instruments was made by the Cutter Electrical & Manufacturing Company, of Philadelphia. This company had a three-sided booth, upon the walls of which were hung standard circuit breakers of various capacities, the new Q. & C. rheostat, etc., one of the walls being reserved for what the company calls its freaks, or instruments made to meet extraordinary conditions. A prominent feature of the exhibit was a 1000-amp. single-pole circuit breaker, with laminated contacts.

The Bullock Electric Manufacturing Company, of Cincinnati, Ohio, illustrated in a simple manner the development in the direct application of electric power for the driving of machine tools. The exhibit included four commercial machines, one 25-kw. engine-type generator, a 65-h.p. motor, a belted 10-h.p. motor running at 1050 r.p.m., and a 6-in. x 5-in. Forbes vertical engine direct connected to a 12-kw. dynamo arranged for the Bullock system of control. An artistic feature of this exhibit was a large revolving globe, around the circumference of which appeared the name of the company in incandescent lights.

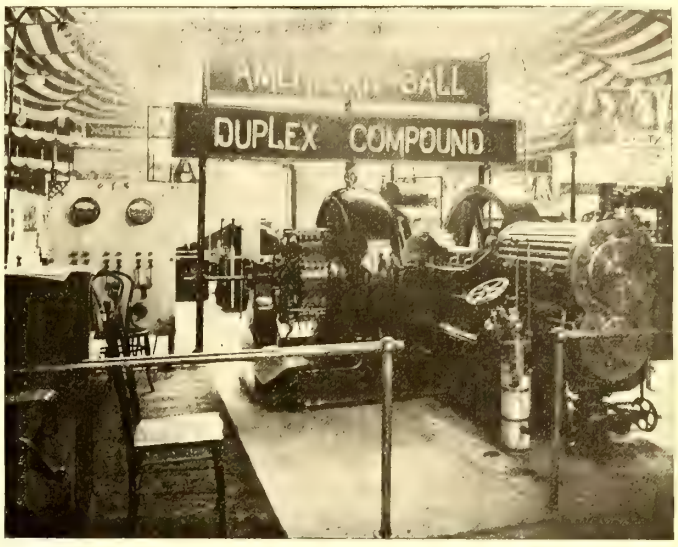
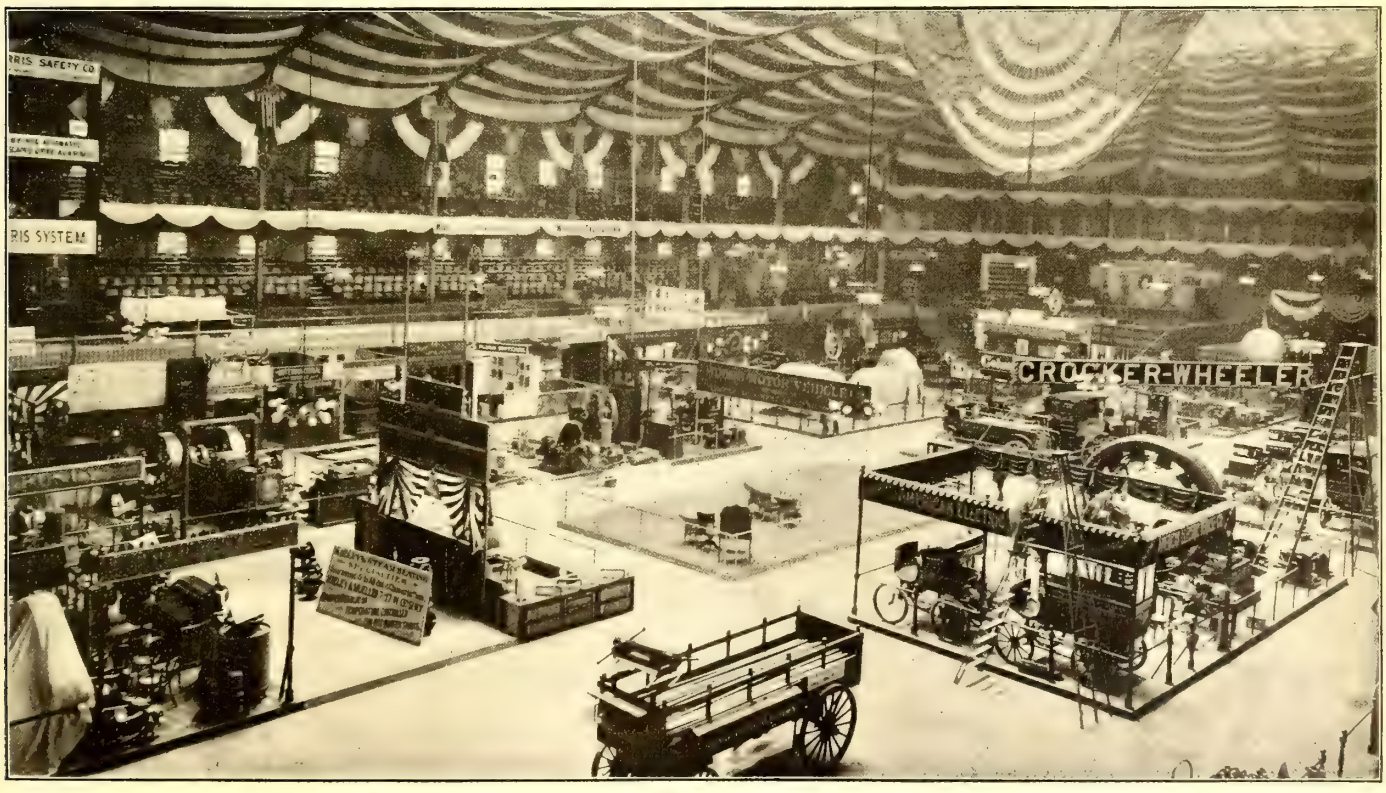


EXHIBIT OF THE AMERICAN ENGINE COMPANY

An exhibit of particular interest to central station managers was made by the Wagner Electric Manufacturing Company, of St. Louis. This comprised a 7½-h.p., 60-cycle, 110-volt, single-phase alternating current generator. The current was taken from the generator through a switchboard, upon which was mounted a number of direct current volt meters and ammeters and alternating current ammeters and volt meters, an indicating watt meter, and other instruments of the Wagner type. Samples of switches were also shown, these being of a new type just brought out by the company.

A time recorder for keeping the time of employees in large factories, street railway repair shops, and other establishments of like nature, was displayed by the Willard & Frick Manufacturing



GENERAL VIEW OF EXHIBITION HALL

Company, of Rochester, N. Y. This instrument does away with the necessity of a separate clerk for timekeeping, each employee making his own record. The system is of such a nature, however, as to prevent fraudulent records.

One of the most interesting features of the show, from a popular point of view, was the collection of automobiles, this being, it is stated, the largest number of electrically propelled vehicles ever brought together at one time. All sorts and conditions of carriages and wagons were shown, including buggies, hansoms, closed and open cabs, delivery wagons, stages, etc. Among the largest exhibits of automobiles were those made by the American Electric Vehicle Company, of Chicago; the Columbia Automobile Company, of Hartford; the Indiana Bicycle Company, of Indianapolis, and the Riker Electric Motor Company.

The American Vitrified Conduit Company showed samples of its multiple duct conduits, containing from two to sixteen ducts. This company in all its conduit work uses dowel pins for alignment in making joints, thus assuring a positive and true joint, and doing away with the necessity of using mandrils in laying the ducts. The company exhibited a subway system laid out in miniature, showing a manhole built of a new type of brick, with a special arch for the top, and covered with the McGregor noiseless manhole frame and cover, made by the McGregor Manufacturing Company, of New York.

The John A. Roebling's Sons Company, of Trenton, N. J., had a very complete display of samples of all its wire products, including bare copper wires, rubber and other insulated wires of all kinds, office and magnet wires, electric light wires, etc. A number of samples were also shown of cables which the Roebling Company has supplied, and which are of historical interest. Among these were sections of the last Commercial Cable. An object of particular interest to street railway men was the special splice of the large three-phase cable for the Metropolitan Street Railway Company, of New York. This cable is made up of three 0000 wires, and will be used for the transmission of high tension current over the company's system. The splice is quite compact, the only visible evidence of its existence being an enlargement about one foot long of the lead casing. Samples of Columbia and flexible rail bonds were also shown.

In one corner of the gallery was shown a device manufactured by the Evans Automatic Illuminating Car Sign Company, of Boston. This is a revolving sign designed to be placed on the front or side of a car, near the transom, and having open letters, through which the light from the interior of the car shows, doing away with the necessity of having extra lights for the sign.

An interesting and instructive exhibit was made by the Union Boiler Tube Cleaner Company, of Pittsburgh, Pa. This company gave practical illustrations of the methods employed in removing scale from the principle types of boilers with the cleaning device which it manufactures. The Union boiler tube cleaner was fully described in the Street Railway Journal for February, and the manufacturers state that it is coming into very extended use. With this apparatus tubes that have become nearly solid with the hardest kind of scale have been thoroughly cleaned and rendered equal to new in less than five minutes. The company showed in operation both the rigid cleaner for straight tubes and the flexible shafting for bent tubes.

The Joseph Dixon Crucible Company, of Jersey City, N. J., had a tasteful booth, in which were shown cases containing samples of graphite products for electricians and electrical industries, including resistance rods from 1 ohm to 1,000,000 ohms, graphite brushes, lubricants for dynamo and motor commutators, etc. The company was represented by John H. Baird, who distributed an acceptable little souvenir made of graphite. Extending the entire length of the booth was a changeable electric sign, which was one of the most attractive at the exhibition.

The H. B. Camp Company, of Aultman, Ohio, made a practical demonstration of the enormous strength of the vitrified clay conduit which it manufactures. It had on exhibition a 15-ft. span composed of sixteen ducts, built entirely without concrete or support of any kind except at the ends. This span had a breaking strain of 32,000 lbs. Various samples of the company's usual and special types of conduit were also shown.

A most tasteful and attractive booth was fitted up by the Safety Insulated Wire & Cable Company of New York. Here all visitors were made perfectly welcome, and something of the company's enormous business was explained to them. A number of samples of particularly interesting cables were shown, among them being sections of cable used in the Philippine Islands, Cuba and Porto Rico by the United States Government for submarine and land lines during the recent war with Spain; also sections of wire used by the telegraph and signal corps. It is a noteworthy fact that all the wire and cables purchased by the United States Government for installing the mine fields in New York, Boston and other harbors during the war were purchased from the New York Safety Insulated Wire & Cable Company, as was also the wire used in the United States Navy. A unique changing electric light sign completed the decorations of the booth.

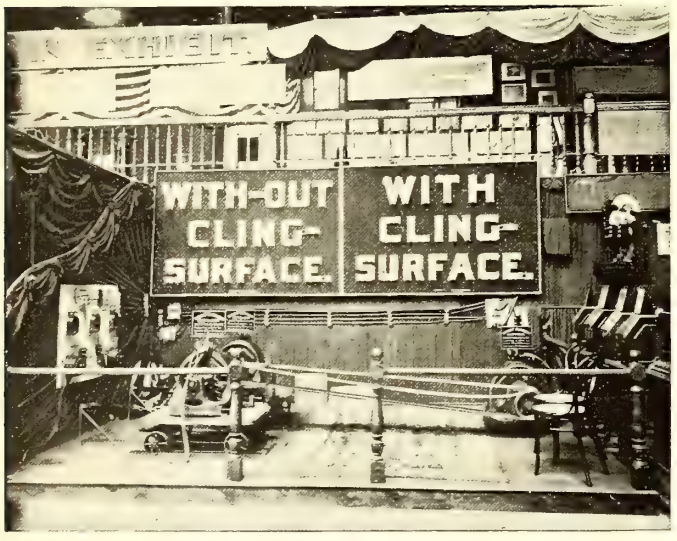


EXHIBIT OF CLING-SURFACE MANUFACTURING COMPANY

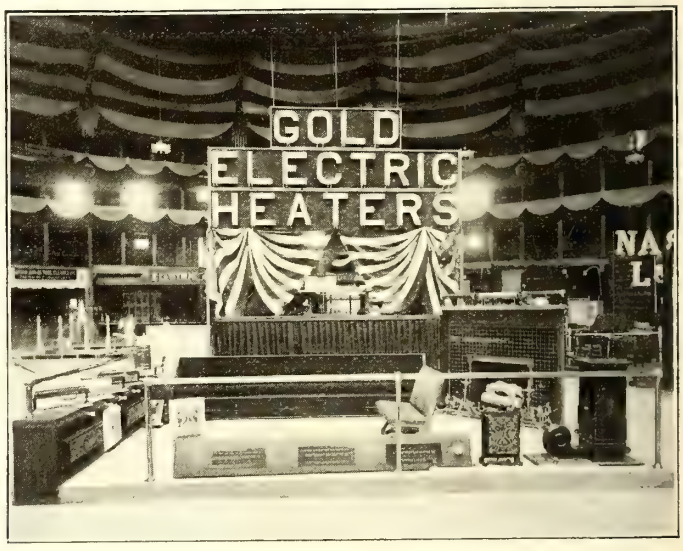


EXHIBIT OF GOLD CAR HEATING COMPANY

The Stirling Company, of Chicago, had on exhibition a full-sized 125-h.p. standard Stirling boiler, showing the details of its construction in the clearest possible manner. A number of strong points are urged in favor of this type of boiler, among them being the advantages in cleaning, as there are no tube caps to remove or replace, the dried steam delivered, and the absence of all injurious strains in the interior due to the alternate heating and cooling. This latter advantage is secured by leaving the lower drum, into which all the tubes enter, without rigid attachment, thus permitting considerable movement of the tubes and drums without strain. In a test of eight hours duration Stirling boilers have been forced 133 1/3 per cent above their rated capacity, and held there through the entire test, without injuring in the slightest degree any of the parts. In actual tests when forcing the boiler 50 per cent above rating the moisture of the steam does not exceed 1½ per cent.

An extremely effective demonstration was made by the Cling-Surface Manufacturing Company, of Buffalo, of the results obtained by the application of cling-surface to belting for the purpose of preventing slipping. The exhibit consisted of a direct current 7½-h.p., 110-volt Westinghouse motor running at 750 r.p.m., and driving, by means of two 4-in. belts on its one pulley, two 3¾-kw., 125-volt Westinghouse multipolar dynamos, each running at 1000 r.p.m. Thus the two dynamos being of the same capacity and deriving their power from the same source enabled a comparison of the performance of the two belts, which were of the same size and made from the same piece of leather. The tension on the belts was obtained by means of heavy spring scales pulling

at the back of the machines, both belts having a tension of 120 lbs. The belt treated with cling-surface was run slack, and, in fact, kept so that both sides touched without in any way affecting the output of the motors. The untreated belt had to be perfectly tight before it would do its work, and any tendency to slacken was immediately noticed by the diminishing of the output. The load on the machine consisted of a bank of lamps forming a sign. Tests were made to show there was no slip on the cling-surface belt, while on the other there was constant slippage. Albert B. Young, manager of the company, had charge of the exhibit.

A very complete line of electric heaters was shown by the Gold Street Car Heating Company, of New York and Chicago. These were the usual forms of the Gold heating appliances having a zigzag rod or support for the resistance coil. The application of the heaters to street cars was shown by a longitudinal car seat fitted with the latest design of the Gold three-degree panel type. This device is divided into three even sections, all of which are controlled by a three-point regulating switch, so that one-third, two-thirds or the full capacity of every heater may be had at any time, according to the outside temperature. The very even methods of graduating insures uniform and comfortable distribution of heat at all times. A Hale & Kilburn walk-over seat was also shown fitted with the Gold standard heater, the construction and connections of which are very simple. Over twenty other designs of electric heaters, using the Gold resistance coil and support, were shown, all suited to different purposes, some of them being designed for steamships, and others for house warming. A very popular feature of this display was the electric fireplace placed at one corner of the booth. This was very attractively arranged, and excited a great deal of interest among visitors. It is well adapted to the heating of country houses, clubs, city residences, etc., wherever electric current is available.

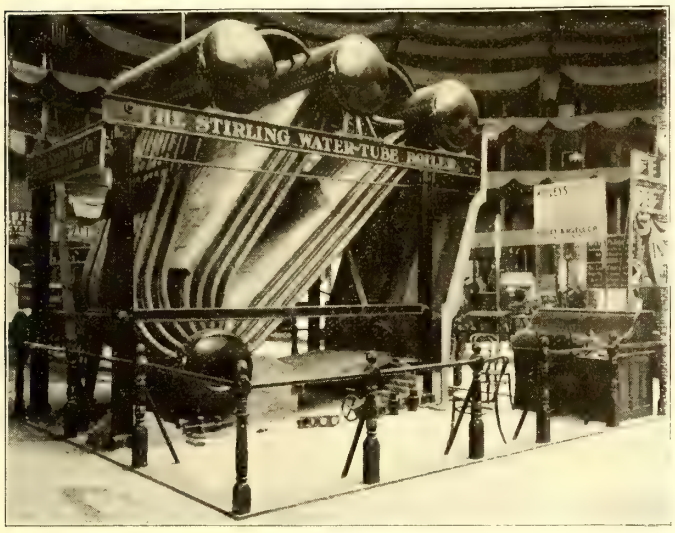


EXHIBIT OF STERLING COMPANY

The H. W. Johns Manufacturing Company of New York presented a novelty in the shape of a non-arcing inclosed fuse. This device is sold under the name of "Noark," and, it is claimed, entirely eliminates injury to electrical apparatus due to overloads or short circuits, at the same time making fires, often resulting from the arc caused by the blowing of the old types of fuses, entirely impossible. The invention consists of a strong inclosing casing filled with a special compound, which quickly and effectually interrupts any excess of current above the fuse's rated capacity. An important feature of the device is the indicator which tells the condition of the fuse at all times, so that there will never be any question as to whether the fuse has blown or not.

The Columbia Incandescent Lamp Company, St. Louis, exhibited a case showing lamp bulbs and filaments in different stages of manufacture. It also had an attractive sign fitted with Columbia lamps. The clear white light given from these lamps indicates the absence of gases in the interior to a remarkable degree. In connection with this exhibit the Bosert Electric Construction Company, of Utica, N. Y., showed samples of its terminal and switch boxes, porcelain cut-outs, porcelain lining and white enamel lining.

The D. & W. Fuse Company, Providence, R. I., had a number of its closed fuses for use with from 50 to 20,000 volts, also samples of its cut-out boxes for underground and overhead construction. This company is bringing out a new quick-make and quick-break switch, which was also shown.

An unusually complete exhibit of electric arc lamps was made by the Adams-Bagnall Electric Company, of Cleveland. Although the company had but a small booth, yet it utilized the space so well that a sample of about a dozen different types of lamps was shown. These included series inclosed, direct current arc lamps for 110 and 220 volts, series open arcs, alternating inclosed arcs, standard potential direct current inclosed arcs for 110 volts, and many others.

A new time recorder for use in factories and other large plants, street railway repair shops, etc., was shown by the Dey Patents Company, of Syracuse, N. Y.

The American Engine Company, Bound Brook, N. J., had in operation a 75-h.p. American Ball engine, directly connected to a 50-kw. generator. This engine attracted unusual attention on account of its smooth and easy running qualities, there being hardly any vibration perceptible even when standing very near the cylinder head. This is a new type of engine that the company is just bringing out, and for which unusual economy under small and varying loads is claimed. Its cylinders are 9½ ins. and 15 ins. x 11 ins. stroke. When running at 290 r.p.m. with 90 lbs. of steam, 25 lbs. of water per i.h.p. per hour are used. The engine is non-condensing.

A novelty in the way of a tower wagon was presented by the Columbia Automobile Company, of New York city. This wagon is operated by storage batteries, and was built for the Consolidated Traction Company, of Pittsburgh. The batteries are of sufficient capacity to carry the wagon 25 or 30 miles without recharging.



EXHIBIT OF BALL & WOOD COMPANY

The Ball & Wood Company of New York exhibited a new 300-h.p. engine with Corliss type valves and self-oiling device. The engine was run non-condensing at 250 r.p.m., with cylinders 16 ins. and 26 ins. x 16 ins. This engine, although carrying an extremely variable load, regulated to a remarkable degree, and many words of approbation were heard on all sides regarding its smooth operation.

The Fischer Foundry & Machine Company installed one of its 75-h.p. double-valve engines, running at 280 r.p.m. The company is making a specialty of this double-valve action, and now claims it can compete successfully with the Corliss type.

Sectional Steam Boilers

The New York Safety Steam Power Company, of New York city, the manufacturers of the Worthington water tube sectional steam boilers, is sending out a new catalogue in which are a number of interesting items on the construction and operation of sectional steam boilers.

Among the claims put forth in favor of this type are noticed the following: They are economical of valuable space, but at the same time are of liberal proportions in heating and grate surface; the furnace extends under the entire boiler and is of the proper height to permit the use of all kinds of fuel; the interior of the entire construction in every part and detail is readily accessible from the outside for examination, cleaning or repairs. Every tube used is lap-welded and of the best make, and each tube is straight; the heating surface and waterways are so arranged that the movement of the water contained in the boiler is constant and rapid.

The Peoria Electrolysis Case

Considerable advance was made last month in the trial before the United States Circuit Court in the case of the Peoria Water Works vs. Central Railway Company, which operates the electric railway system in Peoria. This case, it will be remembered, was brought by the water company against the railway company on account of alleged damages to its water pipes through electrolysis. The real complainant, it is said, is a large number of water companies who are interested in making this a test case. A number of electrical experts for the water company were examined last December and testified that the only remedy for electrolysis was the introduction of the double trolley system. The case of the railway company was not presented until last month, but in rebuttal of this testimony, the railway company presented the testimony of a large number of railway experts who testified that it was perfectly possible to eliminate all chances for electrolysis by good ground return, and that all reasonable precautions to accomplish this had been introduced by the defendant company. Among those who testified to this effect were Israel Lovett, of the Council Bluffs & Omaha Railway; Oscar Stiles, of the Omaha Street Railway; William Hand, of the General Electric Company, of St. Louis; J. C. Noe, of the General Electric Company, of Chicago; Edward M. Burch, of the Twin City Rapid Transit Company, of Minneapolis, and Albert B. Herrick, of New York.

Mr. Herrick, who was the chief witness for the defense, testified that he had made a thorough inspection of the railway system, had examined all the rail bonds and found only a very few defective joints, and that these were not at important points on the road. He had also made tests of the current returned to the station by the rails, and water pipes, and finding a large per cent passing by the water pipes, had made a further examination which disclosed the fact that the water company had placed a large number of its water gate boxes in very close proximity, and also in metallic contact to the rails of the electric railroad. These gate boxes were in metallic electrical connection with the rails and a very large current passed into the water pipe system, abundant to account for all the electrolytic action that was complained of. It was also brought out that these boxes had been placed in position by the water company and electrically connected to the rails after the tracks were placed in position, and that the location of the tracks and their position were made obligatory by the railway company by a city ordinance, but the location of the gate boxes was optional with the water company. Mr. Herrick also testified that from examinations he had made of lead service pipes used underneath the railroad track, and positive to the track near the power station, they permeated the earth between the rails and the track with lead sulphates which greatly reduced the earth's resistance, and this caused an influx of current to the paralleling water pipe system. Iron pipes are much better for this service as the oxide of iron has proved to act as an insulator to the pipe and does not afford a conductive medium in the path of current flow. He also testified that the amount of copper in the return circuit in the Peoria Railway was several times in excess of that in the positive trolley circuit, and that the connections of the negative feeder were made frequently and covered a large area. It was contended by the water company that the double trolley is the only way to relieve this electrolysis trouble and the Cincinnati example should receive general adoption by railroad systems.

Mr. Hand, of St. Louis; Mr. Noe, of Chicago, and Norman McD. Crawford, of Hartford, all testified in regard to their early experience of the double trolley which were not favorable to the imitation of Cincinnati's unique system.

Mr. Crawford's early experience made him abandon double trolley system and return to horses again, and all the evidence showed it to be a more expensive system to keep in repair. Mr. Lovett, of Council Bluffs, and Mr. Stiles, of the Omaha Street Railway, both testified as to having corrected all their troubles due to electrolysis by connecting the water pipes and rails together in affected districts.

Prof. Seaver, of Columbia College, brought out some very interesting facts regarding D. C. Jackson's early remarks in the electrolysis troubles, his lecture before the American Institute of Electrical Engineers taking exactly the same attitude as the experts for the railway company in the present case.

N. C. Draper, who was for three years electrical engineer for this property, gave in testimony all the conditions of the mechanical and electrical construction of the road, and due to his early efforts in bringing this road up to its present point of perfection regarding its negative circuits, the water company will have an extremely hard time in making any case on the grounds of wilful negligence or improper construction.

Judge Pinkney, who is conducting the case for the railroad company, has mastered the subject technically, and this, in connection with his well-known legal ability, makes the case extremely interesting from a technical point of view. The master also asked questions pertaining to the technical side of the subject, showing a technical knowledge very rarely found in court. This trial will be resumed on June 12, when the railway company will introduce further evidence in support of its case.

Meeting of the Southwestern Gas, Electric and Street Railway Association

The annual convention of this association was held in Austin, Tex., May 17 to May 19, and was a great success in every way. The attendance was large, the papers were valuable and interesting, and unusual enthusiasm was shown by all in attendance.

Among the papers presented was one by T. H. Stuart, of Waco, Tex., on "Summer Amusements for Street Railway Companies." In this treatise the author first reviewed the necessity of increasing the traffic on street railways in the South, and then gave a number of practical suggestions for the equipment and maintenance of pleasure parks. He laid particular stress upon the point that the first entertainment of the season given at any park should be a great success and well attended in order to start the enterprise aright. This is on the principle that people like to go wherever the crowd goes, and if the season can be opened with a large crowd in attendance the battle is more than half won. To this end great care should be exercised in selecting a first-class attraction for the opening, and in properly advertising it. The author points out the necessity of presenting nothing but perfectly respectable plays in order to induce women and children to visit the performances.

After suggesting the formation of a "theatrical circuit" of street railway companies, such as is now in operation in a number of places in the north, the writer touches upon the subject of an entrance fee, and the best way of getting revenue from the sale of privileges. He states that in his opinion visitors to the park that come by means other than the companies' cars should be charged the amount paid by those who use the street railway lines. The entrance to the theater, however, should be free, with a small charge for reserved seats. The writer concludes by stating that it has been the experience of the company with which he is connected that summer entertainments have been a source of considerable profit.

Other papers presented were: "The Item of Depreciation," by W. E. Hamilton, Shreveport, La.; "Meters," by W. E. Holmes, Austin, Tex.; "Transformers," by H. L. Monroe, Dallas, Tex.; "The Amount and Extent of Legitimate Investment in Electric Lighting Plants of Certain Capacities," by F. Fries, San Antonio, Tex.; "Art and Science of Selling Gas," by T. D. Miller, Dallas, Tex.; "A Model Plant Under Model Management; What Both Should Be Like," by J. F. Strickland, Waxahachie, Tex.

At the last day's session the following officers were elected for the next year: President, T. D. Miller, of Dallas; first vice-president, J. F. Strickland, of Waxahachie; second vice-president, C. A. Yeager, of Laredo; third vice-president, W. E. Hamilton, of Shreveport. The next meeting will be held at Waco.

A Visit to Schenectady

On Friday, May 26, the delegates to the convention of the National Electric Light Association, held in New York the last month, were the guests of the General Electric Company, who provided for them a most enjoyable trip to Schenectady. The visitors, who numbered about 170, traveled from New York upon a special train of eight palace cars, and reached Schenectady about noon, were guided about the works by the company's representatives.

Among the machinery which particularly interested the electric railway engineers of the party was a device for testing armatures, consisting of ingenius laminated horseshoe magnets. The poles of these magnets embraced an armature, and by means of an alternating winding in the magnet sets up an immense alternating field, which generates high e.m. f.'s in the windings and breaks down the insulation at any weak point. In another part of the works were seen two of the 990-kw. six-phase rotary converters for the Metropolitan Street Railway Company of New York, the first six-phase rotaries ever built; and in still another part four of the 100 gearless motors ordered for the Central London Underground Railroad. The armatures of these motors are mounted directly on the axles, with the wheels pressed on to either end, and present a peculiar appearance to eyes accustomed to geared machines. One of the 225-h.p. geared motors for the Paris-Orleans line was under test at the time of the visit. In the switchboard department were a large number of railway panels ready for shipment, some marked for cities in France.

Electric Locomotives in Practice and Tractive Resistance in Tunnels

An interesting and very extended paper on this subject was read May 4 by P. V. McMahon before the London Institution of Electrical Engineers, based on experiments and observations made by the writer on the locomotives and trains of the City & South London Railway. The extent of the paper forbids its reproduction in these columns in any comprehensive manner, but the following is an abridgement of the portion relating to tractive resistance:

Fig. 1 shows an outline of locomotive and train in the tunnel. The three locomotives used, Nos. 12, 15 and 17, were built to the same general design and over all dimensions, the only outward difference being in the shape of the cab, which in the case of 15 and 17 is bulged at the sides, instead of straight as in the case of No. 12.

LEADING DIMENSIONS

	Feet.	Inches.
Gage	4	8½
Over all height above rail level	8	5½
Over all length, buffer to buffer	14	0
Extreme width	6	10
Wheel base	6	0
Diameter of wheels	2	3
Width of tires	0	4¾

Each locomotive has two motors, the armatures of which are fixed directly on the axles. The motors are arranged in series, and the regulating gear consists of a reversing switch, which changes the armature connections, a simple rheostat switch in series with the motors, and a main break switch.

The remaining details are given in the following table, which makes comparison easier:

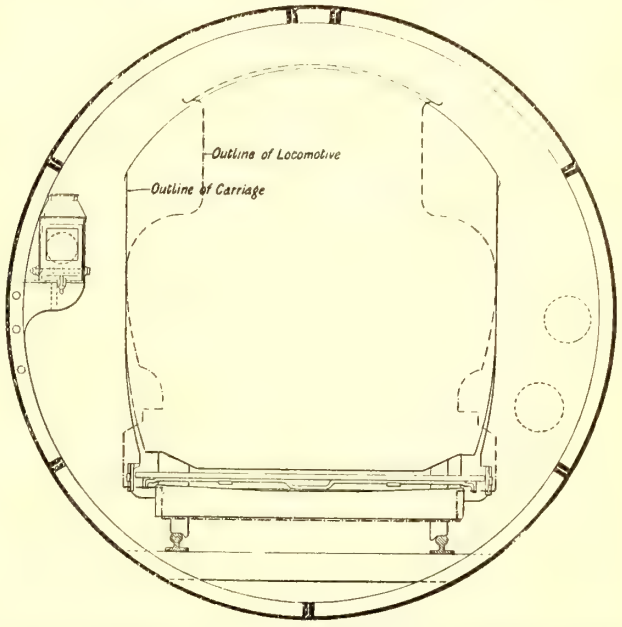


FIG. 1.—SECTION OF TUNNEL SHOWING OUTLINE OF LOCOMOTIVE AND CAR

	No 12 Locomotive.	No. 15 Locomotive.	No. 17 Locomotive.
Type of motor	2 pole Edison Hopkinson	2 pole Siemens.	2 pole Edison Hopkinson
Section of magnet	17" × 10"	24 × 10"	20" × 10"
Weight of magnets, complete with bearings	40 cwt.	53 cwt.	44 cwt.
Type of armature	Gramme Ring	Drum	Gramme Ring
Diameter of cone	17¼"	14⅜"	17½"
Length of cone	17"	24"	20"
Number of turns	540	500	540
Cross-section of conductor	No. 10 = .01286 sq. in.	.400 × .078 = .0312 sq. in.	No. 10 = .01286 sq. in.
Number of segments in commutator	54	125	54
Weight of arm with wheels complete	19 cwt. 3 qts.	21 cwt.	22 cwt.
Armature resistance	.3 ohm.	.181 ohm.	.315 ohm.
Total resistance of locomotive	.8 ohm.	.615 ohm.	.85 ohm.
Total weight of locomotive	10 tons 7 cwt.	13 tons 10 cwt.	11 tons 12 cwt.

Each train consists of three coaches coupled together, with intermediate platforms. The following are the

LEADING DIMENSIONS

	Feet.	Inches.
Gage	4	8½
Over all height above rail level	8	4¼
Over all width of body	6	10
Length of body over end framing	26	0
Centers of bogies	16	9
Wheel-base of bogies	5	0
Over all length of train (three coaches)	96	0
Diameter of wheels	2	0
Weight of empty train complete	21 tons, 2 cwt.	
Seating capacity	96 passengers	

Fig. 2 shows the result of a test made between Stockwell and the city, readings of the current, voltage, speed, and draw-bar pull being taken at five-second intervals. It will be noticed that the current at starting in this case is not over 100 amps., the current being kept low to avoid any jerk at starting, as it was not known at this stage what might happen to the diaphragm of the dynamometer. Although a value is given for the draw-bar pull at the first reading, the gage on the dynamometer did not show that any pull was being exerted for about one to two seconds after the current was switched on, showing that the locomotive takes an appreciable time to move. However, when the gage commenced to indicate, it gave varying values, the pointer sometimes going all over the scale with the current absolutely steady; by carefully watching the pointer during the interval it was possible to form a fairly accurate idea of the average pressure during each period. This jerking was most noticeable on down grades, as the pull of the locomotive seemed to be transmitted to the train by a series of jerks, the train and locomotive buffers alternately touching and separating. Upon an up grade the pull seemed to be more uniform, the buffers being nearly always apart. An inspection of Fig. 2 shows that the draw-bar pull curve follows the current pretty closely in shape, from which one might infer, that the dynamometer gave fairly accurate indications of what was going on between the locomotive and train. From the analysis of these curves the losses in the locomotive, and its draw-bar pull at starting and running were obtained, as well as the tractive force per ton of train hauled on the level, including air resistance.

LOCOMOTIVE LOSSES AND DRAW-BAR PULL AT STARTING

In order to arrive at the value of the draw-bar pull exerted by the locomotive on the level at starting, the starting periods at Kennington with 100 and 120 amps., and Elephant and Castle with the same currents, will be considered; these stations are chosen to avoid the errors (or uncertainties) introduced into the dynamometer readings by a quick down grade. In each of the four cases the values of the dynamometer reading, the tractive force due to gravity, and the tractive force due to acceleration were taken from the plotted curves, at five-second intervals, and reduced to the level at a constant speed. Thus at Kennington (curve Fig. 3) at five seconds after starting the draw-bar pull as shown by the dynamometer was 1075 lbs., the tractive force due to acceleration plus or minus gravity was 201 lbs., and as this force did not appear at the draw-bar, but was given out by the locomotive at the tread of the wheel, it must be added to the draw-bar pull, consequently the total tractive effort which should appear at the draw-bar at a constant speed on the level would be 1276 lbs. for a current of 105 amps. In the same manner at the tenth-second interval the draw-bar pull was 1075 lbs., the tractive force due to acceleration plus or minus gravity was 345 lbs., giving 1420 lbs at the draw-bar at a constant speed on the level for a current of 100 amps.; in the same way the tractive efforts at the draw-bar at the fifteenth and twentieth-second intervals were 1467 lbs., and 1596 lbs. for a current of 100 amps. To facilitate the analysis of these curves during the starting period, both as regards locomotive losses and tractive effort per ton of train at starting, the curves, Figs. 3 and 4 (from the Kennington and from the Oval curves) are plotted to a distance scale in Figs. 5, 6, 7 and 8. The value of gravity for half a coach on the level and half on the grade could then easily be allowed for. Plotting the values of speed and tractive force at the draw-bar at constant speeds on the level, we get two curves showing the tractive effort for 100 and 118 amps., at speeds of from 0 to 9 miles per hour. The value at 0 is taken from the static draw-bar pull. From these two curves it would seem as if the effective tractive force increased, or locomotive losses decreased, with the speed until the latter reached about 9 miles per hour.

LOCOMOTIVE LOSSES AND DRAW-BAR PULL WHEN RUNNING

To arrive at the draw-bar pull on the level exerted by the locomotive for speeds of 9 miles per hour and upwards, for various currents, the experimental runs between Stockwell and the Eleplant, and the Elephant and Stockwell, were analyzed as before

explained, but in this case the area of the speed, current, draw-bar pull, and the tractive force due to gravity and acceleration curves, Figs. 2, 3 and 4, were measured, and from these the average values were obtained as follows: Between Stockwell and the Oval the average draw-bar pull was 268 lbs. for an average current of 36.8 amps. at an average speed of 18.4 miles per hour (during the running period). The average tractive force due to acceleration, plus or minus gravity, was 8.36 lbs., leaving 259.7 lbs. as the tractive force at the draw-bar of the locomotive on the level at a constant speed. From the Prony brake test the tractive force at the tread of the wheel for a current of 36.8 amps. was 340 lbs., leaving 80 lbs. as the locomotive losses, in which are included journal and rail friction, and air resistance. Plotting the tractive force and current from these and other tests, the curve approximates a straight line with a fair amount of accuracy. From this curve it appears as if the locomotive losses increased with the current. This increase must be due to journal or rail friction, as the air resistance is certainly greater at a high than at a low speed, and the smaller current corresponds to a higher speed. There does not seem to be any definite relation between the locomotive losses and the speed as in the case of starting from rest.

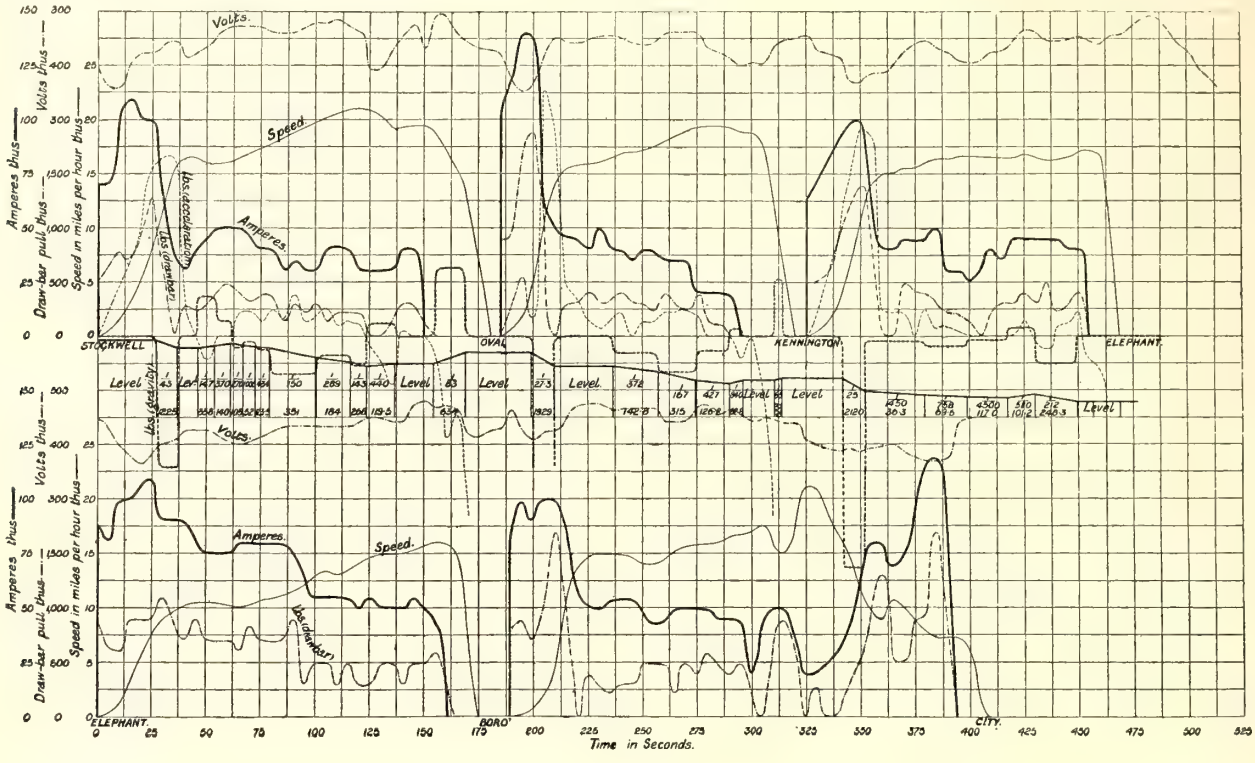


FIG. 2

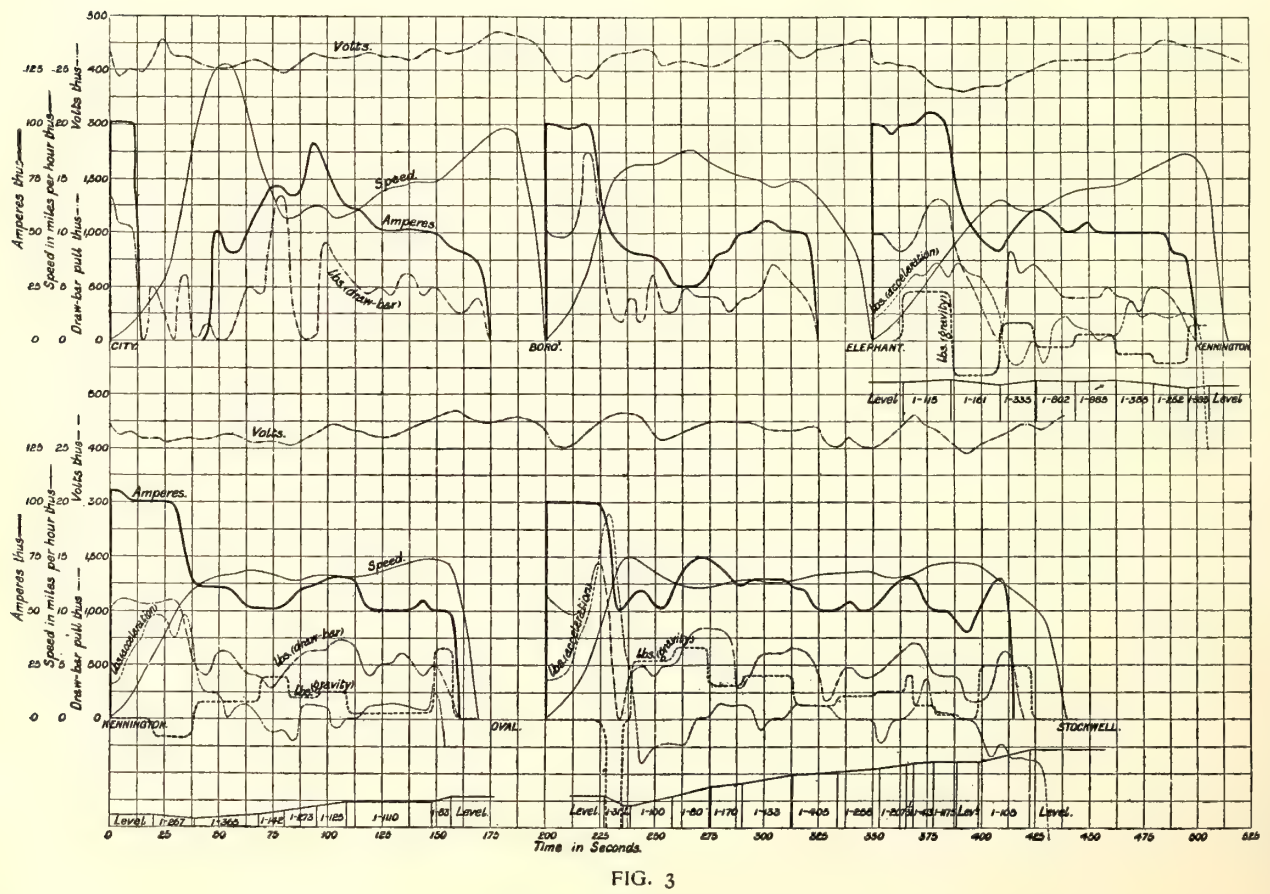


FIG. 3

TRACTIVE RESISTANCE PER TON OF TRAIN

From Figs. 2, 3 and 4, the tractive resistance per ton of train, in-

cluding air resistance, was also arrived at. In arriving at the tractive force per ton at starting, it was necessary to consider the length of the train in passing from one gradient to another, and this was allowed for in the following manner: The speed, draw-bar pull and tractive force due to acceleration were plotted to a distance basis from the calculated distance traveled; the gradient was then plotted and the position of each coach on the gradient (up or down) determined at each interval; the tractive force due to gravity was then obtained and plotted, and so on until a speed of about 10 miles an hour was reached. This is seen more easily by reference to Figs. 5, 6, 7 and 8. Here it may not be out of place to consider in detail what takes place in a starting period, say from Elephant and

The tractive force in lbs. per ton on a level is plotted in Fig. 9, and gives the first part of the curve shown there. The points of this curve above 9 miles per hour are the average values obtained from the running periods between Stockwell and the Elephant and Castle up and down roads, and are arrived at from the dynamometer observation curves, Figs. 2, 3 and 4, in a manner similar to that explained above.

The tractive force per ton in the case of the two-coach train came out rather higher, being 21.1 lbs. per ton for an average speed of 16.5 miles per hour. This slight increase may be due to both trains having the same area of cross-section exposed to the air, while the total weight in the second case is less than in the

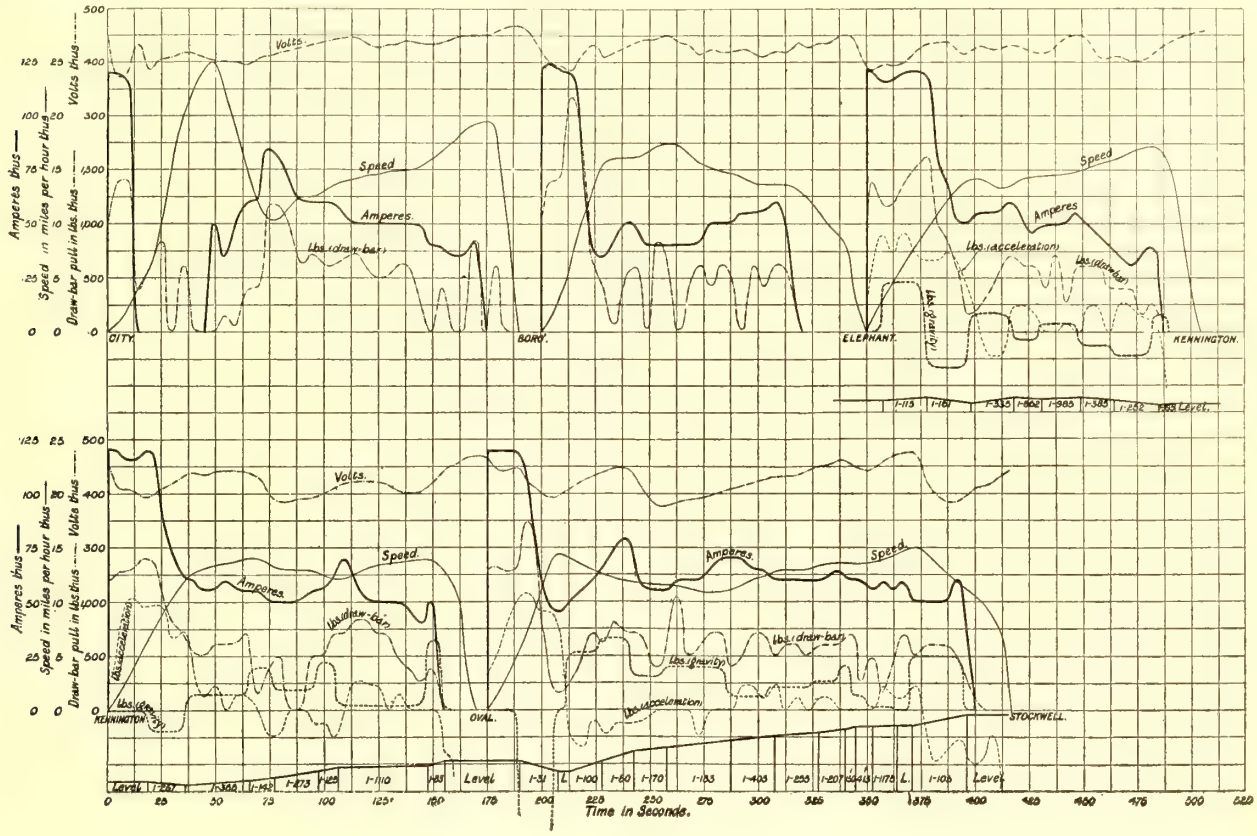
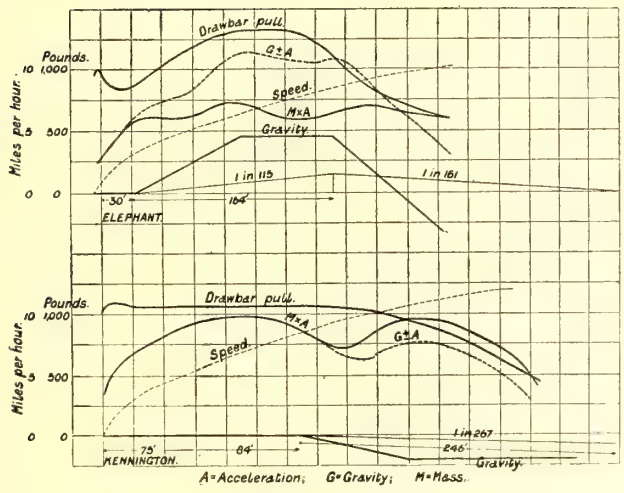
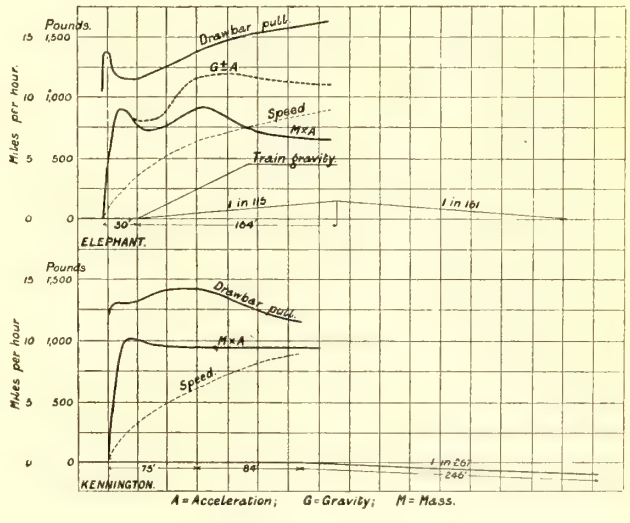


FIG. 4



FIGS. 5 AND 6



FIGS. 7 AND 8

Castle, Fig. 5. At the moment of starting the front end of the train was on the level, and 30 ft. from an up gradient of 1 in 115. After traveling about 60 ft., one coach was completely on the incline; in this position the effect of gravity was 152 lbs.; when another 30 ft. had been passed over, two coaches were on the incline, and the value of gravity was 304 lbs. When the whole train was on the incline the gravity curve ceased to rise and ran parallel to the base until the down grade of 1 in 161 was reached by the first coach. The down gradient was analyzed in a similar manner, and from the result the corresponding part of the gravity curve was plotted.

first. Again, the skin resistance should be less in the second case on account of the train being shorter. In the third experiment the current was shut off earlier, and thus the speed was maintained almost constant until it was switched on again; the resistance per ton in this case came out at 11 lbs. for an average speed of 15.86 miles per hour.

EFFECT OF CURVES

To arrive at the additional resistance offered by the curves on the line, the observations from which the tractive force per ton was obtained were further analyzed in the following manner: The

position of the curve in the section being known, the exact time when the train was passing over the curve was found as already explained, for the gradient, the draw-bar pull, tractive effort due to gravity and acceleration were taken from the respective plottings for the particular section, and in this manner the total tractive effort per ton on the level at a constant speed was obtained; deducting from this the tractive resistance per ton already found at that particular speed, the result gave the additional resistance due to the curve. Although there are several sharp curves their length is small and it was difficult to get accurate results, as in some cases the length of curve was not greater than that of the locomotive and train. The most consistent results were obtained on the curves between the Borough and Elephant stations, and between the Elephant and Kennington stations. The first curve has a radius of 390 ft., and the average of three sets of observations gave 27.9 lbs. per ton at 16.5 miles per hour, the tractive force per ton on the straight and level road being 12.75, leaving 15.15 lbs. per ton due to the curve alone. The next curve has 540 feet radius, and the

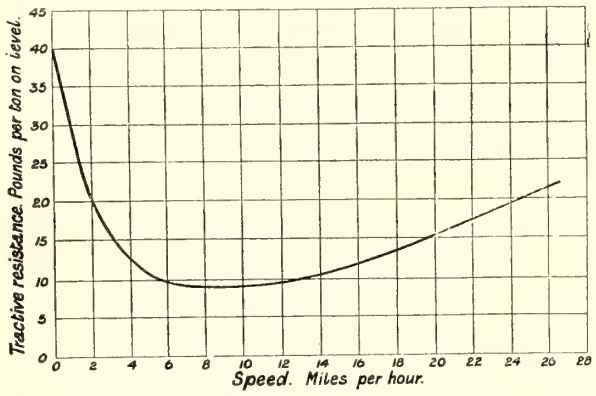


FIG. 9.—CURVE SHOWING TRACTIVE RESISTANCE PER TON AT VARIOUS SPEEDS

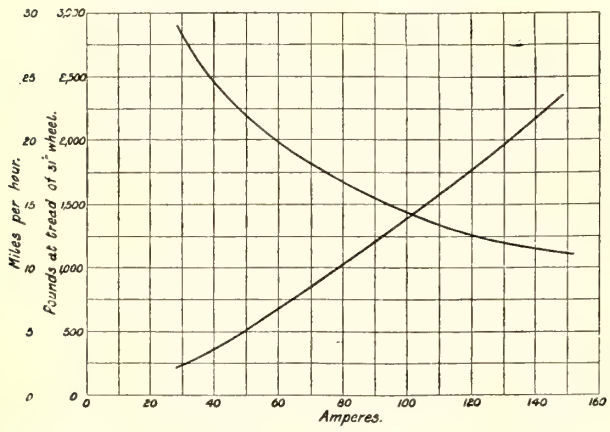


FIG. 11.—CHARACTERISTIC CURVES—NO. 19 LOCOMOTIVE

average of six sets of observations gave 22.6 lbs. per ton, at 13.5 miles per hour, that on the level straight road being 11.3 lbs., leaving 11.3 lbs. due to the curve.

It is, perhaps, worth mentioning that there is a guard-rail on each of these curves, which, although in good condition and very smooth, no doubt adds to the resistance.

ACCELERATION

After an extended consideration of electric locomotive design, the writer takes up the question of acceleration and speed. On this he says:

From practice it appears that to run a level section 2700 ft. long, 130 seconds is a convenient time to meet ordinary traffic requirements. Given this basis, the lowest speed at which it is possible to run the section is 14.25 miles per hour, assuming infinitely quick positive and negative acceleration; or, in other words, entering the section at full speed and running through without stopping. This is, of course, an impossible condition, but the nearest approach to it is to get up to full speed in the shortest possible time, and to stop in the same manner. It has been shown that a negative acceleration of 1.46 ft. per second per second, corresponding to stopping in twenty seconds from a speed of 20 miles per hour, does not cause discomfort to the passengers and is not too hard on the brakes and wheels. In practice we sometimes get an acceleration of 2 ft. per second per second or more, but 1.46 ft. per second will be taken as the maximum in this investigation.

If for practical reasons it is not desirable to adopt a higher negative acceleration than 1.46 ft. per second per second in bringing the train to rest, there is clearly no need to try and get a higher positive acceleration at starting. Adopting this acceleration for starting and stopping, we find that the speed at which the locomotive and train must run, after the acceleration is attained is 16.25 miles per hour. This is made clear by Fig. 10. Here the ordinates represent the speed in miles per hour, and the abscissæ the time in seconds. A series of speed curves can be obtained which will enclose the same area, and consequently any curve of this series will enable the run to be accomplished in the specified time. Stopping from 20 miles per hour in twenty seconds was adopted as the negative acceleration in all cases, and positive accelerations of 1.46, .974, .73, .584, .487, and .417 ft. per second per second were also adopted, corresponding to starting from rest and attaining speeds of 20 miles per hour in 20, 30, 40, 50, 60, and 70 seconds, respectively. A line was drawn parallel to the abscissæ from each of the above acceleration lines (if they may be so called), enclosing the same area in each case; this gave the speed at which the train must run, after attaining its acceleration, until the brakes are applied.

With a uniform acceleration of 1.46 ft. per second per second during the starting period, we see from Fig. 10 that the speed during the running was 16.25 miles per hour until the brakes are applied. The next speed curve, with its acceleration of .974 ft. per second per second during the starting period, requires a speed of

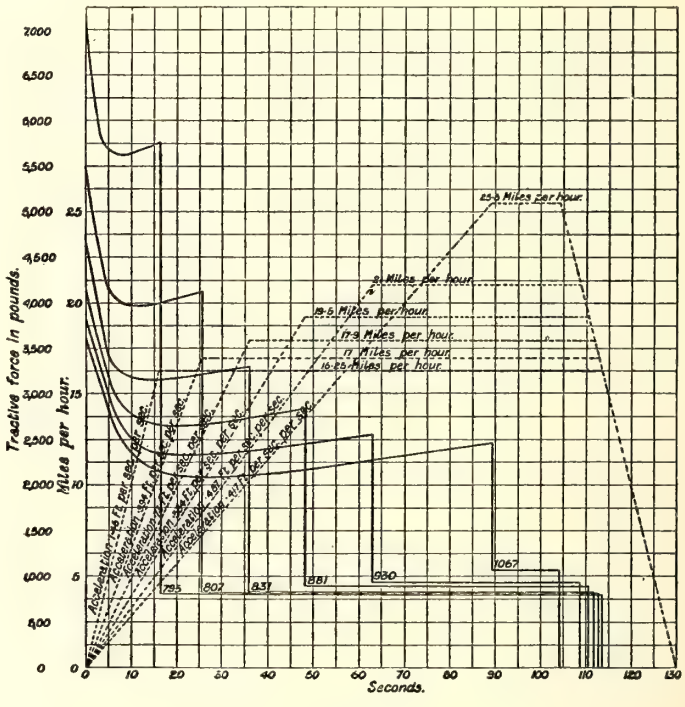


FIG. 10.—DIAGRAM OF ACCELERATIONS AND TRACTIVE FORCES

17.0 miles per hour during the running period. For accelerations of .73, .594, .487, and .471 ft. per second per second, during the starting periods, the respective speeds during the running periods, and until the brakes are applied, are 17.9, 19.5, 21.0, and 25.5 miles per hour. It is evident from this that the more quickly the train attains full speed, the slower the running speed will be. And as will be seen from a study of the tractive force curves, corresponding to the various speed curves, the slower the running speed, the lower the kinetic energy stored up at starting, and taken out again by the brakes in stopping.

Turning now to the tractive force required to obtain the various conditions laid down above, we see (Fig. 10) that to give the train and locomotive an acceleration of 1.46 ft. per second per second, a force of 4915 lbs. is required, and this must be kept up for 16.3 seconds until a speed of 16.25 miles per hour is attained. To this must be added the tractive resistance taken from Fig. 9 at every interval, as already explained. The total tractive force, then, exerted by the motors at the moment of starting is 7125 lbs., dropping to 6250 lbs. at 2 miles per hour, 5750 lbs. at 4, 5650 lbs. at 6, and 5625 lbs. at 8 miles per hour; it now commences to rise again, and is 5650 lbs. at 10 miles per hour, 5700 lbs. at 12, 5725 lbs. at 14, and 5750 lbs. at 16 miles per hour; when 16.25 miles per hour is reached, it drops to 795 lbs., this being the tractive force necessary for running at that speed.

The remaining five tractive force curves were arrived at in a similar manner, and need no further explanation. Returning for

a moment to the tractive force curve for an acceleration of 1.46 ft. per second per second, we see that 4975 lbs., acting for 16.3 seconds, that is 81,100 pound-seconds, were required for acceleration, and if this number is multiplied by the feet passed through in the

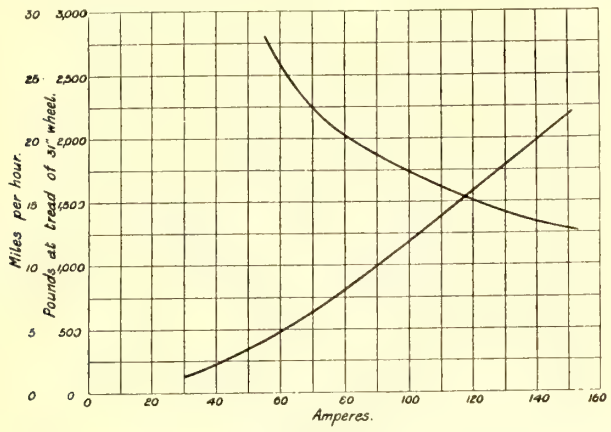


FIG. 12.—CHARACTERISTIC CURVES—NO. 20 LOCOMOTIVE

specified time, the result is foot-pound-seconds. It is, however, more convenient for present purposes to speak of pound-seconds or the area enclosed by the tractive force curve. When the tractive resistance is added to the above, the pound-seconds for the starting period are 95,220, and the running period requires 77,400 pound-seconds, making a total of 172,620 pound-seconds for the run.

The table in the next column gives the results of the six sets, and is self-explanatory.

This table shows the enormous advantage to be gained by adopting the highest acceleration compatible with the practical details of motor design. It fortunately happens, however, that we have a fairly large choice without increasing by more than 6 per cent the total energy drawn from the source of supply. In designing a locomotive, it is not of very great importance, or at least it will not affect the final result to any great extent, if the sharp peak of the tractive force curve at the moment of starting is averaged over the whole period of starting. This will reduce the size of the motors and the tractive force that they must give out during the first few seconds, and will prevent the speed curve from rising in a perfectly straight line as shown. Thus in the case of tractive force curve for an acceleration of 1.46 ft. per second per second, the tractive force instead of being 7125 lbs. at the moment of starting,

Seconds to Attain 20 Miles per Hour.	Acceleration in Feet per Sec. per Sec.	Lbs., Secs. for Acceleration Only.	Lbs., Secs. for Acceleration and Tractive Resistance.	Difference Due to Tractive Resistance.	Lbs., Secs. for Running Period.	Total lbs., Secs. for 2,700 Ft. Run.	Percentage Increase Due to Acceleration.	Percentage Increase in Total lbs., Secs.
20	1.46	81,100	95,220	14,120	77,400	172,620	Stand'd	Stand'd
30	.974	84,600	106,350	21,750	70,600	176,950	4.32	2.51
40	.730	89,400	119,540	30,140	63,150	182,690	10 24	5.84
50	.584	95,600	136,140	49,540	55,200	191,340	17.87	10.86
60	.487	104,600	158,870	54,210	42,650	201,460	29.0	16.7
70	.417	126,800	204,300	77,500	16,070	220,370	56.4	27.65

may be reduced to an average of 5839 lbs. over the starting period.

Fig 10 and the table of results show the way in which to apply the tractive force to obtain economical working.

Since the completion of the portion of the paper given above, some two and one-half years ago, three new locomotives have been

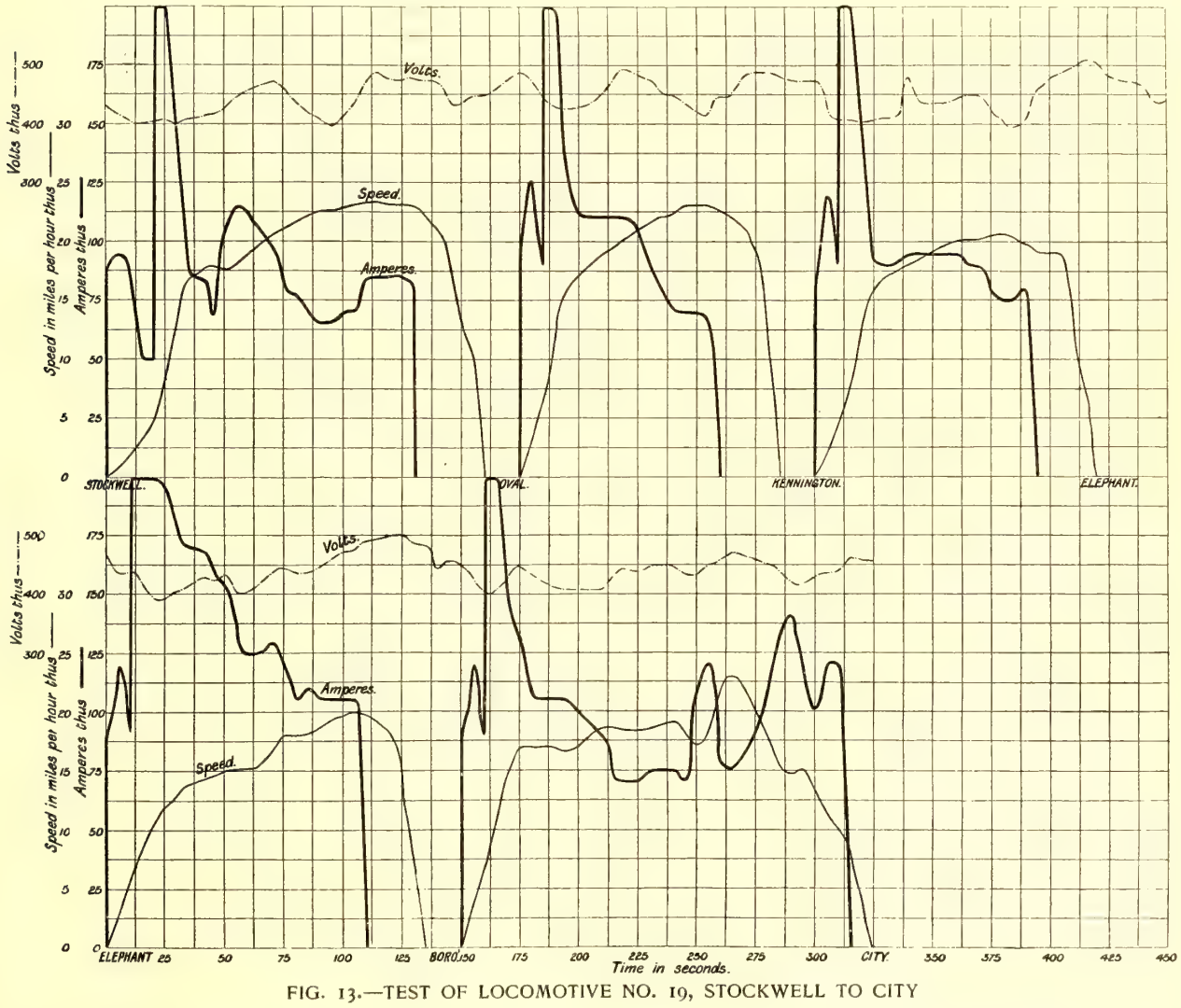


FIG. 13.—TEST OF LOCOMOTIVE NO. 19, STOCKWELL TO CITY

added to the rolling stock of the City & South London Railway, and twelve more are now in course of construction.

DESCRIPTION AND TESTS OF LOCOMOTIVES

Locomotives 19 and 20.—In view of the heavier trains, etc., it was decided to build more powerful locomotives. The size of the locomotive cab was practically limited to the same over all

dimensions as the old locomotives on account of local conditions, and it was therefore necessary to get larger motors into a cab of the same size. In the old locomotives the magnets are very close to the working conductor, and to get more clearance a wheel 31 ins. in diameter was adopted instead of a 27 in. wheel. This also allowed an armature of larger diameter to be used. Each locomotive is fitted with two motors of the four-pole type, the armatures having slotted cores and drum winding. The series-parallel method of control is adopted and, in addition to storage reservoirs for compressed air for the Westinghouse brake, independent electrical air-compressors are used. The weight of the locomotive complete is about 12¼ tons.

The characteristic curves of the motors of locomotives Nos. 19 and 20 are given in Figs. 11 and 12, from which it will be seen that the tractive force per ampere is considerably higher than in the case of the old locomotives. A "performance diagram" for locomotive No. 19, between Stockwell and city, is given in Fig. 13. This test was made with a three-coach train, and as the locomotive

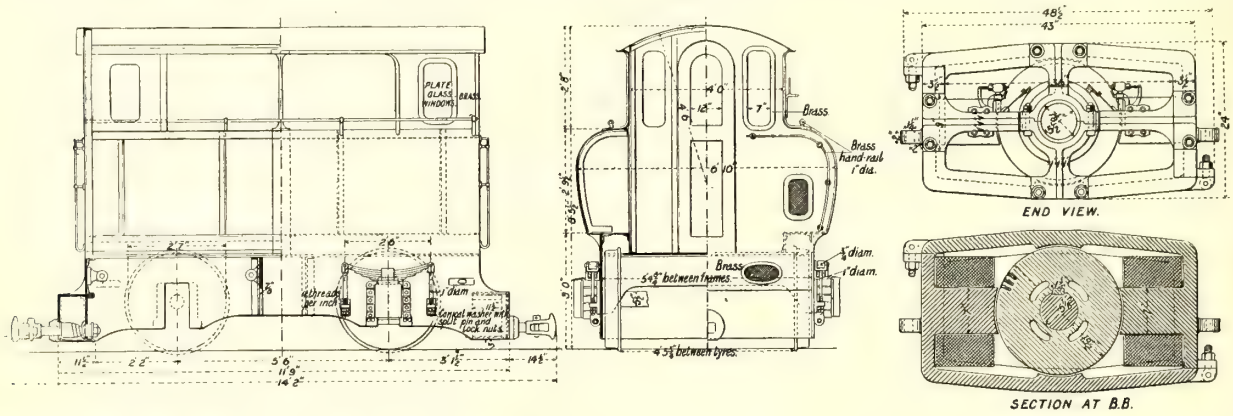


FIG. 14.—SIDE AND END ELEVATION OF LOCOMOTIVE NO. 21

was designed for a four-coach train service, it was not working under most economical conditions. The results of the tests with these locomotives, together with the previous tests of Nos. 3 and 12 locomotives, are given in the following table in kw.-hours per "ton-mile." It will be noticed that while the energy per ton-mile is practically constant, there is an increase in the average speed:

No. of Locomotive.	Kilowatt-hour per Ton-Mile.	Average Speed in Miles per Hour.
12	.0515	13.62
3	.0558	15.60
19	.0552	15.86
20	.0552	16.65

No. 20 locomotive gives the highest average speed, and it may be mentioned here that when this locomotive was ordered the author was in a better position to specify the requirements than when the order for No. 19 locomotive was placed. The latter locomotive was nearing completion before the former was required, and when the plans of No. 19 were prepared, the author had not gone so far into the question of locomotive design.

Locomotive No. 21.—The design and details of this and the remaining eleven locomotives were based upon the result of the tests and deductions already mentioned.

The general appearance and leading dimensions of the cab are given in Fig. 14, from which it will be seen that the wheels are 31 ins. in diameter, and the wheel base is 5 ft. 6 ins. The motors are so arranged that the floor of the cab is level, and the driver has considerably more room than in the old locomotives. The steel cylinders forming the air reservoirs are arranged one on each side of the cab, and have a total capacity of 18 cu. ft. Under the reservoir on one side are fitted the Westinghouse brake cylinder and brake gear connected therewith, and the electrically driven air compressor; while on the other side, the switchboard containing the series-parallel controller, reversing switch, motor cut-out, and main switches and fuse are placed; the regulating resistances are fitted directly under the air reservoir on this side, close to the controlling arrangements. The drawing, Fig. 15, gives the general arrangement and details of the motor, which is of the four-pole type, with the field magnet coils on the horizontal poles. The magnet is split across the diagonal corners, and the brackets carrying the motor bearings are divided in halves, so that each part of the magnet carries its bracket with it when the halves are separated to get the armature out. The armature is drum wound with the conductors in slots. The characteristic curves of the motor are given in Fig. 16. A description of the controlling arrangement and connections is added below. The weight of the locomotive complete is about 12¼ tons.

A "performance diagram" of this locomotive hauling a four-coach train is given in Fig. 17, from which it will be seen that the time taken to run a level section 2700 ft. long is 130 seconds, the current being shut off 74 seconds after starting, the locomotive coasting for 41.5 seconds, and the brakes being then applied. The watt-hour consumption for the section is 1360. If the current is kept on until the brakes are applied the section can be run in 122 seconds, the watt-hours being 1650.

METHOD OF CONTROL

In electric traction with separate locomotives there are conditions slightly different from those where motor cars are used. In coupling up the locomotive to the train the driver cannot always stop in the exact position to enable the coupling to be attached; and it is often necessary to move the locomotive through a mere fraction of an inch. Experience has shown that to avoid

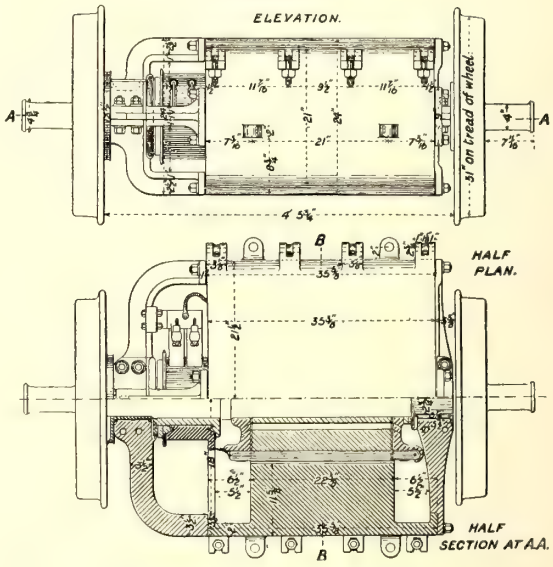


FIG. 15.—MOTOR OF NO. 21 LOCOMOTIVE

bad flashing on the controller contacts when a current of, say, 100 amps. is suddenly switched on and off before the motors have made a fraction of a revolution, the regulating resistance should be divided into a larger number of steps. The plain rheostat switch used on the old locomotives answered this purpose admirably, and in adopting a series-parallel controller this object was kept in view. Further, the drivers were used to this class of switching-gear, and a series-parallel controller, retaining the old form of rheostat switch, was developed. This series-parallel controller consists of two switches operated by a single handle, that part of the controller which puts the motors into parallel being moved only at predetermined points. Magnetic blow-outs, or other spark-killing devices, are not used, the motors being put into parallel practically without any flashing on the contacts, and not being put back into the series position again until the current is switched off the locomotive. Fig. 18 shows the connections of this arrangement. It is not necessary to lock the paralleling part of the switch to avoid short-circuiting when a motor is cut out of circuit, this contingency being provided for in the switch used for cutting out a motor. The contacts for shunting the field at starting are shown alongside the parallel contacts.

This controller was first used on No. 3 locomotive in the latter part of 1897, and has since given excellent results, having run over

22,000 miles in every-day use. It is fitted to No. 20 locomotive, No. 19 being fitted with the Electric Construction Company's controller, similar to the type used on the Liverpool Overhead Railway. The reversing switch which reverses the direction of the current in the armatures is quite independent of the series-parallel controller, and is mounted on a separate base; there is no mechanical interlocking, as in practice it has not been found necessary. A main switch and fuse is also fitted on the same board.

COASTING

In comparing the calculated "performance diagrams" with those actually obtained from tests on the line, a difference in the method of applying the brakes will be noticed. In the calculated diagrams the brakes were assumed to be applied at the instant the current was shut off, this assumption making the calculation easier. This method is not carried out in practice, as the current is shut off earlier and the locomotive allowed to coast before the

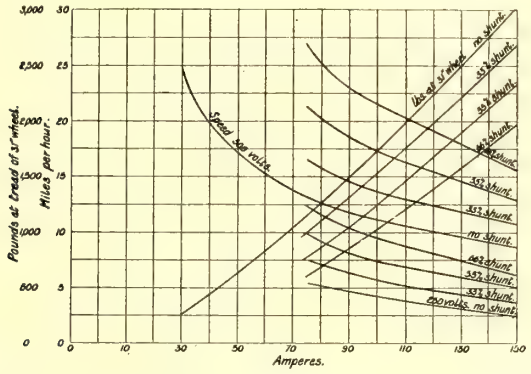


FIG. 16.—CHARACTERISTIC CURVES OF NO. 21 LOCOMOTIVE MOTOR

brakes are applied. The amount of coasting allowable varies with the gradients in the section.

While on this point it may be interesting to give the result of two round trips with No. 19 locomotive. The first portion of the run is plotted in Fig. 13. The time taken for the complete journey was .396 hour, and the average speed 15.86 miles per hour; the energy consumed was 13.32 kw.-hours, or .0552 kw.-hour per "ton-mile." In the second run the current was shut off earlier in each section, with the result that the time taken for the complete journey was .41 hour, and the average speed 15.35 miles per hour; the energy consumed was 12.214 kw.-hours, or .0507 kw.-hour per ton-mile. The average speed in the second case was 3.2 per cent and the energy consumption was 8.15 per cent less than in the first case.

On the up journey there is a continuous down grade to the Elephant station, and from the Elephant to Stockwell a continuous up grade. The average speed from Stockwell to the Elephant in the first and second trips was practically the same (the difference being less than 1 per cent), while there is a decrease of 10.95 per cent in the energy consumption in favor of shutting off the current earlier.

On the down journey from the Elephant to Stockwell the average speed on the first trip was 15.3 miles per hour, and on the second 14.5 miles per hour, showing a decrease of 5.2 per cent, while the energy consumed exhibits a decrease of only 8.25 per cent in favor of coasting. It will be seen from this that the advantages of coasting on an up grade are not comparable with those to be obtained by following this method on a down grade.

RAPID ACCELERATION

The author is aware that rapid acceleration for short sections is very desirable, but in his opinion a point can be reached long before the tractive force becomes equal to the adhesion, when it will not pay.

Apart from its influence on the comfort of passengers, very rapid acceleration necessitates the use of very powerful and heavy motors, and consequently leads to an increase in the ratio of the weight of the empty to that of the fully loaded train. Moreover, the starting current is increased several fold when rapid acceleration is used, and, of course, with it the cost of feeders and generating plant.

For the same section the kilowatts per "ton-mile" will be decreased, but the ratio of the average to the maximum demand upon the generating station will increase, and unless a very careful time table is followed in starting the trains, the generating plant must work on the average considerably under loaded. This remark does not apply with such force where a very large number of trains are running as where only a small number are in service. Again, with a rapid acceleration, the wear and tear of the rolling stock will be heavier.

The following example, worked out for a four-coach train and locomotive weighing 49 tons, running in a section 2700 ft. long, will be considered. The time to run the section is taken the same as before, viz., 130 seconds, giving an average speed of 14.25 miles

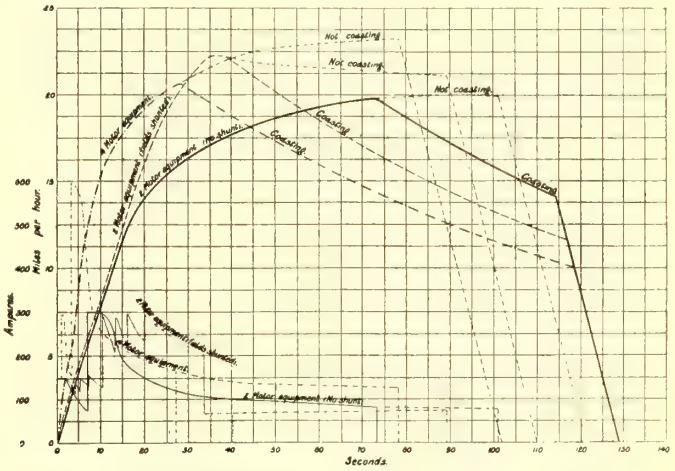


FIG. 17.—PERFORMANCE DIAGRAMS, 2 AND 4 MOTOR EQUIPMENTS

per hour. In the first and second cases "performance diagrams" are worked out for No. 21 locomotive, which has two motors, as already described. In the third case a locomotive is taken with four motors exactly similar to those of No. 21 locomotive; the seating capacity is, however, less, as the same total weight is taken, viz., 49 tons. The three "performance diagrams" are plotted in Fig. 17.

In the first case (2-motor equipment, no shunt) the speed-curve shows that a speed of 12.5 miles per hour would be attained in sixteen seconds, which is equivalent to a uniform acceleration of 1.14 ft. per second per second. After this point is reached the speed-curve bends over rapidly, a speed of 19.75 miles per hour being attained 74 seconds after starting; at this point the current is switched off and the locomotive and train are allowed to coast for 41.5 seconds; the brakes are then applied, and the run is completed in 130 seconds, the energy consumption being 1360 watt-hours, or .0540 kw. per ton-mile.

In the second case the starting current is limited to 150 amps.

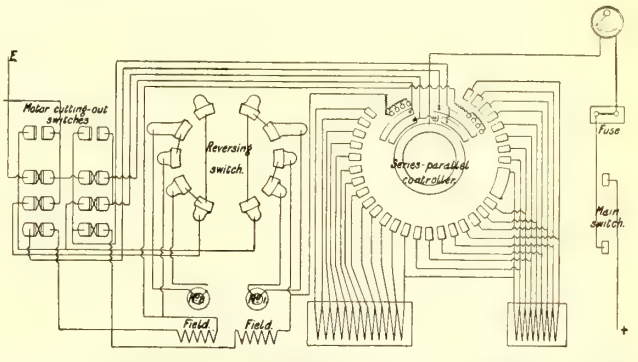


FIG. 18.—DIAGRAM OF CONNECTIONS OF SERIES PARALLEL CONTROLLER

as before, and when the value of the current flowing begins to drop the fields are successively shunted until a speed of 8 miles per hour is attained; the motors are placed in parallel at this point, and the current is limited to 300 amps., the fields are shunted as when in series, and when a speed of 22 miles per hour is reached the shunt is disused. Here the speed-curve bends over quickly and begins to drop, the motors being then in parallel with their full fields. At 40.75 seconds from starting the current is switched off, and the locomotive and train are allowed to coast for 67.25 seconds; the brakes are then applied, and the run is completed in 130 seconds as before. From the curve it will be noticed that a speed of 17.5 miles per hour is attained in twelve seconds after starting from rest, and this is equivalent to a uniform acceleration of 2.13 ft. per second per second. The energy consumed for the run is 1081 watt-hours, or .0430 kw.-hour per ton-mile.

We will next consider the third case, with the four-motor equipment. Starting with the four motors in series and 150 amps. as

before, at 2 miles per hour, the motors are placed two in series and these in parallel, the current being limited to 300 amps. At 6 miles per hour the four motors are placed in parallel and the current is limited to 150 amps per motor, or a total of 600 amps. This peak quickly falls, and in five seconds from placing the four motors in parallel the current drops to 300 amps. At 27.5 seconds after starting the current is shut off, coasting commences and continues for 92.5 seconds, the brakes being then applied, and the run completed in the required 130 seconds. The energy consumed is 946 watt-hours, or .0377 kw.-hour per ton-mile. In nine seconds from starting a speed of 15 miles per hour is attained, corresponding to a uniform acceleration of 2.43 ft. per second per second. From 15 to 20.5 miles per hour the speed-curve bends over more quickly than in the second case considered, but if the fields had been shunted the acceleration could have been maintained uniform until a higher speed was attained.

If in the above cases coasting were not resorted to, but the current were kept on until the brakes were applied, and the negative acceleration in each case were 1.46 ft. per second per second, the respective times required to run the 2700 ft. section would have been 122, 111, and 103 seconds, the average speed would have been 15.07, 16.0, and 17.87 miles per hour, and the energy consumed .0659, .0628, and .0745 kilowatts per ton-mile.

Having arrived at the effect of rapid acceleration upon the energy consumed per "ton-mile," we will now consider its effect upon the capacity of the generating station, feeders, etc.

By way of illustration let us assume ten sections of 2700 ft. each, and allow ten seconds at each station. Take as a basis a two-minute service, or thirty trains per hour leaving the terminal station. With the four-motor equipment, the seating capacity would be something like 20 per cent less than with the two-motor equipment, on account of the weight of the train and locomotive being taken as the same in each case.

Adopting the first "performance diagram" considered, viz., the two-motor equipment (coasting), as the standard, the following comparison is interesting and instructive. The time required to run the ten sections is 23.15 minutes, including stopping at stations. The maximum output of the generating station would be 2715 amps., and the average about 810. Thus the average is about 29 per cent of the maximum. With the four-motor equipment (coasting), where we get a high rate of acceleration, and a low energy consumption per ton-mile, the time to complete the run is the same, but the maximum output, arrived at as before, would be something like 5640 amps., the average being about 565 amps. Here the average is only about 10 per cent of the maximum, and any gain in the low kw.-hour consumption per ton-mile is lost by the low average efficiency of the generating plant.

In the above instances coasting was resorted to for a large percentage of the total running; if, however, coasting is not allowed, and the brakes are applied when the current is shut off, the two-motor equipment can complete the run in 21.82 minutes, or effect a saving of 5.75 per cent in time. The maximum output would be 2095 amps., and the average about 942, bringing the ratio of average to maximum up to 39.6 per cent.

If the four-motor equipment were used under similar conditions, the time would be 18.67 minutes, or about 20 per cent less than that taken by the two-motor equipment (coasting). The maximum output for this set of conditions would be 3407 amps., and the average about 1118, the ratio of average to maximum here being 32.8 per cent.

In practice the brakes would not be applied immediately the current was shut off, but to compensate for this, shunting the fields at starting and allowing a small amount of coasting for both equipments could be resorted to.

From the above considerations it would seem that to adopt very rapid acceleration at starting to reduce the energy consumed per "ton-mile" is uneconomical in working, and that the first cost of both generating and locomotive plant is about doubled. If, on the other hand, it is necessary to increase the average speed, a medium acceleration at starting will pay better than very rapid acceleration.

Entertainment at Berlin

The sixth annual oyster roast given by the Berlin Iron Bridge Company, of East Berlin, Conn., to its employees and a large number of invited guests was held April 26 at the factories of the company. Over a thousand of the company's friends partook of its hospitality, and the event was voted the most successful roast ever given.

Hundreds of barrels of oysters were provided, together with crackers, coffee, and other refreshments. The oysters were roasted in the forging shop and served at long tables. Dancing was enjoyed after the roast.

The Manufacture of Car Wheels*

BY G. R. HENDERSON

Like other branches of mechanical industry, the manufacture of chilled iron car wheels has been a gradually progressing science. Fifteen years ago it was customary to purchase and supply wheels to railroads on a mileage guarantee, the only restrictions as to quality being the depth of chill and the size, shape, and weight of the wheel. Certain mixtures were used by the founder which were known by experience to produce a given chill, and this and the color of the fracture, with perhaps the mileage records, were his guides in continuing his work. Chemical analyses of the pig iron and the finished output were considered unnecessary, if at all contemplated, and the irons, both coke and charcoal, were bought by fracture and chill. Some founders used a certain percentage of steel scrap, but this never became, as far as the writer knows, common practice. Now all this is changed; the progressive wheel-maker buys his irons on specifications, and checks them by chemical analysis, and every heat is tested physically and chemically. Records are kept of the strength and resilience of the various irons on the market, and of the manner in which his wheels fail, and as many as possible of these are examined in order to avoid duplicating unsatisfactory products.

The actual shape of the wheel has undergone but little change from the original Washburn section, except in the matter of size and weight, but we have every reason to believe that the older wheels cannot be compared with modern wheels in strength or endurance. A seeming inconsistency may be occasioned by a long life of old wheels, but it must be remembered that no such weight was then carried as is now the practice, where every effort is made in the interest of economical train movement.

About the time when the drop test was first introduced, the writer was assistant superintendent of a railroad shop which contained a foundry making 100 wheels per day. The introduction of this test, and the failure of a number of wheels in service about that time, caused him to make efforts to secure a stronger casting. Each day test bars were made along with the wheels, and these were subjected to transverse test, and a graphical record kept of the same, as shown by Fig. 1. The bars for this purpose were 2 ins. square by 24 ins. long, and were placed on supports 21 1/3 ins. apart, and a center load applied. As one-half the bars were chilled, it was considered that a 2-in. bar was a proper size to illustrate the chilling qualities, without becoming white through and through, and the span was fixed at 21 1/3 ins., so that when the proper deductions were made for the span and modulus of section, the corresponding direct stress was exactly four times the center load, thus facilitating the preparation of the form for recording the tests.

The bars of wheel iron so tested should stand a center load of from 12,000 to 14,000 lbs. before breaking, this corresponding to a maximum fibre strain of 48,000 to 56,000 lbs. per square inch. The deflection at the moment of breaking is also of great importance, and there are wide differences between various irons in this respect. While the *strength* of the metal indicates a power to stand pressure, we need the *resilience* to withstand shocks. A ready means of comparing the relative resilience of different irons is derived from the curve shown in Fig. 1. As the ordinates represent loads and the abscissæ deflections, the area bounded by the axis of abscissas, the ordinate passing through the final point of the curve (*i. e.*, the ordinate corresponding to the final deflection), and the curve itself will represent the work done or absorbed by the test bar up to the breaking point; and for quick comparisons the small rectangles into which the sheet is divided may be counted within the boundaries above mentioned. Good wheel iron will give curves with an included area of from 150 to 200 of the small rectangles, and a total deflection of 0.2 in. at center. Of course, these comparisons can only be made with bars of the same size and under the same conditions.

This same treatment has been accorded to unmixed pig iron of the various grades suitable for wheel founding, the pig being melted separately in a small experimental cupola, and from these records the wheel founder makes his selections. The curves present to the eye a meaning easier to grasp than mere figures, and when bound together in a book comparisons can be quickly and accurately made. The amount of chill and shrinkage are also noted, together with the color of fracture and the chemical analysis of the iron.

As the composition of different shipments of iron from the same furnace will vary greatly, it naturally follows that the strength and chilling properties are not always the same.

It happened not long ago that a certain iron, which had previously given good results, became almost unfit for use, princi-

* Paper read before the American Society of Mechanical Engineers, May, '99.

pally by reason of a great decrease in the amount of manganese. At one time this would probably not have been considered of such vital importance, but the fact has recently been well established that a certain amount of manganese is necessary in order that a wheel shall successfully stand the thermal test; it also seems to increase its strength under the drop test.

We have now seen that the wheel founder of the present day has the results of chemical analysis and physical tests of the unmixed iron, and also of the mixture, as well as the results of the drop and thermal tests, to guide him in his work. The tests of to-day's heat are carefully studied by him in order that any defects may be corrected to-morrow. For this reason it is important that the analysis and deflection test should be placed in his hands early.

The drop and thermal tests cannot be made until the wheels are taken out of the annealing pits, a period of from five to eight days.

But this is not all. These tests are intended to show us quickly what kind of service we may expect from our wheels when under the cars, and the records of the life and failure of wheels in service are of the utmost importance. The actual mileage of a wheel under a freight car is a difficult thing to obtain; that is, it requires considerable labor, especially when the number of wheels in use runs up into the hundred thousands. For this reason the life of wheels is often kept by months; and while this does not take into consideration the time spent in the repair yard or on the side track, it has the advantage of being very easily obtained.

As new wheels are made, the foreman of the foundry makes a daily report, giving the wheel numbers and the mixture used. The former are entered in a book which contains the serial wheel numbers, and the latter are entered in another book, which later has the result of the drop and thermal tests recorded, as well as the depth of chill, shrinkage, etc. When the wheels are mounted on the axles, a report is made weekly of the number and place at which this work was done, and this is entered in the book with serial numbers. Each week a report is also made from each point at which wheels are scrapped, giving the number and the cause; and when these are also entered, we have a complete record of dates and places of the "birth, marriage and death" of each wheel.

In looking over such a record it is at once apparent that a large number of wheels are always damaged by improper handling or usage. The proportion of *slid-flat* wheels has been very large heretofore; we hope that the more general use of air brakes will effect an improvement in this line. Chipped flanges and worn flanges are also not generally chargeable to the wheels themselves.

What most interest the founder are those which are scrapped for *cracked plates*, *cracked brackets*, and *broken-to-pieces*, as these show improper manufacture in the majority of cases. As the master car builders' regular guarantee is for forty-eight months, all wheels which run over five years may be considered as giving good service; and if these wheels can be obtained, the study of their analysis is very beneficial. Therefore, wheels giving a very short service or a very long one should be carefully inspected and analyzed, as they will show the bad and good features in a much more forcible way than drop or thermal tests. Mr. W. W. Davis, chemist of the Norfolk & Western Railway, who, with the writer, has given much attention to this subject, analyzed a large number of wheels giving a long or short service or tested by the drop or thermal methods, and we present the results of some of his work:

	Analysis of Car Wheels.					
	Which Stood Thermal Test for 60 Mins.		Which Stood 40 or More Blows Drop Test.		Which Gave 5 or More Years of Service.	
	Max.	Min.	Max.	Min.	Max.	Min.
Graphite	3.28	2.65	3.31	2.65	3.18	2.23
Combined carbon	.95	.32	.90	.55	1.24	.56
Silicon	.75	.50	.70	.50	.94	.58
Manganese	.53	.20	.46	.24	.34	.13
Sulphur	.088	.055	.086	.040	.085	.047
Phosphorus	.48	.35	.52	.36	.49	.25

It will be seen that these limits are rather wide, but below are given what are considered to be the desirable limits for the chemical constituents of wheels:

Desirable Wheel Analysis.				
Graphite	2.75	per cent. to	3.00	per cent.
Combined carbon	.50	" "	.75	"
Silicon	.50	" "	.70	"
Manganese	.30	" "	.50	"
Sulphur	.05	" "	.07	"
Phosphorus	.35	" "	.45	"

By comparing the above with the analyses of a large number of wheels it was found that these limits excluded those which broke through rim in ten minutes or less under the thermal test; broke with twenty blows or less under the drop test; or gave less than two years' service. This last is important, as a wheel can easily be made to stand strains, but the wear will be unsatisfactory, and the metal must have enough chill to stand the abrasion of the track. It is possible to obtain a chill ¾ in. deep on the tread with these proportions.

The analyses of seven wheels which had given from eight to eleven years' service each had the following limits:

Graphite	2.56	per cent. to	3.10	per cent.
Combined carbon	.63	" "	1.01	"
Silicon	.58	" "	.68	"
Manganese	.15	" "	.27	"
Sulphur	.05	" "	.08	"
Phosphorus	.25	" "	.45	"

Fig. 2 shows the comparison between chemical analyses of pig iron and of the test bar made by remelting the pig in a cupola by itself. Twenty-seven different irons were examined in this way. The solid line represents the analysis of the pig, and the broken line that of the test bar. It will be seen that phosphorus remains constant, as does silicon when present in quantities under 1 per cent, whereas some of the manganese always disappears. The total carbon remains the same, but the proportions of graphitic and combined carbon seem to vary in an erratic manner. This is evidently due to the effect of the chill, as the analyses were made from the chilled test bars when possible, and the great increase in combined carbon in tests Nos. 11, 12 and 22 may be accounted for by the fact that they chilled clear through the two inches.

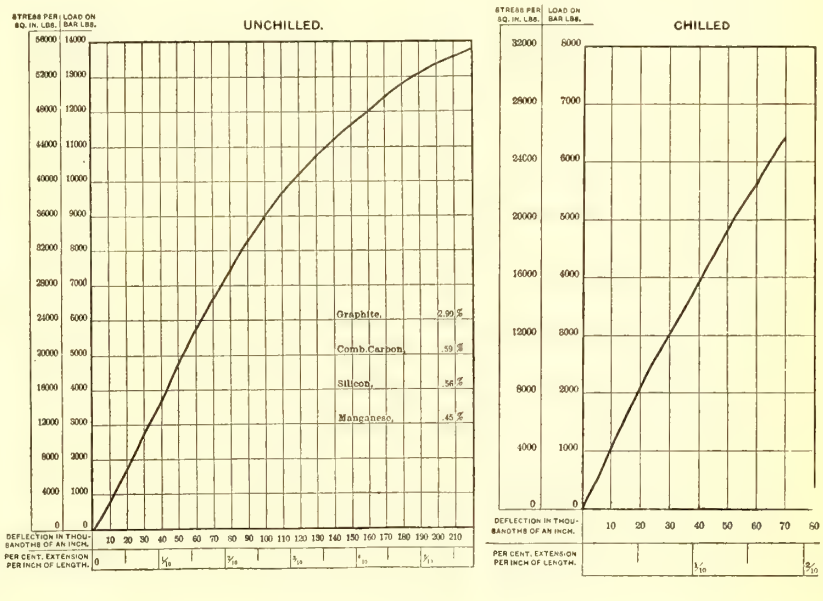


FIG. 1

From the above it will appear that the metal charged into the cupola should contain more graphite, silicon and manganese, and less combined carbon than are desired in the finished product.

If the iron in stock is deficient in manganese, the proper amount can easily be added to the mixture in the ladle by the use of ferro-manganese containing about 80 per cent manganese, 13 per cent iron, and 6 per cent carbon (combined). The use of large proportions of scrap makes this particularly useful, and it is of great assistance in enabling the wheel to stand the thermal test, and consequently the strains from severe braking when in service.

Indeed, cracked plates are almost a thing of the past with foundries keeping the manganese up to the limits prescribed above, where previously much trouble was due to that cause. To overcome this it appears that ¼ of 1 per cent should be present in the wheel. Ferro-manganese, however, seems to reduce the chill by increasing the graphitic carbon, as Fig. 3 will show, and this must be allowed for in proportioning the charge for the cupola. The combined carbon is partly changed to graphite, but not entirely in proportion to the amount of ferro-manganese used.

The experiments from which results Fig. 3 was constructed were made by filling small ladles containing different proportions of ferro-manganese from a large ladle which had been filled with the regular wheel mixture, and casting test bars from these small ladles. The effect of this is plainly illustrated both in altering the structure of the iron and the condition of the carbon content.

In preparing specifications for charcoal irons the difficulty of obtaining limits which should be perfectly satisfactory was not

underestimated. It is therefore hoped that these will be criticized more as representing an effort to compass a complicated subject than as an absolute specification which has stood the test of time.

CHARCOAL PIG IRON

"The material desired under this specification is a charcoal iron with chilling properties as designated below, the various grades to conform to the detail specifications:

Grade.	Chill.	G. C.	C. C.	Si.	Mn.	S.	P.
2	¼ inch.	2.50–3.00	.40–.90	1.25–1.75	.50–1.00	.03 Max.	.25–.40
3	½ "	2.25–2.75	.50–1.00	1.00–1.50	.50–1.00	.03 "	.25–.40
4	¾ "	2.00–2.50	.75–1.25	.75–1.25	.50–1.00	.035 "	.25–.40
5	1 "	1.75–2.25	.90–1.40	.50–1.00	.25–.75	.035 "	.25–.40

"The chill is to be measured in a test bar 2 ins. square by 24 ins. long, the chill piece to be so placed as to form part of one side of the mould. The actual depth of white iron will be measured. The white and gray portions should blend without a definite line of demarcation. The test bars will be made by melting in a small cupola several pigs of the shipment without admixture with other irons.

"The chemical proportions given above are the amounts of the constituents desired in per cents, and will be determined by the analysis of mixed borings in equal quantities taken from twelve pigs from each car.

"In addition to the chilled test bars above mentioned, some unchilled bars of the same size will also be made. These will be placed upon supports 21 1/3 ins. apart. A center load will be applied and the deflection measured. The bar should not break with less than 9000 lbs., and the deflection at center with this load should not be less than 0.15 in."

While charcoal iron is the principal ingredient in car wheels, it is often advantageous to use a small amount of coke iron, and the following specification is therefore submitted:

COKE PIG IRON

"The material desired under this specification is an open-grain foundry pig conforming to and graded by the following detail specifications:

Grade No. 1, Silicon, from 3.00 per cent. to 2.50 per cent.
" " 2, " " 2.50 " " 2.00 "
" " 3, " " 2.00 " " 1.50 "
" " 4, " " 1.50 " " 1.00 "

"Iron will be rejected which shows:

Combined carbon below	.10 per cent.	
Graphitic carbon below	3.00 "	
Manganese below	.50 per cent.	or above .80 per cent.
Phosphorus below	.50 "	" .80 "
Sulphur above	.06 "	

"Should the silicon vary from standard grading, the next lowest grade under the specifications will be paid for, and should the silicon fall two grades low the material will be rejected. No higher grade is desired, and no excess price will be paid for higher silicon.

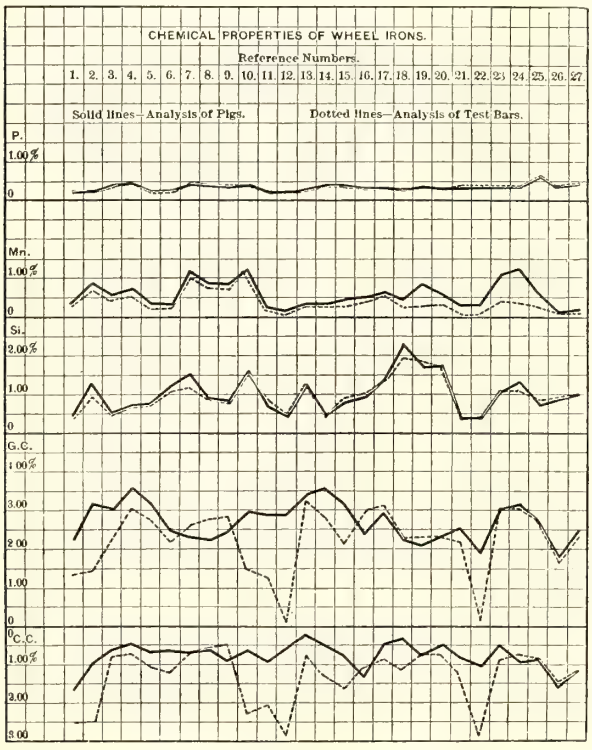


FIG. 2

"Samples of twelve pigs will be taken from each car, two from the top of each end, two from the middle, and two from the bottom. The borings will be mixed in equal quantities and the resultant sample represent the shipment."

Reference having been made to the drop and thermal tests, it may be well to conclude this paper with a specification for car wheels, which will give the details of these tests for ready reference.

33-IN. CAST IRON WHEELS

"The design of wheels must be such that they will be in accordance with the measurements shown on the drawings for 33-in. wheels, and also such that the wheels when cast shall weigh between 590 and 610 lbs. The tread and flange are to be identical with the M. C. B. standard section for same, and the flange thickness must pass the M. C. B. gages for same.

"Wheels must all be cast in true metallic chills of the same internal diameter and of uniform cross section. The body of wheel must be of clean, soft, gray iron and smooth and free from slag and blowholes, and hubs must be solid and free from drawing. The tread and throat of wheel must be smooth, free from deep and irregular wrinkles, slag and sand-wash, and practically free from chill cracks and sweat. The depth of clear white iron must not exceed ⅞ in. at throat and 1 in. at middle of tread, nor be less than ⅜ in. at throat and ½ in. at middle of tread. Neither should there be a variation throughout the same wheel of more than ¼ in. in depth of chill. The blending of the white iron with the gray iron behind it must be without any distinct line of demarcation.

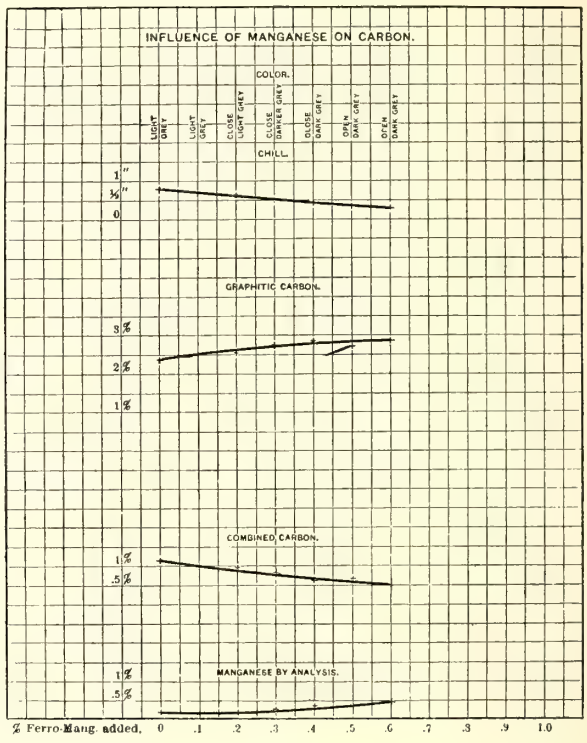


FIG. 3

"Each wheel must be so nearly circular that when a true metallic ring is placed upon the tread, and bears somewhere on the cone, it shall at no part of the circumference stand more than 1/16 in. from the wheel tread. No wheel made in a solid chill will be accepted whose circumference differs more than 1⅝ ins. or less than ⅞ in. from the circumference of the chill in which it is made. Wheels cast in contracting chills should not differ in circumference more than 2 ins. from that of the chill.

"All wheels must, during inspection, receive three heavy blows with a 6-lb. sledge at as many different points under the flange, between the brackets, without cracking flange or brackets.

"Each wheel must also be capable of standing a pressure of 50 tons when being mounted on the axle.

"For each pouring of 100 wheels, or fraction thereof, two additional wheels must be furnished for test purposes. These wheels shall be selected by the inspector, and subjected to the following test: One wheel shall be placed flange downward on an anvil block weighing not less than 1700 lbs., set on rubble masonry 2 ft. deep, and having three supports not more than 5 ins. wide for the flange of the wheel to rest upon; it shall be struck centrally upon the hub by a weight of 140 lbs. falling from a height of 12 ft. Should this wheel stand fifteen blows without breaking in

two or more pieces, the lot of 100 may be accepted (as far as this test is concerned), provided that the broken wheel shows proper depth and uniformity of chill; also subject to return if the wheels do not satisfactorily stand boring and mounting, as explained above. Should the wheel break in two or more pieces with fifteen or less blows, the lot of wheels represented by the one tested will be rejected.

"The other test wheel must be laid flange down in the sand, and a channelway, 1½ ins. wide and 4 ins. deep, must be moulded with green sand around the wheel. The clean tread of the wheel must form one side of this channelway, and the clean flange must form as much of the bottom as its width will cover. The channelway must then be filled to the top with molten cast iron, which must be hot enough when poured so that the ring which is formed when the metal is cold shall be solid or free from wrinkles or layers. The time when pouring ceases must be noted, and two minutes later an examination of the wheel must be made.

"If the wheel is found broken in pieces, or if any crack in the plate extends through the tread, the 100 wheels represented by the test will be rejected.

"Wheels may be dried before submitting them to the thermal test, but must not be warmer than 100 degs. F."

Street Railway Franchises and Fares*

BY EDWIN B. GAGER

So many bills are now pending before you relating to street railways and depending for their intelligent consideration upon a knowledge of the financial condition of the street railway interest in Connecticut, that I have been at the pains of collecting some facts which seem to me pertinent. The transfer bill (H. B. 360), the electric lighting bills (H. B. 371 and H. B. 499), the bill concerning street railway franchises (H. B. 502) and the various fare bills and resolutions (H. J. R. 373, H. B. 497, H. B. 219, H. B. 19, H. J. R. 372) are the more important examples of the class of bills I refer to. You cannot fail to have noticed that in every case these bills have been advocated because it was claimed that the street railways had been granted valuable franchises, that they used the highways for nothing, and that the additional burdens sought to be imposed by these bills could well be borne by the companies as some compensation for these so-called valuable franchises.

Many supporters of these bills, especially the fare bills, have gone so far as to claim that these burdens should be imposed because the people would receive a benefit which they should have whether the companies could afford it or not. Others claimed the companies could afford it. Not a single claim in support of these bills, nor a single argument has been based upon an examination of the conditions and facts fundamental to the proper discussion of these questions. The popular notion of this "valuable franchise" is made to do duty in support of any and every measure imposing further financial obligations upon these companies.

What is this "valuable franchise"?

It is not the right to be a corporation. That right, which is a franchise, is common to all corporations whether created under the general law or by special act of the Legislature. The franchise intended is the right, obtained from the Legislature, to lay down and operate a street railway in the streets and highways without paying for such a right by way of purchase. It is claimed to be a free right of way through our streets, of great pecuniary value, given without compensation to the State or the municipality.

Let us examine the nature of this right. It is a right to operate our vehicles, or cars, in the streets. These cars are the cheapest and most comfortable means of local travel yet devised, which, for most distances, you can hire for your personal use for five cents. This right, therefore, is really a right which enables the people to travel frequently, speedily, comfortably and cheaply. The only thing about it rendering a franchise necessary is that in order to furnish such a service these vehicles must run over a prepared surface or track. In no other respect does the street car differ from the ordinary bus. Any man may establish a line of busses without a franchise and without compensation for the use of the streets. No one would think of imposing special burdens on him. Yet he does not take care of a strip of road nearly 9 ft. wide for a single track at his own expense and pay taxes besides, and then furnish the cheapest service in the world. The Massachusetts Railway Commissioners in their report for 1896 (p. 111) said: "The railway is not to be regarded as an intruder, having no legitimate place or right to be on the public street. It is nothing more or less than an improved method of public highway travel. The use of the highway by one method of travel necessarily interferes to a greater or less extent with the convenience and safety of its use by other methods. There are well known inconveniences and dangers to other travelers attending the use of the highway by travelers in street cars. It must be conceded, however, that there is no known method of conveyance by which such large numbers of persons can be transported through the streets with so much convenience, expedition, and safety to themselves and other travelers, with so litttle noise, confusion and dirt, and with so little obstruction and wear and tear of the street, as by the electric railway. There are carried on the railway whose lines center in Boston, an average of 425,292 persons daily—a number equal to nearly 86 per cent of the entire population of the city. The great majority are carried through the most crowded thoroughfares. If it were possible to transport the same number of persons by any other available method of public or private conveyance, the obstruction, annoyance and danger would, on the whole, be much greater than they now are."

Our every day experience justifies every word of this statement.

But it is said that this right is of immense financial value to these companies. We admit that without this right we could not do business. We deny that, in Connecticut, this right has an appreciable financial value as an asset of the company, adding substantially to the market value of the company's property.

A franchise, to have a financial value as such, must be of such a nature that it will enable its owner to reap a financial profit from its possession in excess of a reasonable profit on his property investment. For illustration, a patent right is a franchise. That right or franchise is of value when it enables its owner to gain a profit or reward beyond the normal return on the capital invested. If a patented article sells for two dollars where, if open to general manufacture, it could be sold at one dollar, and at the same time secure the normal return on the capital invested in its manufacture, then this extra dollar represents the value of the franchise secured by the patent. If a street railway company can, by the use of its franchise to run in the highways, secure a return far in excess of the normal return required by its investment and the risks of its business, so that its property is worth largely in excess of what has been put into it, such excess would represent the value, the financial value, as an asset, of its franchise.

No such value exists in this State, and this is so for several reasons:

1. There is nowhere in this State sufficient density of population. There is no travel to be accommodated that is far in excess of and above the proportion required by the outlay necessitated to construct, maintain and operate the line. You cannot reason from New York and Chicago to New Haven and Hartford, much less to the other cities and towns in this State having street railways. In short, we have not the people to be carried proportional to the miles of track, required to create a financially valuable franchise.

2. This franchise right has not the element of permanency, if the other conditions existed, to make it materially valuable. Every charter in the State is subject to alteration or repeal at the pleasure of the General Assembly. New lines may, at any session of the Legislature, be authorized on streets already occupied or on parallel streets. There is no monopoly in this respect that cannot be broken the moment the Legislature deems the interests of the traveling public require it. A right uncertain as this does not furnish a sound basis for a financial value.

3. If, at any time, it appears to the Legislature that any such franchise is enabling its owner to reap an inordinate profit, the Legislature by its reserved powers has the right to compel a reduction of charges so that the returns will not be out of proportion to the capital invested and the nature and risks of the business.

For these and, perhaps, other reasons, we say that the franchise of a street railway in this State is not, of itself, of substantial financial value. It is simply a preliminary right required to do business, just as the right to use the highways is a preliminary right requisite to enable a man to engage in trucking or running a bus line, and nothing else, and through the medium of the Legislature is subject, like any other business, to the law of competition.

Now if there is, as is claimed, a financial value to this franchise, it ought to appear in the financial results of construction and operation of electric lines in this State.

Two years ago, I had occasion, before the judiciary committee, to examine this question. I could not then find this value. I have re-examined the question and beg leave to submit the results of my examination. It is based on the reports for 1897, the last reports for a full year, and for 1898 so far as available. Briefly stated, the proposition is this: If a street railroad franchise is a

* Address delivered before the committee on railroads of the Connecticut Legislature, May 3, 1899.

valuable pecuniary asset it ought to appear as a material element of value beyond the capital invested in the roads. Such an element I do not find. Several tests may be made.

Take the test of taxable value. Street railways are required to pay to the State 1 per cent on the fair market value of stock, bonds and other indebtedness, just the same as steam roads. The board of equalization has full power to determine this value, and no one but a crank will question that this board has treated the State fairly. In this particular we can use the reports for 1898.

In 1898 the street railways of the State paid to the State Treasurer in taxes $161,164.36. This is 1 per cent on the value of these properties as determined by the board and makes the fair market value of all street railway properties in the State $16,116,436. By the same report the actual cost of construction and equipment was returned as $19,806,240.78. In other words, the fair market value was $3,689,804.78 less than the cost of construction and equipment. There is no margin here for this "valuable franchise." But was this fair market value really fair? For the answer to this we must go to the reports of 1897, as those of 1898 are as to business done, for only nine months. The net earnings of all the roads for 1897 were $951,412.30. From this sum was paid in taxes $132,937.47, leaving for depreciation, interest and dividends $818,474.83. The market value for that year was placed at $13,293,747. This makes the net earnings for that year, exclusive of taxes, 6 1-10 per cent, out of which must come the element of general depreciation of plant which the companies generally have not, in my judgment, sufficiently allowed for. No one at all familiar with the nature of the business and the element of depreciation will say that the valuation was over favorable to the roads.

If we take now the cost of construction and equipment for this same year, viz: $19,849,206.52, then the net earnings, exclusive of taxes, will be 4 1-10 per cent. This does not disclose the "valuable franchise." In Massachusetts in 1897 the net earnings were 6 4-10 per cent on the cost of construction and equipment (Report of Mass. Special Commission. House . . . 475, p. 37).

The stock, bonds and floating indebtedness for the same year amounted to $19,934,661.25, substantially the same as the construction and equipment account and showing substantially the same return, 4 1-10 per cent.

The capital stock of these roads amounted to $9,770,440, and the dividends paid amounted to $265,625.97, being 2 7-10 per cent on the capital stock. The "valuable franchise" element does not appear here.

The steam roads, as a whole, showed in 1897 net earnings, less taxes, of 6 per cent on stock, bonds and floating debt and 7 1-10 per cent on cost of construction and equipment as against 4 1-10 per cent in each case, respectively, for the street railways.

That the reports as to cost of construction and equipment are substantially correct, will appear from a comparison with the reports as to street railways in Massachusetts. In 1897 the average cost per mile of all the street railways of Massachusetts was returned as $44,415. This included long country lines, comparatively inexpensive, for there were in Massachusetts 1413 miles of main track as against 362 in Connecticut, and many of the Massachusetts companies had charged off for depreciation. In 1894 the average cost per mile in Massachusetts was $53,632. (See Table R. R. Comrs. Report for Mass., 1898, pp. 89 and 106). Our average cost per mile was reported in 1897 at $54,829, and in 1898 at $51,177.

This is somewhat in excess of the actual railroad cost, for the commissioners say (Conn. R. R. Comrs. Rep., 1898, p. 27) "the cost of construction and equipment include the cost of electric lighting plants in several companies which cannot be separated from the cost of road and equipment."

You are asked on most of these matters to legislate for the whole State on the theory of this valuable franchise, the use of the street, which it is claimed the roads can afford to pay for indirectly in the various ways presented in these bills. The ultimate reason alleged does not exist. There is no such valuable franchise to draw upon.

As confirming my results reached from an examination of our reports, I would refer to the report of the exceptionally able special commission appointed in 1897 to examine and report on the question of street railways The committee consisted of Charles Francis Adams, William W. Crapo and Elihu B. Hayes. They examined with the greatest care the street railway systems of the United States, Great Britain and the Continent and their report is of very great interest and value. If our friends would study it carefully, they would not be making some of the absurd claims you have heard. On this subject of valuable franchise permit me to quote the following: "So far, however, as a further special street railway franchise tax is concerned, grave popular misapprehension seems to exist as to the burdens in the way of taxation to which street railway companies are already subject—a misapprehension due in no inconsiderable degree to the indirect and anomalous character of those burdens. It seems to be generally assumed that the street railway companies received, and are now receiving, public franchises of unusual value, for which they pay no money consideration and render very inadequate public service; that their profits consequently are inordinately large is also assumed, and that those profits are in some way concealed through a system of vicious financiering and deceptive bookkeeping.

The facts, however, do not seem to be as assumed in this presentation of the case. A more careful investigation fails to disclose those Massachusetts franchises of great value given away without consideration, or unduly large profits on the part of the companies as a whole, or more than exceptional cases of vicious financiering, or a deceptive general system of bookkeeping. There are in all seventy-seven street railway companies in operation in the Commonwealth. Of these, one, the Boston Elevated, or West End Street Railway, may be left out of consideration, its case being exceptional to such a degree as to make it necessary to put it in a separate class, as has, in fact, been done through recent legislation (Acts 1897, chapter 500). Of the seventy-six remaining active companies, thirty-four paid no dividends in 1897, while forty-two paid dividends of from 1.25 per cent to 10.5 per cent, averaging 4.29 per cent—a return certainly not excessive. Upon this point the inquiries of the committee tend to confirm the conclusions of the Board of Railroad Commissioners in their report for 1896 (page 110). While in the business of operating street railways, as in every other business, there are—as, within reasonable limits, there should be—exceptional cases of large profit offsetting cases of failure to earn reasonable profits, yet the idea sometimes entertained that the electric railway is likely to prove a source of extraordinary or abnormal profit must apparently be abandoned. It is a close business, yielding with skilful and prudent management only a fair average return, quite within the limit allowed by statute and conservative opinion as adequate and proper for investment of this character. (Report of Special Commission, pp. 35, 36).

I doubt not you have been struck by the difference between estimates for new lines and the reported cost per mile which I have stated. This is accounted for when you recollect that the value of the older horse railroad plants and the heavy cost of material and plant in the earlier days of electric road construction have to be taken in to the equation.

All this represents actual cost which has gone into the plant and on which the companies are entitled to receive a reasonable return. This feature is so concisely and fully covered by the report of the Massachusetts Commissioners (Report, 1898, p. 110), that I reproduce it in full:

"The establishment and maintenance of an electric railway is a very different thing in point of cost and expense from that of the horse railway. There has been, moreover, a certain amount of loss in the reconstruction of the horse into the electric railway. The construction and equipment accounts of the older companies represent to some extent the cost of two systems, only one of which now exists. There has been besides a very considerable shrinkage in the value of the electric railway properties which were built or reconstructed some years ago, owing to the large reduction in price or market value of material. The motors which cost $2850 can now be bought for $850. A suburban railway which it cost $35,500 per mile of track to build and equip, including power plant, in 1892, could be built and equipped in the same manner the last spring, for $22,600 per mile. Many of the companies require, in order to place or maintain themselves on a sound financial basis, to charge off from their property accounts large sums for shrinkage and depreciation of this character, if of no other character, as soon and as fast as their surplus earnings will permit."

The promoters of these bills desire to take away, as far as possible, all chance for any surplus earnings which will enable the older companies to charge off that portion of their investment which has become valueless so far as the present operation of their roads is concerned. This policy would be extremely unwise for a manufacturing company, and it is equally so for a street railway company.

There is another element in this question which is not to be overlooked. It is said prices generally have gone down, and that we are now paying five cents for a ride that in horse railroad days cost at the most but six. In the "Street Railway Review" of Feb. 15, 1897, is a carefully prepared article on " Reduction in Street Car Fares."

From an examination of twenty-eight large and small cities the writer came to the conclusion "that the price of car fares not only has been reduced, but that no other article of as common use has been as greatly reduced in price."

This reduction has been brought about in three ways, by making a straight five-cent fare, by great extensions of lines and by transfers. The whole matter is exhaustively examined and taking the years 1886 and 1896 for comparison, and taking the purchasing power of five cents in 1886 as the unit, it was found that five cents would in 1896 buy a ride 3.375 times as long, while of steel rails it would buy 1.74 times as much, of sugar 1.37 times as much, of wheat 1.34 times as much and of cotton 1.22 times as much. And this takes no account of the increased speed and comfort of the traveler.

The result in Connecticut is substantially the same. In Bridgeport in 1885 you could ride 4 miles for five cents. Now you can ride 9.75 miles. In 1885 the Fair Haven and Westville R. R. carried a passenger at the lowest rate, 3½ miles for five cents. Now you can ride 9½ miles for the same rate. In Waterbury in 1886 you could ride 1½ miles for five cents. Now you can ride 6½ miles for the same sum. In Hartford in 1892 you could ride 2.9 miles for five cents. Now you can ride 9.18 miles for the same sum.

This very important element should not be lost sight of, that the quantity of service has been tripled while its quality has been greatly improved.

Comparing this with the steam road rates, it will be recollected that on steam roads rates to-day are substantially the same as in 1885, the standard being now, as then, two cents per mile.

But it may be said, and especially in relation to the fare bills, that in New Haven, Hartford and Bridgeport, neither your figures nor your reasoning will apply. From their size we ought to, as we do, find the best results in these cities. These results, however, do not come up to the results on the consolidated road, and this Legislature has already refused to attack its fares. We do not expect different treatment from the steam roads unless it appears we are doing much better than the steam roads. I have already shown that the general result on street roads is 4 1-10 per cent, as against 6 per cent on stock, bonds and debt of steam roads, and 4 1-10 per cent as against 7 1-10 per cent on cost of construction.

The Hartford Street Railway Company controls the entire traffic of the second city of the State. The total cost of its construction and equipment was reported in 1897 as $2,608,030.43. Its net earnings, less taxes, $155,212.15, or 5 9-10 per cent on its cost of construction and equipment. Its capital stock, bonds and debt amounted to $2,469,000, upon which its net earnings would be 6 3-10 per cent. This is less than the general average of the State on steam roads, based on cost of construction, and only 3-10 of 1 per cent above on stock, bonds and debt. There is no franchise value here.

In New Haven the traffic is divided between two companies, the Fair Haven & Westville and the Winchester Avenue lines, which in a general way divide the city, the Fair Haven and Westville having taken in the New Haven Street Railway Company. The total cost of construction and equipment returned in 1897 was $3,615,924. The net earnings, less taxes, $264,638.27, or 7 3-10 per cent of cost of construction and equipment. The total capital stock, bonds and debt of the New Haven roads was $3,026,700, upon which its net earnings would be 8 7-10 per cent. This is a little better than the average steam road results. This, however, is far below the results upon the consolidated road, which for the same period showed 15 per cent on cost of construction and equipment and 9 + per cent on its total investment, and paid 8 per cent dividend with a surplus of $74,728.76.

The Bridgeport Traction Company reports a cost of construction of $3,836,468, and net earnings of $123,145, or 3 2-10 per cent on cost. Its stock, bonds and debt were $4,030,000, upon which its net earnings, less taxes, were 3 + per cent. Now, none of these roads so far as appears charged off for general depreciation. It is self-evident that no ordinary repairs will quite suffice to keep a road up to its best standard, that there must at times be reconstruction as distinguished from repairs. This will not come till a road has been some years, perhaps ten or more in operation, but it is sure to come and must be met by an extraordinary outlay which must increase the permanent investment unless provision is made for this expense either by charging off some percentage yearly or the creation of a surplus. For the long continued operation of a road the above percentages should be materially reduced to show a sound basis of net income which can be paid to the stockholders as dividends.

The foregoing figures do not show a situation which justifies the Legislature in interfering in the business management of these companies. They are simply well managed, fairly successful companies, such as we would like to see all the railway companies in the State.

The more we study the reports and the more we learn about the narrow margin of profit after paying all expenses of operation, maintenance of track and roadway and taxes, the less shall we feel inclined to look at street railways as furnishing any short and easy road to wealth. The cold fact is, taking them generally, that thus far the riding public and the local property owners have been the gainers. Stockholders have invested on faith in ultimate results which have not yet been realized. The best of the roads have done no better than a fairly successful manufacturing or mercantile business. If they are left to themselves to conduct their business on ordinary business principles without spasmodic, uncertain and almost surely disastrous legislative interference, the public will be better served and the just claims of those who have invested their money better protected.

Permit me to quote again from the Massachusetts Report already referred to (p. 110). I do this the more freely because in Massachusetts the street railways have long been under supervision of an able board and the conclusions reached by it are based on a wider experience than has been possible in our State:

"It is not by any means intended to convey the impression that electric railway operation is, or is destined to be, a financial failure. The idea that it is likely to prove a source of extraordinary or abnormal profit must, however, be abandoned. It is a close business, yielding with skilful and prudent management only a fair average return, quite within the limit allowed by statute and conservative opinion as adequate and proper for investments of this character. It was suggested in the report of two years ago that the financial conditions and results of street railway enterprise would not be found to differ in the long run essentially from those of railroad enterprise. The average return on street railway capital was the last year a little below that on railroad capital, in this State."

This conclusion, you will observe, coincides absolutely with the conclusion reached from an examination of our own roads and is not, I think open to question. If this conclusion is correct, then every proposed law based on the idea of valuable franchises and excessive profits and which must result in directly or indirectly diminishing these profits must be rejected, because the assumed conditions do not, in fact exist.

It has been said by those who are favoring these various bills, and especially the fare bills, that foreign cities furnish very much more favorable rates than are furnished with us. Upon this point I beg again to refer to the report of the Massachusetts Special Committee already mentioned. This committee was not unmindful of the claims of the visionary and enthusiast, that somewhere beyond the seas, a condition existed that was infinitely better than our own, and they examined the roads of Great Britain and the Continent, and as a result of a careful examination, have said this: (See Report, page 15): "On this head, as already intimated, it is not safe to accept loose assertions, no matter how positively made or frequently reiterated, as evidence of what really exists. In every community, persons claiming to speak as authorities are apt to be in evidence declaring that somewhere else, in this case in Baltimore, perhaps, or in Toronto, in Glasgow, or in Birmingham, or in Berlin, an ideal condition of affairs has been reached, in which perfect street railway accommodations, low fares, rapid transit, and contented officials and employees are working in harmony with a thoroughly well-satisfied municipal government, to the expenses of which the railway company contributes a liberal share, while at the same time paying reasonable dividends to its stockholders. The members of the committee have only to say that, if such a street railway Utopia anywhere exists, they have in the course of their investigations failed to find it."

Various foreign cities have been mentioned in which the street railway management would, it is claimed, throw the excellency of our American systems into the shade. Among others those of Birmingham, Glasgow and Berlin. I can only refer in detail to one of them, and I take my figures from the same special report, pages 16, 214 and 217. Glasgow has a population of some eight hundred thousand, served by 73 miles of tramway measured as a single track. Compare this for a moment with Hartford with a population recently estimated at about 75,000, and served by 56 miles of track; or New Haven with a population in the neighborhood of 100,000, served by between 70 miles and 75 miles of track; substantially more miles of track in New Haven than in Glasgow. In Great Britain at least the same ratio will very generally apply. For instance, Birmingham with a population of 501,000, has 33 miles of track; Southampton with a population substantially that of New Haven, has 5 miles of track; or, taking the United Kingdom generally, Great Britain shows 618 miles of street railway in a city population of 7,600,000, while Connecticut, with its little population of 800,000 urban and country, has 387 miles. But even with the very short mileage of tracks in Great Britain and upon the Continent, there is to be specially noted the fact that rates there are based upon distance instead of the flat five-cent rates for ordinary service as with us, and the distances are divided so that they

increase by comparatively short stages. Take Glasgow again for illustration, we find there that on the rate of the Glasgow corporation, for one cent you can ride one-half of a mile; for two cents, 1¾ miles; for three cents, 2 1-3 miles; for four cents, 3½ miles; for five cents, 4 2-10 miles. You cannot, in Glasgow, in our money, buy as long a ride for five cents as you can upon most of the street railways in Connecticut.

It has been said over and over again that the street railway is the poor man's carriage; practically, we know, it is the carriage of the rich and poor alike. But look at it from the point of view of a man working for wages. In Glasgow it costs him a much greater proportion of his wages to travel a given distance than it does with us. For illustration, in Glasgow point boys, as they are there called, or switch boys, as we would call them, get 28 cents a day; in New York the boys doing the same service get $1 to $1.25 per day. Drivers and conductors, as their highest rate of wages, after three years' service, get $1.08 a day, as against $2.25 in New York for conductors and $2.40 for motormen; and so it runs through the various classes of workingmen upon the roads, and this relative scale of wages is, I believe, about proportional to the difference in wages between Glasgow and this country, so that actually a man who is working in a shop or anywhere for wages here has to work less time to get a given mileage of ride than in Glasgow.

Well might the Massachusetts committee say that, after examining these conditions in the Old World, they have failed to find the street railway Utopia which the visionaries loudly, and with amazing assurance, claim existed there.

There is another point of view founded on the foregoing examination. We have seen that the average street railway net earnings, without deducting for general depreciation, is 4 1-10 per cent on cost of construction and equipment, and 4 1-10 per cent on total stock, bonds and floating indebtedness, yielding after paying interest charges 2 7-10 per cent on capital stock, and that under the very best conditions in the State, viz., New Haven; still without deducting for general depreciation, the net earnings show only 7 3-10 per cent on cost of construction and equipment, and 8 7-10 per cent on capital stock, bonds and floating indebtedness. Now, as a fair business proposition, at what point can the Legislature presume to manage or regulate the financial management of these roads better than those who make it their business to manage street roads? Do you think, as careful business men, that an average of 4 1-10 per cent will, with any information you have obtained here, justify you in imposing additional burdens on all the roads of the State, or that the exceptional rate of 7 3-10 per cent, under the most favorable conditions, will justify you in interfering in the management of the roads in the larger cities?

Do you think so, especially in view of the fact that in the case of a steam road earning 15 per cent on cost of construction and equipment you have, properly enough, deemed it unwise to interfere with its rates?

What is the point where the Legislature may, with propriety, be asked to consider the rate question? Perhaps the neighboring States may aid in answering, for I assume that this committee is desirous of dealing with all these bills in a prudent, conservative way.

In New York it is provided that rates may be reduced, but not below a net income of 10 per cent on the amount actually expended. In New Hampshire rates may be regulated, but not so as to reduce the net income below 10 per cent on the capital stock. In Massachusetts the Railroad Commissioners control the rates, but no reduction is permitted which will bring the income below 10 per cent on the actual cost. We have no law, but rely upon the good sense of the Legislature, and primarily of this committee, and I submit that you can justify yourself to the business world if you conform to the standard of New York, Massachusetts and New Hampshire. The street railways generally, and every one of them in detail, do not show, nor can they be made to show, any such net income as will justify your interference in the management of their financial affairs.

No one can be presumed to know better than the managers themselves what the financial results of any change in rates would be. If advantageous to the companies, they would long ago have been adopted. If disadvantageous, then you certainly will let them alone. The settled policy of this State has been hands off. The result has been that our railroads and street railways have been as well managed, and the public have got as good service at as low rates as in any State of the Union.

The Legislature of the State of Wisconsin has just enacted an anti- pass law, by virtue of which no city, county or State official or employee will be permitted to accept or use passes of any kind on steam or street railways. This law applies as well to local police.

Receipts of Street Railways in New York State

At the hearing on the Ford Franchise Tax bill, before Governor Roosevelt, Executive Chamber, Albany, N. Y., May 11, 1899, the following statement was submitted by G. T. Rogers, president of the Street Railway Association of the State of New York.

STATEMENT

The following facts and figures are compiled from the annual report of the State Board of Railroad Commissioners for 1898:

One hundred and three street surface railroads submitted annual reports to the State, forty-nine of which show a surplus amounting to $1,102,855, and fifty-four show a deficit amounting to $471,848. Of the $1,102,855 surplus, $805,288 is shown by twelve companies in Greater New York, leaving but $297,567 to be divided among the thirty-seven companies outside of that city.

Of the 103 companies reporting, but eighteen declared dividends (five of these being in Greater New York), the total dividends amounting to $3,069,465, of which the five Greater New York roads paid $2,512,374, leaving a balance of only $557,091 to be divided among the remaining thirteen dividend paying roads. Six of the dividend paying roads showed a deficit after so doing. Eight of the 103 street surface railroads mentioned have gone into the hands of receivers during the past four years.

In addition to the above mentioned eight companies, at least twelve or fifteen have gone out of business entirely or saved themselves from going into receivers' hands by making some arrangement with the bondholders.

Briefly, the above report shows that the small and medium sized street surface railroads in New York State, and in fact all the roads with the exception of those in the very largest cities, are struggling along under the most discouraging conditions.

I submit the following significant figures:

1st.—Showing a proportion of net income paid in taxes by street surface, elevated and steam railroads of the State of New York, during the year 1898.

STREET SURFACE RAILROADS

The net income after deducting operating and miscellaneous expenses, interest on funded debt, rentals, etc., not including taxes	$5,139,722
Taxes paid in 1898	1,439,250
	$3,700,472

Percentage of net income paid in taxes, 28 per cent.

ELEVATED RAILROADS

The net income after deducting operating and miscellaneous expenses, interest on funded debt, rentals, etc., not including taxes	$1,929,327
Taxes paid in 1898	886,853
	$1,042,474

Percentage of net income paid in taxes, 46 per cent.

STEAM RAILROADS

The net income after deducting operating and miscellaneous expenses, interest on funded debt, rentals, etc., not including taxes	$29,356,598
Taxes paid in 1898	8,543,587
	$20,813,011

Percentage of net income paid in taxes, 29 1-10 per cent.

2d.—Statement of percentage of dividends upon the capital stock of the street surface, elevated and steam railroads of the State of New York, for the year 1898.

	Cap. Stock.	Div. Paid.	Per Cent.
Street surface railroads	$132,844,303	$3,069,465	2 3-10
Elevated railroads	49,224,352	1,200,000	2 2-5
Steam railroads	771,452,304	14,546,582	1 9-10

The above statement demonstrates that the transportation companies of the State of New York are bearing all the burden of taxation they can stand, and are already paying a large proportion of their net income into the public treasury.

The sum of $1,683,195,749 is invested by the combined transportation companies of this State in road-bed and equipment. A large portion of this enormous amount invested—representing the capital stock and bonded indebtedness of the several companies—has been sunk in a depreciation of the value of both construction and equipment and in expenditure for replacement made necessary thereby, particularly by street surface railroads for the development of mechanical traction, especially electrical, the operation of which for the past decade has been largely experimental, necessitating frequent expensive changes of station and car equipment, and the consignment to the scrap pile of costly machinery, which necessarily had to give way to more improved and modern equip-

ment; also the expenditure incurred in the construction of experimental electrically operated roads, both overhead and underground, which have been tried and have proven a failure, both from the standpoint of profit and operation.

In many instances where horse street railroads were purchased for the purpose of installing with electricity, the entire equipment, for which high prices were paid, proved absolutely valueless to the purchasers.

In the early days of electrical traction enormous prices were charged for equipments of all kinds; for instance, ten years ago $3000 and upward was the price charged for a car equipment which to-day, owing to its crude and undeveloped condition, is worthless, and which can be replaced by a modern, up-to-date outfit for $720.

Without going into details, I would state in a general way, that the same rule applies to track and overhead construction, to car bodies and appurtenances, all of which have to be kept up to date and carefully maintained to meet the requirements of an exacting public.

The interest paid upon that portion of the bonded indebtedness, sunk by depreciation of values, and expended for replacement by the several street surface railroad companies of the State, in order that the city or village wherein their respective roads are located, might be properly subserved, is a material and permanent burden imposed upon each individual road which should be taken into careful consideration in the adjustment of the important question of taxation.

The sum of $164,161,692 was paid out in operating expenses in 1898, the greater portion of the amount being for labor, proving the benefit of these institutions, and demonstrating the fact, when taking into consideration the immense amount of money invested and the cost of operation, that the net income as shown by the above statement is small, and proves conclusively that the proposed tax imposed upon the railroad companies of this State would be unjust, unfair and undeserved.

Two years ago the Legislature of this State passed a gross earning tax bill, imposing upon street surface railroads a tax of 1 per cent upon gross earnings (while the tax law affecting steam railroads remained unchanged). This measure imposed a serious additional burden upon provincial street surface roads, particularly the non-dividend paying companies.

The street railroad companies of the smaller cities of this State are entitled to consideration and relief, rather than additional burdens. In fact, they must receive such consideration and relief, otherwise the number of street railroad companies in receivers' hands will be materially increased. Furthermore, the imposing of additional taxation upon street railroads will thwart the splendid growth and development, which they have successfully inaugurated throughout the State, and curtail the convenience and comfort of the people, and stop the increase of assessed valuations (particularly of suburban property), they have materially assisted in building up, as it goes without saying that extensions and new roads will not be constructed with a franchise tax confronting them.

We ask that you adhere to your message of March 27, and respectfully submit that the bill should not receive your sanction until it becomes operative for the entire State. As it now stands, if it becomes a law, Greater New York will escape this year, while the country roads would suffer. We maintain that this would be an unjust distinction.

Air Brakes on European Street Railways

[*From Our Regular Correspondent*]

To Germany belongs the credit of having had the first experimental electric railway in the world, but many years later, when it was proposed to operate the street railways by electricity, the conservative authorities imposed many restrictions which impelled the managers to adopt power brakes in cases where American managers would consider the hand brake quite sufficient. The very general use of trail cars has also been a factor in encouraging the employment of continuous brakes, as by them the service of an extra man on the trail car for operating the hand brake, may be dispensed with. The Standard Air Brake Company, of New York, early recognized that in Germany there was a good field for its apparatus, and this company has now more than 600 cars equipped. Its first installation was made three years ago on 150 motor cars and 100 trailers of the Grosse Leipziger Strassenbahn, which has been adding to its equipment every year until it now has some 250 motor cars, all with air brakes.

At first the motormen were permitted to use the air brakes only when hauling trailers, but, it being so much easier to stop the cars by means of the air than by hand, they naturally used them also when without trailers, if they thought they were not liable to be detected; they are now expected to use the air at all times. This brake had been tried in other cities, where the conditions were similar to those in Leipzig, and was condemned, but it would seem that the failure must have been due to lack of proper understanding and care. Each car comes into the repair shop every three months to have the motor cleaned out, and the compressor is then taken off the axle and cleaned; every second time the eccentric strap has to be closed about 1-32 in. to take up the wear, and occasionally the axle bearings are closed, but the parts being enclosed in an oil-tight casing, wear very slowly. A pint and a half of good oil is put into the casing every two weeks. The management takes considerable interest in the brake and has devised a special screen that is put directly on the pump head over the air inlet, instead of using the screen that is ordinarily put under the car seat. About all the track is paved, so there is very little dust, but to prevent the oil from dropping on the pavement, a drip pan is hung under the pump that catches all that works through the axle bearings. In how many American cities would objections be raised to such drippings?

The city of Prague, in Austria, owns its street railways and is equipping them electrically as fast as possible; they are putting on the "Standard" brakes and have forty out of the first hundred already in operation. The very long and steep grades are favorable to the use of air brakes, as the power used in controlling and stopping on the descent is supplied by the momentum of the car, and the motors have a chance to cool off after the heavy work of ascending the grade. These single truck cars, with channel iron body frames, have the truck running well out toward the ends, and the parts of the two are so intermingled that it is very difficult to distinguish which is which, and the reckless way in which expensive forgings are employed in the construction of these, and, in fact, a large part of the German cars, would bankrupt an American car on a line which will run a little way into the suburbs, and they favor for the denser city traffic and they are being equipped with power brakes, although the limit of speed is still below that of similar American practice.

The accompanying illustration shows a handsome car built on lines familiar to American readers; this is one of a hundred on the Munich Electric Railway, equipped, as are the Leipzig cars, by the Union Electricitäts Gesellschaft, of Berlin, and supplied with air brakes. Nuremberg is putting twenty-four of this same type of car on a line which will run a little ways into the suburbs, and they will be equipped with air brakes. All of the above equipments are of the axle, eccentric driven compressor type, which the Leipzig experience has proven to be well adapted to the needs of city service, but the Grosse Berliner Strassenbahn is trying a later type of spur gear driven axle compressor that is doing very good work. All of this company's electric cars that run into the center of the city are double-truck, and are operated by storage batteries, within certain limits, and by trolley when outside. The cars are naturally very heavy (over 30,000 lbs.) and it has been impracticable to brake them by hand, so the company adopted the expedient of making the stops by short circuiting the motors, which, however, has been found to be severe on the motors, and liable to make a jerky stop. Here the trucks have a great pivotal movement, so it is impracticable to have a mechanical connection between them for the brakes; by putting a cylinder on each truck, the mechanical connection is unnecessary and the brake shoe pressure is perfectly equalized betwen them.

Another car illustrated is one on the Siemens & Halske Company's Berlin-Treptow combination overhead and underground trolley line, on which an extended trial was made by that company of the "Standard" motor compressor air brake equipment before adopting it for the Düsseldorf-Krefeld interurban electric railway, a road about 13 miles long, built on its own right of way. This latter road is operated by 40,000-lb. motor cars with 29-ft. bodies and vestibuled platforms, carried on pivotal trucks; these have a strong plate frame that forms pedestals for the journal boxes. Each box has bolted to its under side a semi-elliptical leaf spring which is parallel with, and just outside the plate frame. The ends of these four springs are fixed to the plate frame by means of stirrups, and the cars ride very smoothly. Each truck carries on its inner axle a 75-h.p. motor with armature mounted direct on the axle. The current is taken from a flexibly supported trolley wire by two of the Siemens & Halske standard low trolleys, of such length that when the direction of the car is reversed the trolley throws over without any attention on the part of the employees; switch points never give trouble as the trolley can't get off. The contact part is renewable and made of an aluminum casting of inverted U section, ¾ in. wide, 1¼ ins. deep and 3 ft. long; it is kept well greased and gives good satisfaction.

This same motor compressor type of air brake is used in large numbers on the Upper Silesia Interurban Electric Railway, which is an interurban road with 75 miles of line connecting a number of cities in the coal mining and iron smelting district of Eastern

Germany, an open rolling country that reminds one of Nebraska. The gage is but 29½ ins., and the company has at present fifty double truck motor cars and fifty double truck trailers, all equipped with air brakes, and more have been ordered.

The only other air brake for street railways that is used in Germany is Riesinger's "spring pressure" brake, which, as its name implies, makes use of a strong conical spring of steel of a rectangular section, and with a long range of action, as the braking power. The rod to which the spring pressure is applied is also connected to a diaphragm similar to that used in vacuum brakes, in such a manner that when compressed air is admitted to the chamber, the spring action is overcome to any desired degree, thereby reducing the brake pressure or throwing it off altogether. Thus air pressure must be maintained in the train pipe and diaphragm chambers while running, and to apply the brakes air is allowed to escape, giving a braking force equal to the difference between strength of spring and the pull of the diaphragm. This is, therefore, an automatic brake, as the parting of the coupler will allow the air to escape and the springs will make an emergency application. The hand brake must, of course, operate in the reverse from the ordinary, i. e., it must be pulled off to effect a release. This brake is used on the Bergische Kleinbahn, near Elberfeld.



ELECTRIC CAR IN MUNICH

Brussels is situated at the base and on the side of a very considerable hill, and the finest boulevard runs well up on to it and down again, having thus two steep grades, each about three-quarters of a mile long. One of the tramway companies has a line running from the Southern Railway station, through this boulevard, to the Northern station, a distance of 3½ miles, and it is operated with single truck cars drawing trailers. On account of the grades, a city ordinance requires that these trains be equipped with automatic brakes, and the road has therefore supplied the twenty motor cars and their trailers with Westinghouse automatic air brakes. Each motor car carries on its roof two main reservoirs 12 ins. in diameter and 12 ft. long, which are charged, at the southern terminus, by a stationary compressor situated in the power station not far away. They use a maximum pressure of 105 lbs. per sq. in. and run it down to 50 lbs. The balance of the brake equipment is similar to that used on steam railways. One charge will last for 12½ miles, making 100 stops with motor car and trailer. The railway people express themselves as being well pleased with the brake, but do not use it as yet when running the motor car without the trailer.

In France the electric tramways have hardly done anything with air brakes, although there is a growing interest in them. Here, as in European countries generally, the trail car meets with considerable favor, and the Department of the Prefect of Police of Paris has recently issued an ordinance to the effect that all street railways running into Paris and operating trail cars must be equipped with a continuous power brake, that may be applied from any platform of the train without previous warning to the "wattman," as they term the motorman. The Thomson-Houston Company, which built and operates the Bastille-Clarenton line of the Cie Générale Parisienne de Tramways, proposes to use trailers there, and as the electric brake does not fulfil the requirements of the Prefect of Police as regards trailers, they are trying the "Standard" geared axle compressor equipment. The engineers, preferring the less complicated direct air system to the automatic with triple valves, etc., fulfil the requirements by carrying a reservoir pipe back through the trail car, and providing on each platform a stop cock, by means of which the conductor can let the air from the reservoir into the brake cylinders whenever necessary. The police also require that all cars shall be provided with a brake that will stop the car (loaded to its allowed capacity) on a 2 per cent down grade, within 65.6 ft. when running at a speed of 12.5 miles per hour. This the hand brake will do if the slack is well taken up before the signal to stop is given. The engineer of the Prefect of Police states that in a test made by him of a loaded car equipped with air brakes, it was stopped, without using sand, on a 2.2 per cent grade in 33 ft. when running at 13 miles per hour, which was highly satisfactory. The illustration shows one of the motor cars of this line, and it will be noted that steps are provided only at two diagonally opposite corners, also that the platform extends into the body for a distance equal to half the width of the car. Swinging doors are provided so they may be swung out from the sides until they meet, shutting off the narrow outside platform,



BERLIN CAR WITH AIR RESERVOIR ON ROOF

at the forward end, and forming a little vestibule in which eight second class passengers may ride, six standing and two sitting on little folding seats that shut up to permit of swinging the doors open when this end is to the rear. Eighteen first class passengers may sit inside, and ten more second class may ride on the rear platform. The fare within the city is, first class, four cents, and second class, two cents.

For many years tramways have been operated in Paris by steam or compressed air motor cars hauling trailers, and these are equipped with the Soulerin automatic air brake. The compressor, placed on the front platform (the cars always run one way) which is occupied by the driving mechanism, stands vertically, and is actuated, through a bell crank under the car, by an eccentric on the



PARISIAN ELECTRIC CAR WITH STEPS AT SIDE

axle with a long connecting rod, so the vertical motion of the car body has practically no effect on the stroke. This brake has given very good satisfaction, but the speed rarely attains 15 miles per hour; this compressor could not be used on electric cars, as its location on the platform would be objectionable, as also the long connecting rod.

In England, on the Liverpool Overhead Railway and the Waterloo & City and the City & South London, the Westinghouse automatic brake is used, the air being stored in reservoirs carried on the train. The latter road, however, is equipping its new electric locomotives with Standard compound motor-driven compressors and will have twelve in service shortly. The Central London Underground Railway electric locomotives will all be equipped with motor-driven compressors supplied by the Christensen Engineer-

ing Company. The surface tramways have begun to use the air brake, fifteen of the "Standard" geared axle compressor equipments having been put on the double truck cars of the Liverpool Tramways last fall. There are some long, steep grades in Liverpool that make it advisable to equip the heavy cars with power brakes. This corporation also operates fifteen trains of single truck motor cars with trailers, supplied by a German firm, and these are equipped with electro-magnetic brakes. The Potteries Tramway Company, of North Staffordshire is to operate with single truck cars hauling trailers, and they are equipped with the same air brake that is used on the Liverpool tramways.

Power brakes have become a necessary part of the equipment of double truck cars, and of single truck ones on roads with heavy grades, or where trailers are used, and the use of the compressed air for this purpose is meeting with increased favor.

Electric Railway Construction in Germany

George P. Pettit, American Consul at Düsseldorf, writes as follows:

"Of the more important German cities, Aix la Chapelle, Brunswick, Chemnitz, Dresden, Hamburg, Hanover, Leipzig, Munich and Stettin have almost completely abandoned horse cars and are supplied with electric roads. In the cities of Berlin, Breslau, Cassel, Cologne, Frankfort-on-the-Main, Düsseldorf, Barmen, Elberfeld, Königsberg (East Prussia), and other places, horse lines are being converted into electric roads, and most of these have suburban electric roads completed. A large number of electric lines are being constructed in the country districts about Aix la Chapelle, Bochum, Gelsenkirchen, Düsseldorf, Vohwinkel, Elberfeld, Barmen, Elbthal, Essen, Krais Hoerde, Reisengebirge, Waldenburg (Silesia), Witten-Ruhr, and in the mining districts of the Saar (Southern Rheinland) and in Upper Silesia. In thirty-five cities and districts, not mentioned in the above lists, electric roads were in the course of construction on Sept. 1 last, in nine of which the roads were completed and put into operation before the close of the year; so that at the beginning of the year 1899, there were seventy-seven cities and districts in the Empire supplied with electric roads. In thirty-five of these places, extensions were being made to the lines in operation Sept. 1, 1898, some of which were completed before Jan. 1.

"The following is a comparative statement of electric railway construction in Germany for the past three years:

DESCRIPTION.	August, 1896.	September 1, 1897.	September 1, 1898.	Per Cent. of Increase in 1898 Over 1897.
Power houses	42	56	68	21.4
Miles of roads	362.2	594.7	888.1	21.4
Miles of tracks	530.7	842.1	1,204.9	43
Motor cars	1,571	2,255	3,190	41.5
Trailers	589	1,601	2,128	32.9
Electric power, kw	18,560	24,920	33,333	33.8

"Adding the roads put in operation since Jan. 1, 1899, it is estimated that there are now 930 miles of electric roads, with a total of 1300 miles of tracks in Germany. Many American cars are used.

"From the city of Düsseldorf there are now four suburban electric lines completed: From Düsseldorf to Crefeld, about 12 miles; from Düsseldorf to Rattigen, about 8 miles; from Düsseldorf to Benrath, about 6 miles, and from Düsseldorf to Kaiserswerth, about 5 miles."

An Outside Paint

Thomson Brothers, of 395 Park Place, Brooklyn, N. Y., manufacture a paint for the protection of all kinds of metal and wood structural work, etc., and which, it is claimed, will greatly prolong the life of such constructions. The company exhibits a number of testimonial letters testifying to the fact that the Thomson paints, wherever applied, have shown unusual qualities in retaining their life in pigment color and body to a remarkable degree, and effectually protecting metal work from corrosion and rust.

One firm, after using these paints for from seven to eight years, states that it has not re-painted its freight car bodies which were treated with the Thomson paint in 1891, 1892 and 1893, and that the roofs of the same cars did not require repainting until after four years of hard service. Another concern says, "we cannot recommend Thomson's paint too highly;" and another states it is the greatest coverer and cheapest paint of which it has any knowledge. The Government Building, at the World's Fair, Chicago, was painted with this brand.

The Functions of an Electric Truck, I

BY EDGAR PECKHAM

I read with much interest and some amusement the article on the Parallel in the Development of the Locomotive and the Electric Truck, by John A. Brill, in the May issue of the STREET RAILWAY JOURNAL. The comparative description of the early English locomotive and a recent type of heavy passenger locomotive intended for use on American railways seems to me to be particularly unfortunate, and especially so in the deductions drawn that, because the two engines are not alike, the bar type of frame is more suitable than a plate frame for use on an electric car. The writer forgot, or perhaps he is not aware, that the great majority of the locomotives of the world have plate frames, and that the bar frame is a distinctively American characteristic and is by no means acknowledged to be the best by builders and users outside of the United States. He also overlooked the fact that the duties required of a locomotive and of an electric truck are entirely different.

It would have been better, it would seem, to have discussed the stresses which an electric truck has to bear, and then to have considered the most desirable means for carrying an electric car,

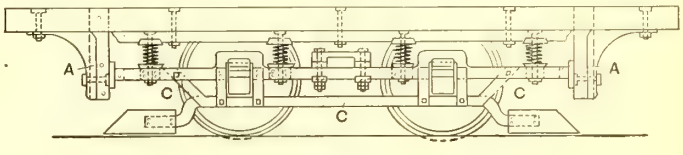


FIG. 1

rather than to have branched off into a field where the conditions are absolutely dissimilar.

The function of a locomotive frame is not to sustain a load, as is the case with an electric truck frame, but to hold the wheels in alignment and resist the stresses resulting from the operation of the machinery. The electric truck, on the other hand, is built to carry a load and the horizontal stresses are those involved in the propulsion of its own burden. As the power is applied directly to the axle, these horizontal stresses, due to propulsion, drop to comparative insignificance, leaving the principal function of the

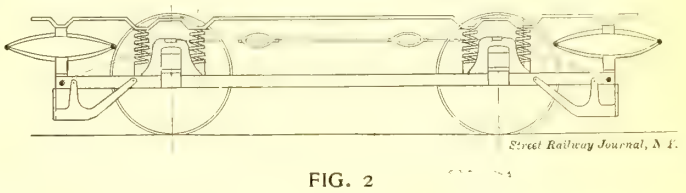


FIG. 2

truck that of carrying the load, which must be done in such a way as to make the car ride easily and without oscillation. Both experience and theory dictate that to eliminate the oscillation, a long spring base is necessary, so that, as a result, practically all of the single trucks on the market carry the greater part of the weight of the car at the ends of the truck.

With these facts before him, the writer of the article under consideration says that "it is hardly surprising that the truss idea took such firm hold upon the builders who had thought of the subject in a superficial manner only. The truss is naturally the first thing that comes into the mind, because the load seems to be the most important factor of the problem."

This statement is apparently accompanied by a lapse of memory, which can be easily filled in by a reference to Figs. 1 and 2, which are examples of the first attempts to introduce the principle of the truss into truck construction. Fig. 1 is that of the braced cantilever construction, which has been found to be so thoroughly suited to the needs of the service for which it was designed, and so capable of being adapted to all varieties of cars that it has been adopted, and is in use by the largest electric railway companies of both this country and of Europe, over 10,000 of these trucks being in constant service. Ever since their introduction these trucks have been continuously and are still replacing the solid forged truck frames, for the reason that their design is based upon correct mechanical principles.

The truck shown in Fig. 2, on the other hand, was an attempt to utilize the suspension principle in the framing of the cantilever car truss. This design was found in practice to involve the constant taking up of the stretch of the rods, coupled with the liability of the ends of the cantilever to droop. These conditions

caused the Brill Company to abandon the use of the suspension rods and substitute therefor the plain bar frame.

In a recent discussion of the subject in the London "Electrical Review," by Henry E. P. Cottrell, A. M. I. C. E., some illustrations are given, which are here reproduced in Figs. 3 to 6. Figs. 3 and 4 are examples of the standard extension trucks, as made by the Peckham and Brill companies respectively, and drawn to the same scale. Figs. 5 and 6 are diagrams showing how the cantilever trusses have been combined by the two companies. The differences betweeen the two are clearly apparent, and it is equally apparent that the form shown in Fig. 5 is superior to that of Fig. 6, and that, with the same wheel base, the spring base of the type shown in Figs. 3 and 5 is much greater than that of Figs. 4 and 6, and that the inclination of the raking members of the extension truss is much more favorable for affording support in the former than in the latter, also that whereas the underframing of the car body serves to materially increase the strength and resistance of the same to bending moments at the ends or to counteract the tendency to drooping into the former, this is not at all the case with the latter truck. Referring to these diagrams the writer mentioned says:

"The adaptation of the extension principle in the truss shown in Figs. 3 and 5 is evidently the *only* practical solution of the problem involved in the ever increasing demand for longer car bodies supported on a single four-wheel truck of a limited wheel base."

Could anything be more widely removed from the above opinion of an English expert than the closing sentences of the article in the Street Railway Journal, where it is stated that: "A little practical experience was required to show the fallacy of the idea," that is, of the truss. To be sure there is some reason for considering the truss idea fallacious when experience in practical construction was limited to the design shown in Fig. 2, and which, not being susceptible of improvement, was naturally abandoned, especially when practical experience agreed so perfectly with the theoretical analysis, that has been carried out to embrace even the type for which Fig. 2 was abandoned as shown in Figs. 4 and 6. In short, for extended car bodies, the unbraced solid brackets prove entirely inadequate, as is shown by the attempt to employ a modified truss frame under the car by the advocates of the single bar truck, but hampered by the unfortunate design of the truck proper, the result has been unsatisfactory.

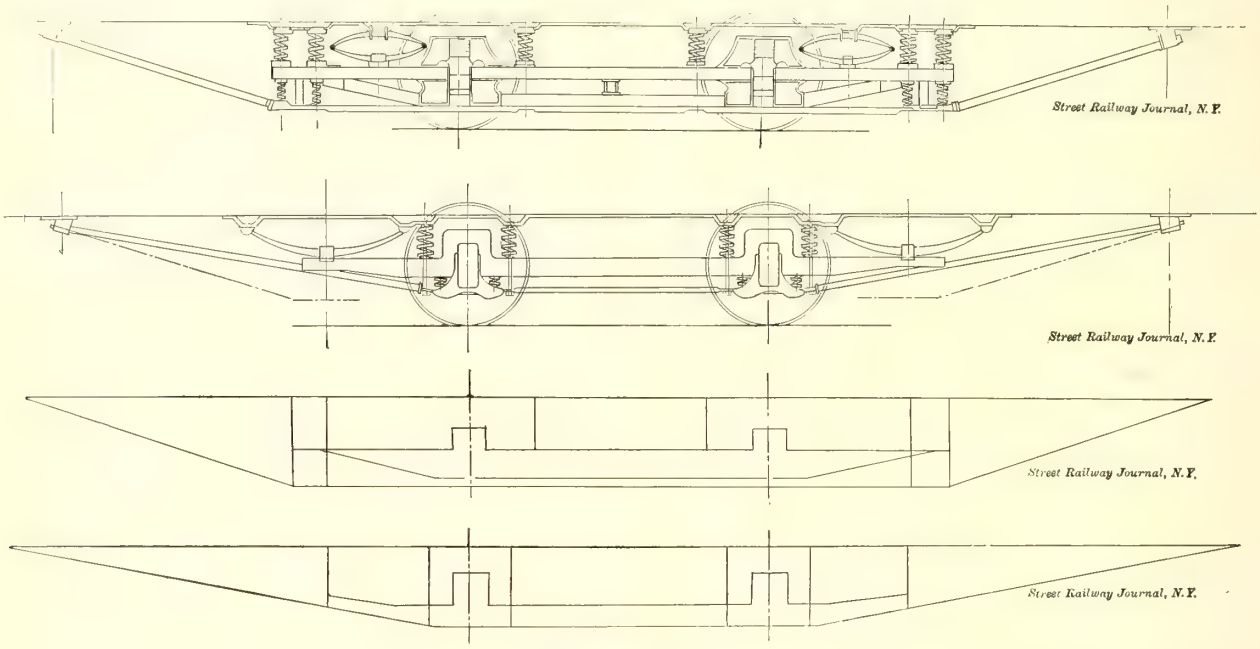
As a final argument, Mr. Brill claims to believe that the riveted construction used in the cantilever bridge truss frame is an objectionable feature, and thinks that the rivets will become loose under service, but the same argument would apply to all made-up structural work, including railroad bridges, trusses and viaducts, in which the jars and strains upon the members are greatly in excess of those encountered under an electric car. If there was any foundation for this claim that riveted girders are structurally weak, every railroad bridge in the country, and every supporting span on elevated railroads would be unsafe for travelers. As a matter of fact, the riveting in truck construction is carried on and surrounded by all the facilities of an up-to-date machine shop, with pneumatic machines, so that the construction is certainly superior to that possible outside of a shop, but the experience with all structural work in the country proves that there is nothing stronger or more durable than riveted construction, when properly done.

It is, of course, quite impossible within the limits of a single article to discuss the distribution of the stresses as applied to an electric truck and a comparison of the same in relation to those applied to a locomotive. I, therefore, reserve such a discussion for a future article, and meanwhile merely wish to reiterate the fact that an electric truck does not perform the functions of the framing of a locomotive, that its main purpose is to carry the weight of the car and motors, and that this is the viewpoint taken by competent engineers, and that when they are called upon to design the two, they plan in accordance with principles suited to the work in hand, and do not make a thoughtless jump to the conclusion that because American engineers consider a bar frame as best suited to their locomotives, it follows that the same construction is to be blindly followed in the building of an electric truck.

(To be Continued.)

New Rail Bond Catalogue

The Protected Rail Bond Company, with general offices at Philadelphia, Pa., has just issued an exceptionally attractive catalogue of its rail bonds and rail bonding tools. The catalogue consists of thirty-two pages and cover, and illustrates fully all of the various types of "Protected" rail bonds manufactured by the company. The Protected Rail Bond Company has acquired all of the patents and the rail bond business heretofore conducted by Messrs. J. M. Atkinson & Company, of Chicago, and the Forest City Electric Company, of Cleveland, and is now manufacturing the "Protected" bonds under these patents.



FIGS. 3 TO 6

The product of the company will be sold through two general sales agencies, located in Philadelphia and Chicago. Messrs. Mayer & Englund, of Philadelphia, Pa., will have full charge of all business in the eastern part of the country, including all export business. Messrs. J. M. Atkinson & Company, of Chicago, will have full charge of all business for the western part of the country. District agents will be appointed to work under supervision of the general agencies.

The rail bonds manufactured by this company are so well known that they need no introduction to street railway managers and engineers, as they have been sold in large quantities all over the world for the past three years. The facilities of the Protected Rail Bond Company for manufacturing its bonds are most excellent, and provisions have been made to take care of the unusually large business already secured for this spring. The factory, which is located in Cleveland, Ohio, is now working night and day to keep up with the orders, and the season of 1899 is just opening up.

The Protected Rail Bond Company will shortly announce its readiness to place upon the market its complete outfit for punching and bonding rails with hydraulic tools, on which experiments and tests have been conducted for the past year. Two or three important contracts have been taken for the installation of "Protected" bonds with these hydraulic tools, and the result is being watched with interest by many leading engineers.

Electro-Magnetic Traction System

For some years the Westinghouse Electric and Manufacturing Company has been perfecting an electro-magnetic system for traction purposes. A short line equipped with this system was operated successfully for several years on North Capital Street, Washington, and it has been in active daily service in the yards of the Westinghouse Company for the past four years.

The Government has recently installed an electric railway on this system at the United States Navy Proving Grounds at Indian Head on the the Potomac. The entire line is about 3 miles in length, part being operated by an overhead trolley, and the remainder by the Westinghouse magneto-electric surface contact system. The railway track crosses the firing line, where the overhead wires would be in danger from projectiles, and an underground or surface system was imperative. A part of the track is shown in Fig. 1. The line is equipped with two 100-h.p. Westinghouse freight locomotives shown in Fig. 2, and one combined passenger and freight locomotive of 50 h.p. The principle and operation of the magneto-electric system will be best understood by referring to Figs. 3 and 7.

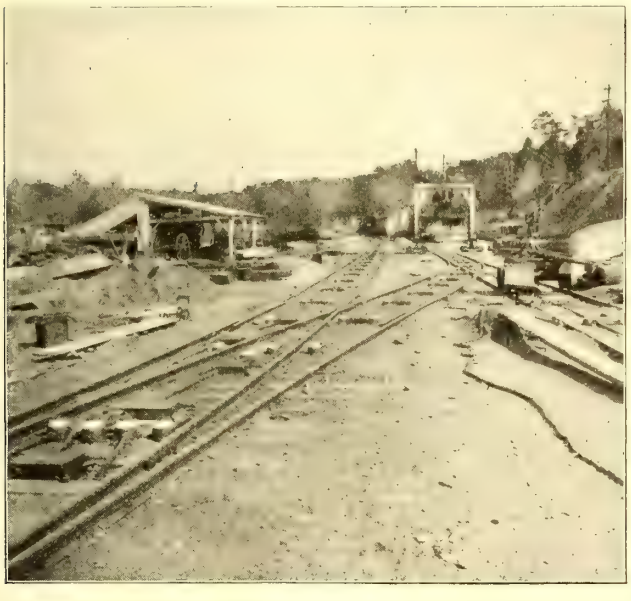


FIG. 1.—VIEW OF TRACK

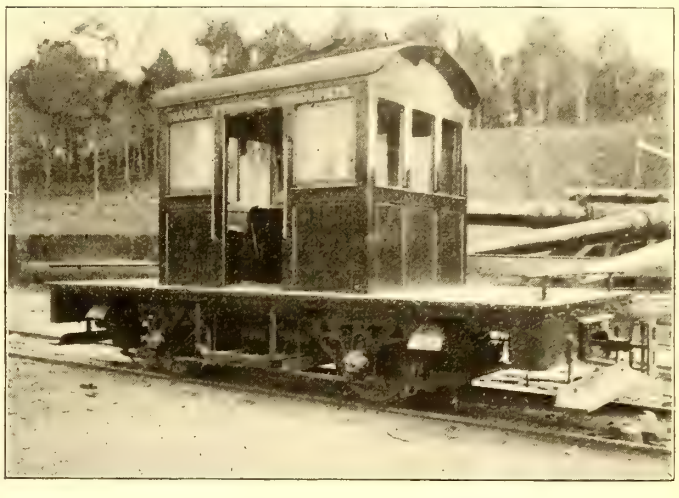


FIG. 2.—ELECTRIC LOCOMOTIVE

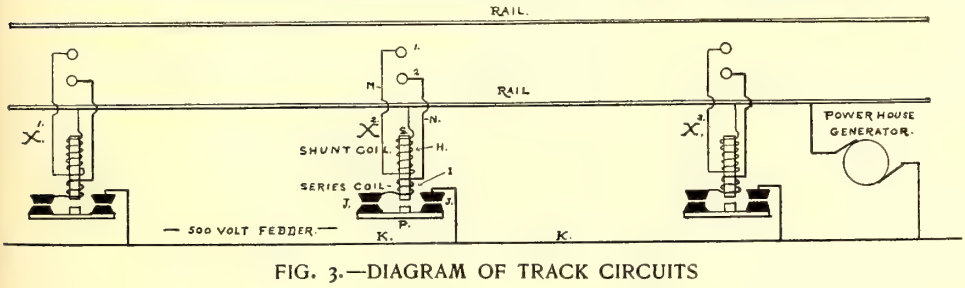


FIG. 3.—DIAGRAM OF TRACK CIRCUITS

Electro-magnetic switches, X, X, X, encased in water-tight casings, are installed at intervals of about 15 ft. along the track to be operated. Each switch is provided with two windings, I and H, which are connected by the wires N, M, to two cast iron contact plates, 1 and 2, which are mounted on suitable insulators and placed between the running rails. Each car to be operated on this system is provided with two spring mounted T steel contact shoes, Q^1 Q^2, six cells of storage battery, and a small motor transformer in addition to the usual controllers and motors. The contact shoes, Q^1 Q^2, are mounted at the same distance apart as the contact pins 1 and 2, so that as the car advances along the track the shoes will make contact with the successive pairs of pins in turn, always being in contact with at least one pair, as the length of the bar exceeds the distance between any two pairs by several feet. To fully understand the operation of the system, suppose a car is standing on the track over the switch X^2, the contact shoes Q^1 and Q^2 being then, of course, in connection with the pins 1 and 2 respectively. The first step is to pick up the current, i. e., render the pins 1 and 2 alive. Switch A is first closed, this completes the circuit from storage battery D, through the motor transformer, which immediately starts up. As soon as transformer is up to speed, requiring only a few seconds, switch B is closed; current then passes from transformer through wiring R R, contact shoe Q, pin No. 1, coil H to ground. This current passing through the coil H, magnetizes the core S, which, in turn, attracts the armature P, closing the switch and establishing connection between the pin 2, and the 500-volt main feeder K, K, through wiring N, coil I, and contacts; switch C is now closed and switches A and B opened, the transformer then stops, the switch X^2 is kept closed, however, by the current flowing from the main feeder through lamp L connection R, M, coil H to ground. The car now proceeds on its way, current from the main passing through coil I, contact bar A^2 connection T, to the controller and motors in the usual manner. When the car has advanced a short distance the contact bars make connection with the pair of buttons connected to switch X^3. Current then passes from the bars through the shunt coil of this switch, closing it, and connecting it in its turn with the main feeder.

As soon as the bars leave the pins 1 and 2, current ceases to pass through the coils I and H, and switch X^2 immediately opens by gravity, leaving the pins connected to it dead and harmless. As connections with the main have already been established through switch X^3, the opening of switch X^2 does not interrupt the flow of current to the car. It will be observed that all the current passing to car from main through switch contacts J, J, passes through the heavy coil I, holding the switch firmly closed, precluding all possibility of switch opening while current is passing through contacts, even should circuit through coil H be interrupted. Although the act of "picking up the current" requires some time to describe, it takes in practice only a few seconds. The battery and transformer are employed only to lift the first switch, for after that has been closed, the contact shoes bridge the main voltage over from one set of pins to another, closing the successive switches, without further attention from the motorman. If it is desired at any time to render the section "dead," over which the car is passing, this may be immediately accomplished by opening switch C. Figs. 4 and 5 show the practical installation of this system for yard work, and is the form installed at Indian Head Proving Grounds.

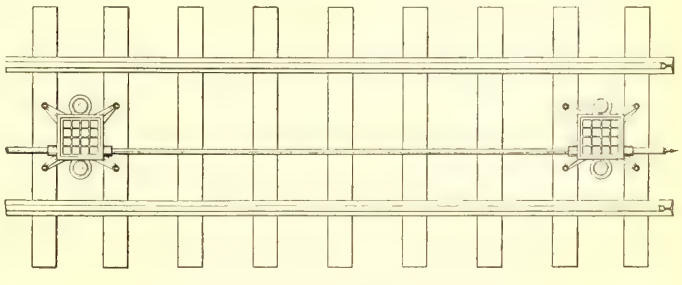


FIG. 4.—PLAN VIEW OF BOXES

The switch, switch box, and contact pins as shown, are made up into a complete unit which is wired up before leaving factory

and shipped ready for installation, only requiring to be set upon the ties and connection made with the main feeder. This spider-like structure consisting of box rim, insulator receptacles, and supporting arms, is made in one malleable iron casting. The lid, which is removable, is a separate casting. A wooden box coated with tar is fitted into a recess provided for that purpose in the bottom of casting and is bolted in place. In this box is placed the electro-magnetic switch which is covered by an air-tight bell shown in Fig. 6, and which will be described more fully later on.

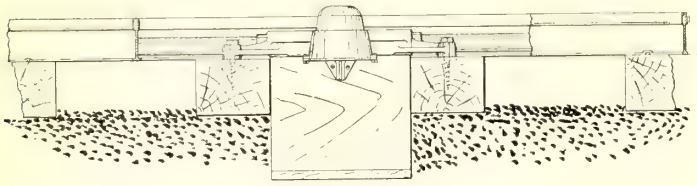


FIG. 5.—SIDE ELEVATION OF TRACK

The insulators, Fig. 5, which are mare of a special composition, are cemented in the tapered cups and backed up by the malleable iron plate. The contact pins are mounted on top of these insulators, and stand, when placed in position, 1½ ins. above the running rail.

The simplicity in the wiring required for this system should here be remarked. One wire only, and that the main feeder, is required to be run, and this is encased in iron pipe and passes

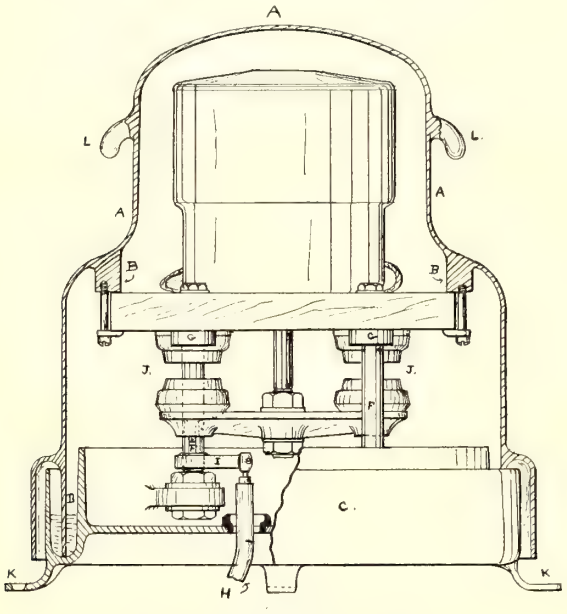


FIG. 6—SECTION OF BOX

directly through each switch box. No additional wires are used interconnecting the coils or contacts of adjacent switches, this objectionable feature being entirely eliminated. The contacts are of carbon and their life seems practically unlimited, as we have been unable to detect any appreciable wear on the contacts of switches which have been in continual use for three years.

Fig. 6 clearly shows general arrangement of switch, bell and

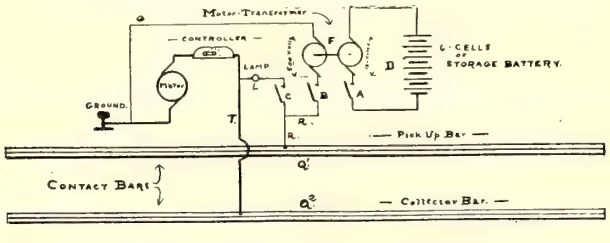


FIG. 7.—DIAGRAM OF CAR CONNECTION

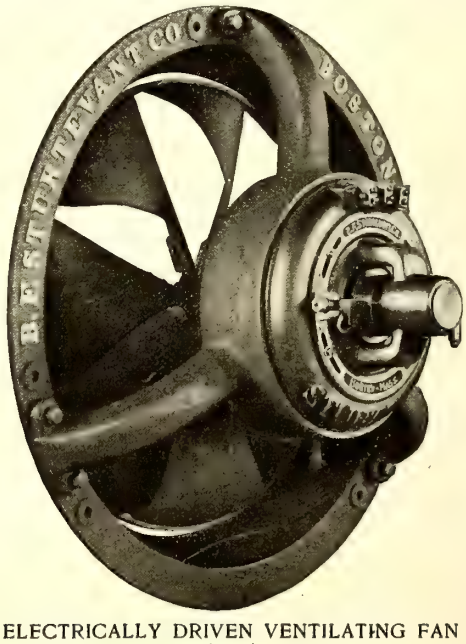
pan. The switch is mounted upon a marble slab, which is secured in the circular bell by means of screws to the bosses, B, B. The bell A is provided with lugs L to facilitate handling, and also with a double lip which fits into and over the annuallar groove D, in pan C, when bell is in position; thus providing a simple and effective method of protecting the switch from moisture. The bells may be entirely submerged in water without affecting the operation of the switches. Connection from the several cables is made to split pins, which are supported upon lugs in the pan C, and insulated therefrom. The switch is provided with receptacles which correspond to these pins, so that it may be quickly and readily removed for examination, without the necessity of disconnecting any wires. All switch parts, bell, pans, insulators, etc., are made interchangeable.

On the turn tables are placed two switches and pairs of buttons. A light section of steel, bent to the radius of turn table pit, is fastened on insulators to inner side of same, and permanently connected to main feeder. A spring contact finger mounted on turn table, makes contact on face of T section, thus keeping up constant connection with the main regardless of position of turn table.

A New Type of Electric Propeller Ventilating Fan

Since the B. F. Sturtevant Company, of Boston, Mass., has entered extensively upon the manufacture of electric motors and generating sets, it has been carefully studying the problem of the manufacture of a compact, efficient and convenient type of electric ventilating fan. Exhaustive tests were made with different types of wheels. The result is made clear by the accompanying engraving, showing a view of one of its electric ventilating fans which has just been put upon the market.

The fan wheel has eight blades rigidly attached to a spider at the center, and held in place by a hoop at the periphery, at an angle of approximately 30 degs. The angle is increased in such a manner that as the center is approached, the theoretical velocity of the air remains practically constant. In other words, the delivery edge is helical, and the air is picked up on the inlet edge of the blades at low velocity. When well under the influence of the blades, it is accelerated to its maximum velocity with the least amount of slip. The result is an extremely efficient wheel.



ELECTRICALLY DRIVEN VENTILATING FAN

The motor likewise has been the result of very careful study in the attempt to provide a light machine, entirely enclosed, and at the same time to avoid the excessive temperature which is incident to the operation of most enclosed motors. The result is a machine capable of continuous operation for ten hours, with a maximum temperature rise of not exceeding 30 deg. F. A practical efficiency of over 80 per cent is obtained even with the small-sized motors, and an excess load of 75 per cent above the rated capacity may be carried without sparking, and without changing of brushes. This feature, combined with the small temperature rise, allows of carrying temporary overloads with impunity.

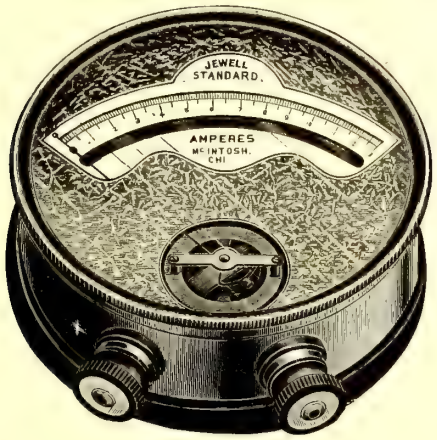
The bearings are self-oiling and self-aligning, and are fitted with phosphor-bronze sleeves, which are removable from the outer ends of the boxes.

The wheel is partially enclosed in a conoidal inlet ring, which decreases the frictional resistance of the entering air, and furnishes at the same time a rigid support for the motor, to which it is attached by the tripod hanger.

These fans are built in sizes from 18 ins. to 120 ins., with motors designed for either medium or maximum speed, and to run at any ordinary direct current voltage. A speed controller is always provided, by means of which the fan can be efficiently operated at different speeds.

Standard Portable Meter

A new portable standard electrical measuring instrument, for direct current only, is being placed upon the market by the McIntosh Battery & Optical Company, Chicago, and is shown herewith. Its construction is exceedingly rigid, fitting it to withstand the rough usage to which portable instruments are frequently subjected. This meter is of the d'Arsonval pattern, having a coil moving in the field of a permanent magnet. It has uniformly spaced scale divisions and an adjustable dial, so that should the



PORTABLE AMMETER

index become bent it is but the work of a moment to set it to zero. The instrument is dead beat.

The permanent magnets are made from imported magnet steel, and are thoroughly aged before being placed in the instrument. The springs are made from a special low-resistance phosphor-bronze alloy, and are of a very fine temper. The series coils in the volt meters and the shunts of the ampere meters are made from an alloy having a zero temperature coefficient.

A neat hardwood carrying case is provided with each meter. The volt meters have a resistance of about 120 ohms per volt of scale; *i. e.*, a 0-150 volt meter has a resistance of 18,000 ohms.

New Open Cars for Brooklyn

The Brooklyn Heights Railroad Company, of Brooklyn, N. Y., is now putting in service a large number of thirteen-bench, bulkhead open cars, which, on account of the careful way in which the details have been worked out, are worthy of special attention from street railroad men. These cars are built by the J. G. Brill Company, and are 35 ft., 9 ins. over the corner posts and 45 ft. 2 ins. over all. The greatest width, which is over the drip rail, is 7 ft. 10¾ ins. At the sills they are 6 ft. 6 ins. there are two platforms, each 3 ft. 11 ins. long, and a seat is placed on each of them. The height from the head of the rail to the underside of the sill is 25 ins. The height over all is 8 ft. 11 ins. A single step is used which is 18 ins. from the head of the rail, with a 15-in. riser. These cars are mounted on a pair of Eureka maximum traction trucks with the usual 4-ft. wheel base and wheels of 20 ins. and 30 ins. diameter. These long, large and comfortable cars are especially fitted for the heavy work which the Brooklyn street railways experience during the Coney Island season. The power is furnished by two W. P. 50 motors. Although plated sills are used, and the Brill Company in the construction of these cars has taken great pains to make everything as strong and substantial as necessary, the total weight of the car complete, without motors, is only 18,250 lbs.

There are four stationary seats set back to back against the bulkheads, and nine reversible seats in the body of the car. All of these are furnished with round corner seat end panels. The seats and backs are of slat. The interior finish is of ash, with a plain three-ply quartered oak head lining with the usual advertising moldings, etc. The guard rails are of solid ash, made in one piece, extending from bulkhead to bulkhead. These slides on the hickory grab handles which are set in bronze sockets. The platforms are closed with leather covered chains. The glass in the raised roof is of beveled edge throughout. There are electric headlights on each platform. The curtains are of pantasote mounted on Hartshorn fixtures and come all the way to the floor. These cars when closed have nearly a perfect protection from the weather the same as an ordinary closed car. The curtains being waterproof and fitting closely are much more effective than the old type. The registers are operated by a half-inch square rod running along the posts with ringing handles at the proper places. The edges of the sill plates are carefully rounded so that there is no danger of catching the foot in entering or leaving the car. The seat arms are made in such a way as to give great strength and to have the least possible projection in the seat. The seats themselves are spaced 2 ft. 7 in. This is not so great as to invite overcrowding, and yet it gives ample space for comfortable seating. The details throughout have received an unusual amount of attention. The car is tastefully painted in cream and maroon, with striping and lettering of aluminum. Taken in connection with the solid bronze trim, which is used throughout, these cars are among the handsomest recently turned out from the Brill shops.

Demand for Brake Shoes

The "Compo" brake shoes, as manufactured by the Composite Brake Shoe Company, of Boston, Mass., and which have been in very extensive use for some time on the electric street railways of the United States, are now being introduced into other fields. By making a few minor modifications the shoe has been adapted for use on all kinds of heavy carriages and wagons, fire apparatus, automobiles, etc.

As is well known, these shoes are made of cast iron, with sock-



NEW OPEN CAR FOR BROOKLYN

ets into which cork inserts are compressed. The cork is tenacious, and being elastic, gives excessive braking or frictional results without the gripping effect of contacting metals. It wears uniformly with the iron; not more, nor faster.

In proof of the fact that the Compo shoes are well suited to the requirements of heavy wagons, such as fire apparatus, etc.,

it is stated that the fire department of Boston, after a very severe test, has ordered these shoes placed on twenty engines, twenty hose wagons, and ten ladder trucks in that city.

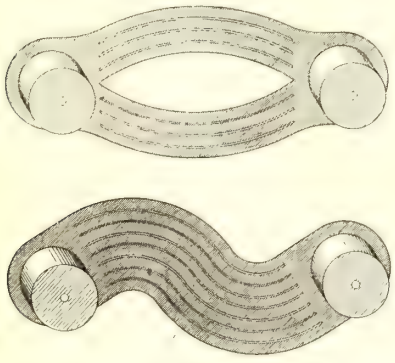
The Compo shoe is, of course, also well adapted to the needs of steam railroads, and is very extensively used on passenger and freight cars throughout America. In a recent test on the Boston & Maine Railroad a shoe fitted with cork inserts ran 58,794 miles from March 18, 1898, to March 1, 1899, and when taken off was still good for service. During this period it had made 14,688 station stops; the average miles per hour, including stops, being 30. The shoe weighed when put in 64½ lbs., and when taken out 51¾ lbs., showing a loss of metal of 12½ lbs. The average thickness of the shoe when new was 2⅛ ins., and when taken out it was 1 5/16 ins., showing an actual wear of 13/16 in. This record gives 4700 miles for each lb. of metal lost by wear. There are a number of very heavy grades on the route over which the test was made.

A One-Piece Rail Bond

A device that promises to perfectly fulfill the long existing demand of street railway managers for a one-piece protected copper bond is being brought out by Elmer P. Morris, of New York city, the well-known dealer in electric railway specialties and supplies.

The new bond is shown in the accompanying illustrations. It is drop forged compleett, with terminals and body in one piece from pure copper, thus insuring the best possible carrying capacity. To give flexibility, and to permit the bond to be used under varying conditions, a number of parallel slits are cut, running the length of the body as shown. The bond is then spread apart or bent at the middle, according to the circumstances under which it is to be used.

The bond is applied in the usual way, terminals being furnished in any size desired, ranging from ⅝ in. to 1 in. or more in diameter. The connecting strap or body is made of any capacity, from that of 00 copper wire up to 00000000. Mr. Morris reports that there are orders already in hand for this new device to keep the works busy for six weeks to come.



TWO FORMS OF ONE-PIECE RAIL BOND

Heavy Engine Building in Milwaukee

The home and foreign demand for heavy engines for electric railway work continues to be urgent, and it is becoming impossible to fulfill desired dates of delivery. The E. P. Allis Company, of Milwaukee, one of the best-known heavy engine builders in the world, has now actually going through its works in various stages of construction, nearly 125,000 h.p. of heavy engines for electric railway service, among these being engines for the following well-known companies:

Metropolitan Street Railway Company, of New York, eleven engines of 4500 h.p. (each maximum capacity 7000). These are the largest engines of any kind ever built in this country and perhaps in the world. The cylinders are 46 ins. and 86 ins. x 60 ins., and the distance from the foundation to top of cylinders is about 38 ft. 3 ins. The shaft is hollow, being 37 ins. in diameter at center, and having an opening 16 ins. in diameter extending the entire length. The journals are 34 ins. x 60 ins. Three of these engines have been delivered and the fourth is ready for shipment.

The Boston Elevated Railway Company, two engines, 4500 h.p. each, of substantially the same type as the Metropolitan engines, but without the cross connections between high and low pressure cylinders, which, in the New York engines, secure independent operation of each side, in the event of breakage.

The South Side Elevated Railway Company, of Chicago, two engines of 2500 h.p. each.

Metropolitan Street Railway Company, Kansas City, one engine of 2500 h.p., and one engine of 1200 h.p.

Metropolitan West Side Elevated Railway Company, of Chicago, two engines, 2250 h.p. each.

North Jersey Street Railway Company, Jersey City, one 2000-h.p. engine.

Northwestern Elevated Railway Company, Chicago, three 2000-h.p., and one 1000-h.p. engines.

London Electric Lighting Company, three 1600-h.p. engines.

The Milwaukee Electric Railway & Light Company, two 1600-h.p., and two 1000-h.p. engines.

Toledo Traction Company, one 1600-h.p. engine.

Consolidated Street Railway Company, Grand Rapids, one 1300-h.p. engine.

New Orleans & Carrolton Railway Company, one 1300-h.p. engine.

Richmond, Va., three 1000-h.p. engines for railway service.



LARGE ENGINES FOR NEW YORK

Bristol, Eng., four 1000-h.p., and the London Tramways Company, four 1000-h.p. engines.

Among the smaller railway engines building in the same shops are a 900-h.p. for Sioux City, and 800-h.p. for Buenos Ayres, Argentina; two 600-h.p. for Cork, Ireland; two 500-h.p. for Lebanon, Pa., and two 400-h.p. for Anderson, Ind.

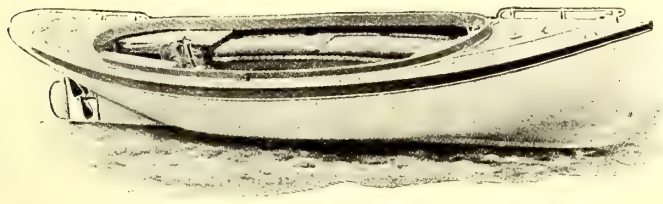
It is announced that the Fifth Avenue Stage Line, of New York city, has been purchased in the interest of the Metropolitan Street Railway Company, and will be used as a feeder to that line. It is also reported that automobiles will be put in operation at once along the route, in place of the old horse busses.

Vapor Launches

To street railway companies owning pleasure resorts containing bodies of water of sufficient depth to float light boats there can be no better investment than a number of neat, strong open launches. It has been proven beyond question that the patrons of such resorts will take advantage of a boat ride when no other form of amusement will attract their attention. The number of launches and the price to be paid for them will, of course, depend entirely upon local conditions.

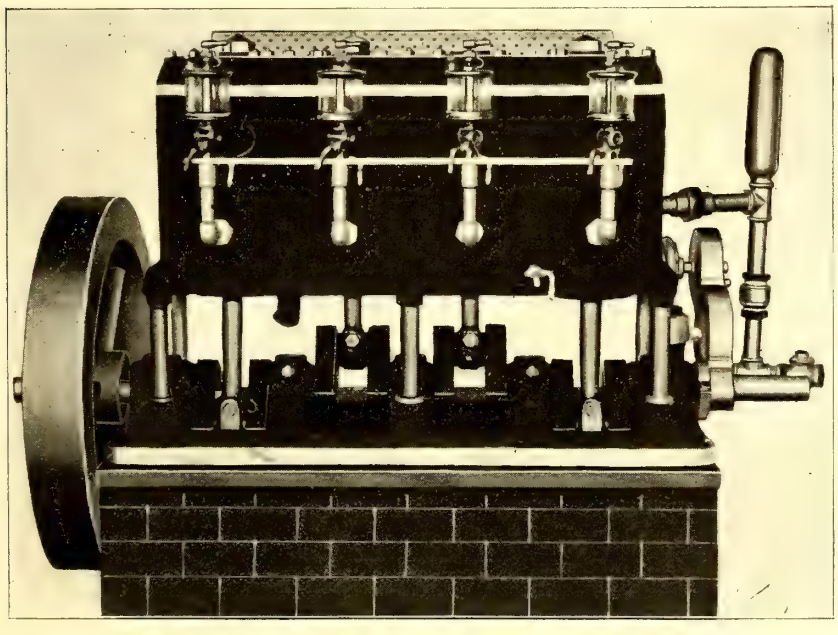
One of the best types of pleasure launches, and at the same time one of the least expensive, is the gasoline or naphtha boats, for which C. B. Sterling & Co., 120 Liberty Street, New York, are the agents. The boats handled by this concern are made entirely from the best materials, on the most approved lines, and of any size from 12 ft. to 53 ft. in length.

The motive power is furnished by an improved type of marine gas engine, using a vapor of either gasoline or naphtha for power. The vapor is exploded in the firing chamber of the cylinder by an electric spark from a small chemical battery regularly at each revolution. It is claimed that these engines are absolutely safe,



VAPOR LAUNCH

there being no vapor of water, gasoline, naphtha or alcohol under pressure, no storage of dangerous pressure, and no boiler or retort. Therefore, there is no possibility of explosion from overpressure. Special care has been given in the designing to secure the greatest simplicity possible, and the use of all complicated parts liable to derangement has been avoided. The engine occupies a small space at the stern of the boat, leaving the cockpit



FOUR-CYCLE VAPOR ENGINE

free of machinery, and can be safely operated by any one of ordinary intelligence without any previous engineering training.

These engines are also made in the four-cycle type, having an explosion every other revolution. These are built for from 8 h.p. to 40 h.p. The company has recently booked a number of orders for large boats, one of which is to have twin screws.

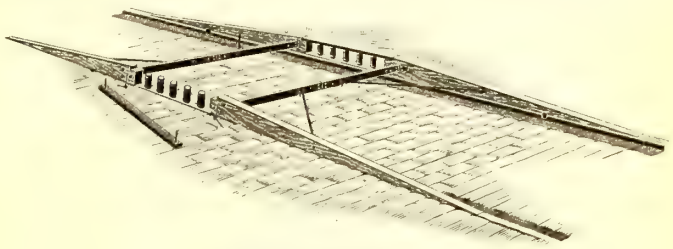
New Line in Wisconsin

The Citizens' Traction Company, of Oshkosh, Wis., is building a 14-mile line to Neenah, and has closed a contract with the Falk Company of Milwaukee for the entire and complete construction of this line. The Falk Company has contracted with the Babcock & Wilcox Company for boilers, with the General Electric Company for generators, with the St. Louis Car Company for double-truck cross-seat cars, and with William Wharton, Jr. & Co. and Pennsylvania Steel Company for rails and track material. The power will be sent from the Oshkosh power stations to a rotary converter substation 9 miles away, and a General Electric six-pole, 300-kw., three-phase generator will be used, with 6600 volts transmission.

A Portable Hose Bridge

In the accompanying engraving is shown a portable hose bridge designed for the purpose of preventing blockades due to fires. As is well known, traffic on a street railway line is often interrupted for several hours owing to the necessity of fire companies running their hose across the track, although the fire may be several blocks off. These delays can be entirely avoided by the use of this bridge.

As will be seen from the cut, the device consists of two parallel trusses, 16 ft. in length, fastened together by two double-hinged



PORTABLE HOSE BRIDGE

joints. When opened the joints form a cross-bar, and become a rigid connection between the two trusses, each cross-bar being locked in position by two iron rods, which are permanently fastened to the truss by an eye and staple at one end, and when in use are hooked into the center of the cross-bar at the other end. These rods have four braces, which render the bridge perfectly rigid. A steel lug an inch in length projects downward from the inside of the lower rail of the trusses at each of their ends. These lugs are slightly beveled, and will fit against either a T, flat, or grooved rail equally well. There is no downward pressure on them, their mission being simply to keep the bridge from sliding off the rail sideways. When the device is in position these lugs fit just inside of the inner side of the rail.

The total weight of the bridge is about 117 lbs., and it being contractable to 9 ins. in width, four of the machines may be readily carried on the ordinary repair or tower wagon. There are six pockets, 4 ins. square, for the reception of hose.

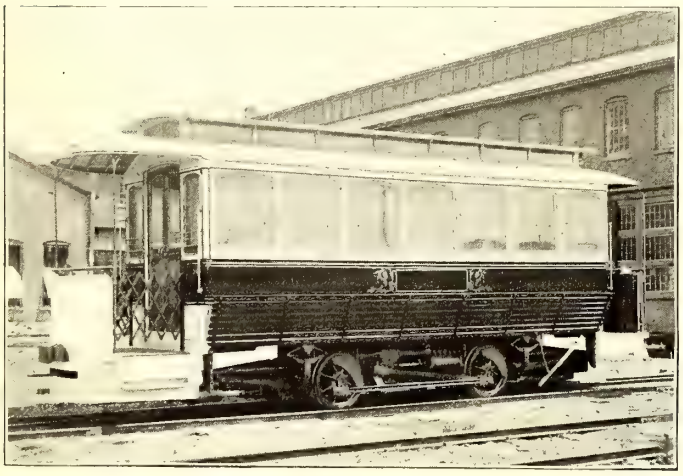
Changes in Dublin

Owing to the recent death of Dr. Carte, by which the chairmanship of the Dublin Union Tramways Company was made vacant, William Murphy has been appointed by the company to that position. At the same meeting William Anderson was elected to the place on the board of directors filled by Mr. Murphy, and was also appointed managing director. His service of twenty-six years as secretary and manager of the company, during which it has been steadily and increasingly successful, makes Mr. Anderson's appointment to his new position a particularly desirable one. R. S. Tresilian has been appointed secretary of the company to the place made vacant by the change of position of Mr Anderson.

The suit brought in the Circuit Court of the United States for the Northern District of Illinois by the Falk Manufacturing Company vs. the American Improved Rail Joint Company and Andrew S. Littlefield, for alleged infringement of letters patent No. 587,718, dated August 10, 1897, for a "portable melting furnace," was duly argued and submitted to the court in pleadings, proofs, illustrative exhibits, etc., introduced by complainant and defendants, but before the rendering of the decision by the court suit was withdrawn at the request of the complainant, who assumed costs.

Compressed Air Cars in Chicago

A test is being made of compressed air as a motive power on some cars being operated on the lines of the North Chicago Street Railroad Company. The work is being done under the auspices of the Compressed Air Motor Company, of Chicago. The cars are modeled after those that were operated for a year on 125th Street, in New York, and have all the added improvements suggested by the experience secured with this type of cars in New York. The system employed is known as that of the Hardie, and



COMPRESSED AIR CAR

Robert Hardie, chief engineer of the company, and well known in the field of compressed air development, is in charge of the installation, and superintends the operation of the cars. To bring out the new features, a brief description of the equipment will follow: The cars are 28 ft. long over all, and weigh, when fully equipped, including the truck and mechanism, about 9 tons. The wheels are 26 ins. in diameter, and are coupled after the manner of locomotive practice. The power is supplied from two cylinders, each 7 ins. x 14 ins., mounted one on each side of the truck, from which the piston rod connects with the crosshead, and this is connected to the coupling rod by means of a rocker arm. The valve gear is controlled by a regular Stevenson's link, with a cut-off, and is operated by separate eccentrics. A variation of cut-off is effected by the reversing link.

Air brakes are employed for controlling the car, and the brake cylinder is located under one end, near the platform. The controlling handle is located against the dashboard, and in connection with this is a by-pass starting-valve.

The air is stored in reservoirs, which are located under the seat and in other convenient positions on the truck beneath the floor of the car. The tanks under the seats are 9 ins. in diameter, and extend the full length of the car. All these tanks are of seamless tubing, manufactured in Germany by the Mannesmann Company, and bear the marks and guarantee of the inspectors of the German Government, by whom every tank is tested before shipping. The testing pressure is 4860 lbs. to the square inch. The charge for operating the cars is carried at an initial pressure of 2200 lbs. to the square inch, and the tanks included in the equipment have a capacity of 51 cubic feet. The pressure is automatically reduced, however, to 150 lbs. to the square inch, and is then passed through a reheating tank, and is delivered to the cylinders at the latter pressure. The reheating tank consists of a shell of boiler plate, and is 18 ins. in diameter x 7 ft. in length, and when the car is ready for service is reheated by live steam at a temperature of about 300 degs. The air is admitted to a perforated pipe in the bottom of this tank and bubbles up through the water, and in its passage absorbs heat and moisture, which adds to its economical value and prevents the ports from freezing from the excessive low temperature attending the expansion of the charge.

It is interesting to note in this connection the economical feature of reheating the air. From some tests that have been made, it was found that a car with a full charge of cold air was able to make a trip of 8 miles, while with the same charge and the air reheated as above described a total of 15 miles was easily made, a gain of 7 miles having been secured with an estimated expenditure of 10 lbs. of coal, the amount theoretically required for raising the water to the necessary temperature. This estimate is based on the theory that there are about 8000 available heat units to a pound of coal. For starting the car the valves are so arranged that air under increased pressure can be delivered to the cylinders, enabling the cars to start easily and positively under all conditions, without regard to the position of the cut-off valves. As soon as the car is under way the high pressure is cut off, and the cylinders work under a normal pressure of 150 lbs.

In order to provide the necessary pressure for operating the cars two Norwalk three-stage compressors have been installed in the tension room of the Clark Street cable power system, and steam for operating them is taken from the boilers of the station. A nest of twenty reservoirs of the same type as those described for carrying the charge on the car is provided near the compressors. These are arranged in four rows and five tiers, and are divided in two sections of ten each, each section being coupled at one end by means of copper tubing to a single pipe, which is fitted with a valve and operating wheel. These tanks are 22 ft. in length and 9 ins. in diameter. In the process of compressing a charge the air passes through a coil of pipes contained in a large tank filled with water. From this it passes through a condensing device, by means of which the condensation from the moisture in the atmosphere is tapped off, so that only comparatively dry air enters the storage tank.

Mr. Hardie has been experimenting with compressed air as a motive power since 1876, and is now confident that he has brought his system to a commercial success. He states that the only drawback or delay in the introduction of compressed air as a motive power has been the difficulty of getting sufficient capital to demonstrate the system on a large scale. He claims that the compressed air motor has passed through the stages of evolution very much as the electric motor; that while the early types of electric motors were virtually failures in the light of present experience, they have now reached a degree of commercial efficiency, and he believes that with ten years of experience with the compressed air motors, under the same care and interest that has been expended on the electric motor, that the air will have surpassed the latter and become as universally popular. The Compressed Air Motor Company in Chicago was virtually organized four years ago, at the time the experiments were undertaken in the East, but very little has been done, as the company has been awaiting results of experiments made by the Eastern company. The organization of the company is now composed of the following: Henry D. Cooke, president; Alexander C. Soper, treasurer; William E. Selleck, assistant treasurer, with Robert Hardie as chief engineer. W. J. Chalmers, of the firm of Chalmers & Co., engine builders of Chicago, is one of the directors.

Portable Air Compressing Apparatus

The Christensen Engineering Company, of Milwaukee, Wis., has recently put a very neat and compact compressing apparatus on the market, to be used wherever electric current is available



PORTABLE AIR COMPRESSING APPARATUS

for general purposes, such as cleaning car cushions and operating pneumatic tools for chipping, calking, riveting or drilling. The apparatus herewith illustrated weighs about 1400 lbs. and is strictly

portable and self-contained. The air compressor has a capacity of 50 cu. ft. of free air per minute, and is of the same style and pattern as the company is putting on the market for air brake purposes. The manufacturers are prepared to furnish this kind of portable apparatus in all sizes, ranging from 10 cu. ft. to 300 cu. ft. free air per minute.

All working parts run in a bath of oil, the motor being arranged on the top of the compressor, and connected to the compressor crank shaft by means of a gear and pinion of special pattern, first introduced by the Christensen Engineering Company, said gear and pinion being composed of sections of a true helical form, which construction makes their operation practically noiseless and increases their durability, it is stated, fully 25 per cent over that of the ordinary straight faced spur gear and pinion.

The compressor delivers air into the reservoirs from which a hose connection is taken, and the compressed air thereby conveyed to the point where it is to do the work. The action of the compressor is controlled by means of an automatic governor, which operates by the air pressure accumulated in the reservoirs, in such a way that the motor stops whenever the pressure is at a maximum and starts when it is at minimum, with any desired variation between the two extremes.

The compressor is not provided with a water jacket, as it is claimed, in this form of construction the compressor will run half the time without any undue heat. This makes the apparatus much more practical than if it were necessary to have cooling water around the cylinders and the back heads, thereby introducing extra complications and need of care taking.

The box which encloses the motor compressor, together with the electric apparatus in connection with same, is all water tight, and is so arranged that access is readily had to all the various parts of the apparatus by simply opening doors arranged in the box for that purpose. This apparatus is used in connection with riveting the structural iron work now being done on the new Post Office Building in Chicago.

Well Known Supply House

The Falk Company of Milwaukee has absorbed the Cloos Electrical Engineering Company of Milwaukee, manufacturers of devices for the controlling of high voltages, especially oil switches, in which a special acidless oil is used, imported from abroad, by means of which arcing between high voltage terminals is absolutely done away with. Switching, which formerly required many careful precautions on the part of station attendants, is now rendered almost as safe as that of ordinary direct-current work. The well-known mechanical ability of the Falk Company is a guarantee that its work in this line will become well known and widely used.

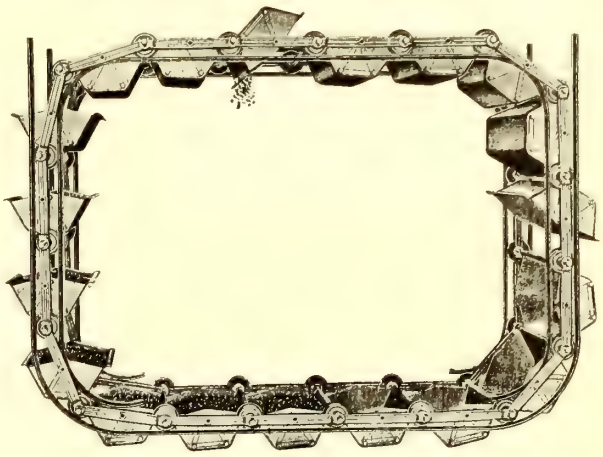
The construction department of the Falk Company has recently obtained some important contracts, including one for the change of a 5-mile cable line of the Metropolitan Street Railway in Kansas City to electricity, and a bulk contract for the complete construction of a 14-mile line between Oshkosh, Wis., and Neenah.

The company's gearing and special work departments have also large contracts on hand, and the cast welding business is assuming constantly larger proportions all over the country, and, in fact, the world. The Falk Company has just closed a contract with the Yerkes lines in Chicago for three complete cast welding equipments and a license to weld joints under the Falk patents. Equipments have also been furnished to the Boston Elevated Railway Company, and a full equipment of welding machinery was recently sent to Buenos Ayres for work being done there under the supervision of Kincaid, Waller & Manville, the well-known London tramway engineers.

In fact, the work of the Falk Company in all its departments is increasing so rapidly that the present factory facilities have been entirely outgrown, and new ones are being created on a large scale. A plot of eight acres of land has been purchased near the present shops, and is now being prepared for the erection of new shops, in which all the work of the various departments will be concentrated. The machine shop will be 100 ft. x 200 ft. in length. The foundry, which will be equipped for casting steel, will be of the same size. There will be a power house covering 60 ft. x 140 ft., and an office building 40 ft. x 60 ft. Electric motors will be used throughout for driving machinery, the power coming from the company's own power house, and the buildings will be so put up as to make possible large expansions longitudinally. A special spur track from the Chicago, Milwaukee & St. Paul yards in the immediate neighborhood will be run directly through the center of the shops, and large electric cranes will travel longitudinally through the foundry and machine shop for the transference of work in all stages.

Coal Bucket Conveyor

As stated in another part of this issue, the new power station of the Milwaukee Electric Railway & Light Company is equipped with complete coal conveying apparatus. This is manufactured by John A. Mead & Company, of New York City, and is shown in the accompanying illustration. The apparatus consists of an endless series of chain links and cross shafts, mounted on track wheels, and from which the conveyor buckets are pivotally mounted in the chain. The conveyor is supported on, and is guided by the system of tracks through all the various changes of angle or direction in which the conveyor is moved. The chain links are so constructed as to give the proper strength, bearing



COAL BUCKET CONVEYOR

and perfect alignment for the conveyor buckets. There are four links to each section. The conveyor buckets are made out of the best quality of steel plate, and have malleable dump cams riveted to either end, which form the pivotal connection with the chain links, and also for turning the buckets on their pivots for discharging their contents.

The conveyor buckets when on a horizontal track overlap in such a manner as to form a continuous receptacle, and in passing from a lower to a verticle or inclined track the buckets maintain their normal upright position by gravity. By overlaping the buckets the material is delivered into the conveyor at any desired point along the horizontal track through an ordinary chute, having in it a gate to regulate the flow of the material. The material is carried from receiving point to place of delivery without transferring from one system into another and without breakage.

The driving mechanism consists of two hexagonal shaped spider wheels, having rollers in the outer ends of their arms, which bear against the track wheels of the conveyor. The track at the driving point is concentric with the centers of the driving wheels. There is no sliding or lost motion between the driving spiders and the conveyor chain, and consequently no wear. The motion imparted to the conveyor by this arrangement is remarkably even and steady, and any elongation in the centers of the chain links is automatically compensated for by the point of contact between the driver and chain.

John A. Mead & Company have installed this device in a large number of power plants, including the stations of the Chicago City Railway Company, the Southside Elevated Railway Company, Chicago, the Consolidated Traction Company, of Pittsburgh, the Cincinnati Edison Company, and three stations of the Metropolitan Street Railway Company, of New York.

Air Brake Catalogue

A neat brochure, that illustrates in a very forcible manner the simplicity and efficiency of the storage system for air brakes on electric railway cars, is being sent out by the G. P. Magann Air Brake Company of Detroit, Mich. In the Magann system the air is compressed at the power station, and is stored under each car in a reservoir at 300 lbs. pressure. From here it is taken through a reducing valve as required. This apparatus does away entirely with all complicated compressing devices on the car, and, in addition, it is claimed, gives a more satisfactory and reliable pressure at the shoes, preventing skidding of the wheels and "jamming" of the brakes.

Lubrication in Power Plants

BY J. N. EDELIN

In constructing power plants the owners or consulting engineers often say, when the subject of lubrication is approached, "we have not completed the large and more important contracts yet, and when these are completed we will then take up the minor details of our plants." Now, one of the most important necessities of a plant is the proper lubrication of the machinery, and it is one of the points which should be considered in making the original plans. This thought was suggested by a recent visit to the immense power house of the Southern Electric Railway Company, of St. Louis, as well as to the two large power houses of the Missouri-Edison Electric Light Company, of St. Louis, Mo., who furnish the lights for the whole city of St. Louis. To prove the importance of the subject of lubrication, we take the liberty of quoting a few remarks from Herbert A. Wagner, general superintendent, Missouri-Edison Electric Company, who says: "In the six months that we have had our oiling system in use we have effected a saving of over $300 per month in the cost of oil, and $150 a month in wages paid to oilers. All of the saving in wages and about half the saving in oil we attribute to the use of the Siegrist oiling system, the balance being due to the change of the character and price of the oil itself. This apparatus, being entirely automatic, practically does away with oilers, for where we had four we have now only one."

The Siegrist oil pump, as used in this station, is mounted on a highly polished iron table 2 x 4½ ft., on which are four small duplex pumps, two for engine oil and two for cylinder oil. Only one of each set is used at a time; the other is held as a duplicate or reserve, and can be thrown in by a valve in a second, to take the place of the other in case of accident. There are also on the table three steam gages, one for steam pressure, one for cylinder oil pressure, and one for engine oil pressure, and three governors, which regulate and control the pumps, making them entirely automatic. Through suitable piping these pumps are connected to tanks. The engine oil is pumped to all necessary parts of each engine and generator, and a pressure of from 60 to 80 lbs. per square inch is maintained. This pressure is carried constantly throughout the oiling system, no matter how much or little oil is being used, by means of suitable regulating valves, placed in a discharge pipe of each pump and acting to close or open the steam admission.

At each bearing or part to be oiled is located a Siegrist automatic sight feed pressure oil cup, connected to the oil pipe system. The rate of speed of each oil cup can be regulated at will by a thumb-screw provided for that purpose, but a diaphragm pressure valve in each cup instantly closes the oil drip if the pressure in the system is lowered more than 2 or 3 lbs. One globe valve placed in the supply pipe for the oil system of each engine is therefore sufficient to start or stop all the oil cups on that engine. In closing this valve the flow of oil is stopped within a few seconds at every oil cup whether located in the highest or lowest parts of the engines. This precludes any waste of oil after the engine is stopped.

Mr. Wagner states that hot journals or bearings belong to the past, for with this system it is possible to use three times as much oil on the bearings as before and yet effect a big saving over the old gravity system, "which is affected by changes in weather and the feed not being reliable." All the surplus oil is piped back from the drips of the engines and generators to the filters located in the basement, where it is refiltered and repumped by this system over and over again.

For the lubrication of cylinders with cylinder oil the Siegrist automatic sight feed lubricator is of polished brass, and has a 1-in. glass, which allows a free passage for the oil without coming in contact with glass whether in a drop or a stream. This sight feed is also controlled automatically by a diaphragm. There is also a connection from the main pipe of lubricator connecting under the diaphragm, giving the same steam pressure as on top; this causes the sight feed to close if the oil pressure gets below that of steam, and also prevents the oil from backing down in glass. This steam also keeps diaphram hot, thereby heating the oil and allowing it to flow freely.

Influence of Mechanical Draft

Walter B. Snow, a member of the engineering staff of the B. F. Sturtevant Company, of Boston, Mass., and an expert on the subject of induced and mechanical draft, has recently written an interesting article on "The Influences of Mechanical Draft Upon the Ultimate Efficiency of Steam Boilers." Mr. Snow treats the subject very exhaustively, and his paper is a valuable addition to the engineering literature of the day.

He says in part: "Mechanical draft may be applied under either of two general methods, the plenum or the vacuum. Which is to be employed must depend upon the circumstances, for it cannot be asserted that either is unqualifiedly superior under all conditions. As ordinarily applied under the plenum or forced draft method, the air is delivered to the closed ashpit under pressure, and then finds its escape through the fuel on the grates above. Its success depends largely upon the manner of introduction of the air to the ashpits. Under the vacuum or induced method a fan is introduced as a direct substitute for the chimney, creating a vacuum in the furnace and drawing therefrom the gases generated in the process of combustion. As the draft is thus rendered positive and practically independent of all condition except the speed of the fan, it is only necessary to provide a short outlet pipe to carry the gases to a sufficient height to permit of their harmless discharge to the atmosphere."

The author has worked out very carefuly the relative cost of installation, and also the total amount that can be saved by substituting the various systems of artificial draft for natural draft. He states that from actual conditions he has found that the total expense for installing a forced draft plant is only 18.7 per cent; that of a single induced fan and accessories 26.7 per cent, and that of a complete duplex induced draft plant 42 per cent of the cost of building the necessary chimney. In each case the cost of a short steel plate stack for carrying off the gases is included. In other words, if a chimney is estimated to cost $10,000, there can be saved on a basis of these averages the respective amounts of $8,130, $7,330 and $5,800 in the first cost, according to which system of mechanical draft is substituted. It is found that in a plant where the annual fixed charges (including interest, depreciation, repairs, insurance and taxes) of a chimney would be $800, the figures for the various mechanical draft systems would be $462 for the duplex induced draft, $294 for the single fan induced draft, and $206 for the forced draft with one fan. In addition to this the mechanical draft apparatus can be easily placed overhead or on top of the boilers, where it occupies no valuable space, and also leaves the space otherwise occupied by a chimney available for other purposes, in many cases this being an important point, especially where real estate values are high.

Convention of the Ohio Street Railway Association

The annual convention of the Ohio Street Railway Association will be held at Springfield, Ohio, on June 14 next. We are advised by Charles Currie, of Lima, Ohio, secretary of the association, that a special rate of a fare and a third for the round trip will be granted on the certificate plan to those desiring to attend the meeting. A large representation of supply men is expected, and Mr. Currie is desirous of being notified as soon as possible by all who expect to be present, in order that proper provision may be made for their comfort and convenience.

Municipal Ownership in Detroit

The transfer of the street railway lines of the city of Detroit to the municipality has been delayed indefinitely on account of the failure of the city and the street railway officials to agree upon the price to be paid the present owners of the line. The matter will probably be decided in the courts.

Strike at a Truck Works

There was a strike of short duration among the men of the McGuire Manufacturing Company in the early part of May, 250 truck builders and machinists refusing to work over time for less than double pay. The works were shut down for two days, when a compromise was reached by the company putting on a complete night shift, thus avoiding the question of over-time altogether.

The truck which is known as the No. 39, which this company is now turning out for the South Bend (Ind.) Street Railway Company and the Peoria & Pekin Terminal Railway is attracting considerable attention, because of its very peculiar features. A full description of this will appear in the next issue of the Street Railway Journal. The company has begun delivery of the trucks for the Northwestern Elevated, of Chicago.

New Road in Mississippi

One of the best equipped railway lines for its size in this country was opened at Vicksburg, Miss., April 24. The Vicksburg Electric Street Railway is 8 miles in length, and runs through the center of the city, with two or three branches. The company was formed in 1898, and construction work was begun last November. The prime movers in the enterprise have been S. F. Mordaunt, the general manager, and J. C. Schaffer, of Chicago, who furnished the necessary capital for the construction of the road. The power house is equipped according to the very latest methods, and contains two 250-h.p. Stirling and one 200-h.p. Heine boilers; one 300-h.p. Cooper and one 300-h.p. Russell engines, and Westinghouse generators. The road was constructed by the North American Railway Construction Company; the cars were built by the St. Louis Car Company, and the Westinghouse Company furnished the complete electrical equipments. The opening day was a gala occasion, and the cars were received with great enthusiasm by the entire city.

Consolidation in Buffalo Completed

The organization of the International Traction Company is now fully completed, and the following official statement is made of the securities in the company's treasury:

The entire capital stock of the Niagara Falls & Suspension Bridge Railway Company (operating the Niagara Falls Whirlpool & Northern Railway, under a traffic agreement); the entire capital stock of the Niagara Falls Park & River Railway Company, the entire capital stock of the Niagara Falls Suspension Bridge Company, the entire capital stock of the Clifton Suspension Bridge Company, the entire capital stock of the Lewiston Connecting Bridge Company, the entire capital stock of the Queenston Heights Bridge Company, 9985 shares out of a total of 10,000 shares of the Buffalo & Lockport Railway Company, 12,369 shares out of a total of 12,500 shares of the Buffalo & Niagara Falls Electric Railway, 52,094 shares out of a total of 53,705 shares of the Buffalo Railway Company. The Buffalo Railway Company owns the entire capital stock of the Buffalo, Bellevue & Lancaster Railway and the Crosstown Street Railway Company, of Buffalo. The Buffalo & Lockport Railway owns the franchises and other property of the Elmwood Avenue & Tonawanda Railway Company.

It is expected that the total outstanding stock of the above companies will soon be acquired, and negotiations are either in progress or have just been completed for the acquisition of certain other properties in the neighborhood.

The capital stock of the International Traction Company is $15,000,000, of which $10,000,000 is common stock, and $5,000,000 is 4 per cent preferred cumulative stock. The company has no direct funded indebtedness, but the funded debt of the nine constituent companies amounts to $12,548,000, as follows:

	Funded Debt.
Buffalo Street Railway Company	$6,150,000
Crosstown Street Railway Company	2,830,000
Buffalo Traction Company	600,000
Buffalo & Niagara Falls Electric Railway Company	925,000
Buffalo & Lockport Railway Company	500,000
Niagara Falls & Suspension Bridge Railway Company.	518,000
Niagara Falls, Park & River Railway Company	600,000
Bridge companies	425,000
Total	$12,548,000

Personal

MR. ROBERT C. TAYLOR has been appointed chief engineer of the Twin City Rapid Transit Company, of Minneapolis.

MR. W. J. HAMMER contributed an interesting article on the present status of electric railroading in the Independent for May 5

MR. WILL CHRISTY, of Akron, Ohio, has entered upon his duties as manager of the reorganized Akron Traction & Electric Company.

MR. JOHN C. DOLPH, of the Sterling Varnish Company, is making a business trip in Europe, visiting both Great Britain and the Continent.

MR. F. E. FISHER has been appointed superintendent of the Joliet Street Railway Company, Joliet, Ill., succeeding Mr. C. C. Rush, who recently died.

MR. HARVEY R. BOWEN has left the Binghamton Railroad Company, and has accepted the position of chief engineer of the Utica Street Railway Company, Utica, N. Y.

MR. JAMES R. LEDYARD has been given the superintendency of the South Covington & Cincinnati Street Railway Company, taking the place of Mr. T. M. Jenkins, who has accepted a position in St. Louis.

MR. A. G. DAVIDS has been promoted to the position of general manager of the Schuylkill Valley Traction Company, of Norristown, Pa., to take up the duties laid down by Mr. R. M. Douglass, the former general manager.

MR. CHARLES F. MORSE, president of the Metropolitan Street Railway Company, of Kansas City, Mo., will retire from that position on June 1, and will probably be succeeded by Mr. W. H. Holmes, the present general manager.

MR. GEORGE F. GREENWOOD, who recently resigned as general manager of the Consolidated Traction Company of Pittsburgh, has been appointed general manager of the Havana Street Railway Company of Havana, Cuba.

MR. J. F. MACARTNEY, of Macartney, McElroy & Company, made a short visit to this country last month. Mr. Macartney is at present located in London, and reports large business as a contractor for electric railways and tramways.

MR. FRED H. FITCH, formerly with the Chicago City Railway Company, and recently manager of the South Western Missouri Electric Railway Company, has accepted the position of general manager of the Sioux City Traction Company, of Sioux City, Ia.

MR. PHILIP DAWSON, who is connected with R. W. Blackwell & Co., and who is a well-known writer on electric railway subjects, sailed for America, May 20, on the steamship Lucania. Mr. Dawson is accompanied by Mrs. Dawson, and will spend some time in America.

MR. W. F. KELLY, general superintendent of the Columbus Street Railway Company, of Columbus, Ohio, has tendered his resignation, to take effect immediately. Mr. Kelly leaves Columbus to take up more important duties in New York, and will be associated with Mr. Emerson McMillin. He will probably be succeeded by Mr. M. S. Hopkins, electrician of the company.

MR. B. F. HARRIS, JR., and his brother, Mr. N. M. Harris, of Champaign, Ill., formerly the principal owners of the Urbana & Champaign Railway, Gas & Electric Company, have sold their holdings in this property to a party of capitalists of Portland, Me. Mr. Harris and his brother will probably remain in Champaign for the present, at least, but will have no connection with the street railway company.

MR. CHARLES FITZGERALD has taken up his duties as general superintendent of the Consolidated Traction Company, of Pittsburgh, this position until recently having been filled by Mr. G. F. Greenwood. Mr. Fitzgerald has had a very extensive engineer training, both in the street railway and other fields. He has been connected with a portion of the Consolidated Traction Company for some time, having been employed with the Citizens' Traction company since 1889.

MR. H. TALBOT, electrical engineer of the City of Nottingham, Eng., made a trip to this country last month to investigate the subject of electric traction with the view to the proposed installation of an electric tramway in the city of Nottingham by the municipal authorities. Mr. Talbot was accompanied by the city engineer of Nottingham and visited a number of the cities in the eastern part of the country, including New York, Philadelphia, Baltimore, Washington, Buffalo and Boston.

MR. J. H. GIBSON, who was formerly connected with the Baltimore City Passenger Railway Company, has accepted the position of superintendent of the Philadelphia and West Chester Traction Company, whose system is described elsewhere in this issue. Mr. Gibson is well known as a practical street railway engineeer, and previous to his connection with the City Passenger Railway, of Baltimore, held responsible positions in the engineering staff of the Short Electric Railway Company and the Edison General Electric Company.

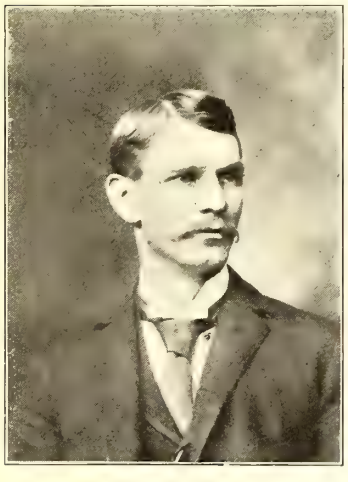
MR. T. M. JENKINS, who was for some time superintendent of the South Covington & Cincinnati Railway Company, has resigned that position to accept a place with the St. Louis & Sub-

urban Street Railway Company and the St. Louis & Meramec River Railway Company, of St. Louis, Mo. Mr. Jenkins has been very successful in his management of the Cincinnati property, and has developed it until it is now one of the best systems of its size in the United States. He has been extremely popular with all the men on the road, from the officers of the company down to the conductors and motormen, and just before his departure for his new field the employees tendered him an elaborate testimonial banquet. Preceding the dinner a large parade was formed, and Mr. Jenkins was given an old-fashioned serenade and ovation.

MR. C. L. ROSSITER, president of the Brooklyn Rapid Transit Company, of Brooklyn, N. Y., has just returned from a short combined pleasure and business trip to Europe. On his departure, which occurred May 9, Mr. Rossiter was presented with a handsome floral piece in the shape of a miniature electric car, by the employees of the company, the men taking this method of showing their regard. Before leaving, Mr. Rossiter gave out the following notice of appointments recently made on the Brooklyn Heights system. Mr. Ira A. McCormack will be general superintendent, having charge of transportation; Mr. J. C. Brackenridge will be chief engineer, having charge of all construction and maintenance work and the operation of all power houses. A new position is created, that of superintendent of shops, and Mr. F. S. Drake is appointed to fill this. Mr. Lincoln Van Cott is appointed purchasing agent for the system.

MR. ROBERT H. DERRAH, who has been for the last ten years connected with the West End Street Railway and the Boston Elevated Railway Company, in the office of the president, leaves the service of the latter company to enter upon business for himself. He has for several years made a special study of the growing electric railway system of New England, and as the publisher of "Derrah's Street Railway Guide for Eastern Massachusetts" has a wide acquaintance among street railway men. Mr. Derrah is to start upon a new enterprise in this part of the country—the management of electric car excursions for individuals and parties. In England the low price excursion is a popular form of entertainment, and in Boston and its vicinity more attractions of greater diversity can be found than in any other section of the country. While such a business is an experiment in New England, it has great possibilities, and Mr. Derrah leaves the Boston Elevated Railway Company accompanied by the best wishes of its officials and employees to be first in the new field.

MR. RICHARD McCULLOCH, of St. Louis, has been offered an excellent position in Geneva, Switzerland, and is now on his way to take up his new duties. Although his many friends will be pleased to hear of his advancement, they will learn with regret that he is to be absent from this country for several years. Mr. McCulloch's genial nature and unusual ability have attracted to him a wide circle of acquaintances and friends, and he has been especially popular with the employees of the company with which he has been connected. In order to manifest to some extent their appreciation of his sterling qualities, about a hundred of his business and social friends in St. Louis tendered him a farewell banquet at the Planters' Hotel on Thursday evening, May 11. An elaborate menu was prepared, and a number of the leading citizens of the city were present. Mr. McCulloch will superintend the construction of an electric street railway for an English syndicate at Geneva.



RICHARD McCULLOCH

Obituary

MR. C. C. RUSH, who has been the successful superintendent of the Joliet Street Railway Company, of Joliet, Ill., for some time, died on May 3 from injuries received by being struck by an engine on the Chicago & Alton Railroad. Mr. Rush was walking along the tracks, and for some reason did not hear the approaching train. He was born on September 10, 1864, in Champaign, Ill.

CAPT. ALFRED E. HUNT, president of the Pittsburgh Reduction Company, of Pittsburgh, Pa., and a well-known chemical expert, died recently at Philadelphia from illness contracted while in command of Battery B of the National Guard of Pennsylvania in Porto Rico during the Spanish war. Mr. Hunt was born at East Douglas, Mass., on March 31, 1855, and received his technical education at the Massachusetts Institute of Technology. In 1888 he organized the Pittsburgh Reduction Company, to manufacture aluminum, and up to the time of his death was president and general manager of this concern.

AMONG THE MANUFACTURERS

THE BRITISH THOMSON-HOUSTON COMPANY, of London, has moved its Glasgow office from 639a St. Vincent Street to 141 West George Street.

THE FRANK W. MEAD AMUSEMENT COMPANY, of Boston, Mass., is prepared to furnish high class vaudeville specialties for street railway parks, casinos, etc. The company's new catalogue mentions a few of the artists in its employ.

THE UNION BOILER TUBE CLEANER COMPANY, of Pittsburgh, Pa., has begun action in the United States Circuit Court to enjoin Gameliel St. John from manufacturing, selling, or using a certain device for cleaning the interior of boiler tubes.

THE ELECTRICAL INSTALLATION COMPANY, Monadnock Block, Chicago, has just closed a contract for building and equipping the Waupaca Electric Street Railway, Waupaca, Wis. There will be 5 miles of single track. Work was to begin May 24, and the line is to be in operation July 1, giving only thirty-seven days for the completion of the entire contract.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, of Pittsburgh, Pa., among recent publications, has issued catalogue No. 222, devoted to direct connected railway generators; No. 223, devoted to lightning arresters for alternating current and direct current circuits, and No. 228, on Tesla polyphase induction motors, type C, for constant speed.

THE CLING-SURFACE MANUFACTURING COMPANY, of Buffalo, N. Y., is arousing great interest in its new compound for treating leather belts. A test upon this dressing and the results secured were published in the last issue of the Street Railway Journal. Owing to a typographical error the company's office was there given as New York city instead of Buffalo.

THE MULTIPLEX REFLECTOR COMPANY, of Cleveland, is making a specialty of Schroeder's patent multiplex reflector, and is also manufacturing a complete line of reflectors, headlights and bicycle lamps of every description. The Cleveland City Railway and the Cleveland Electric Railway Company have a number of these reflectors in use, and are thoroughly testing the same.

THE ROBB ENGINEERING COMPANY, of Amherst, N. S., has been awarded the contract for two 230-h.p. engines by F. S. Pearson, of New York, consulting engineer for the Cuban Electric Company. These engines are for an electric railway from Regla, on the opposite side of the harbor from Havana, to Guamacoa, about 8 miles distant.

THE RUMOR that the works of the Pennsylvania Car Wheel Company, of Pittsburgh has been purchased by another company is authoritatively denied by that company. To enable the company to further enlarge its business this year additional property has been taken and its capital stock increased from $100,000 to $200,000, paid in. It is possible that the rumor mentioned was occasioned by these proposed changes.

THE SIMONDS MANUFACTURING COMPANY, of Pittsburgh, Pa., is sending out a new circular on electric railway supplies. A large part of the catalogue is devoted to a discussion of gears and pinions and the different stages of the gears, from the rough casting to the accurately finished wheel are shown. The catalogue also discusses Babbitt bearings, worms, worm wheels and racks, and the Murphy car wheel truing machine.

THE GENERAL ELECTRIC COMPANY, of Schenectady, N. Y., among other printed matter, has issued during the past few weeks the following bulletins: No. 4172, devoted to the G. E. 51 B railway motor; No. 4173, to the G. E. 53 railway motor; No. 4174, to slow and moderate speed motors, type M. P., Form H; No. 4177, to pendant push-button switches; No. 4178, to current indicators, Form B; and flyer No. 2038, to improved practice for series incandescent street lamps.

THE CLAYTON AIR COMPRESSOR WORKS, of New York city, have published a very complete catalogue describing their air compressors for all pressures and for every purpose to which compressed air is applied. The greatly extended use of compressed air has created a positive demand for efficiency and maximum economy in the design and construction of air compressing machinery, and it is thought that the Clayton compressors perfectly fill this demand.

THE CLEVELAND FROG & CROSSING COMPANY, of Cleveland, Ohio, has found its Eastern construction work increasing so rapidly as to require the establishment of an Eastern agency. The company has, therefore, appointed L. J. Buckley & Company, of 257 Broadway, its Eastern agents. F. A. Lapham, of the company, has been spending some time in the East recently, giving Messrs. Buckley & Company such information as will enable them to care satisfactorily for their customers.

THE DREHER GREASE & OIL COMPANY, of 80 Cortlandt Street, New York, is making some very broad claims as to the superiority of its journal and motor grease for electric car work. These claims seem to be well substantiated by the numerous letters testifying to the merit of these greases, and by the fact that a large number of roads are using them exclusively. To any one not familiar with these greases the company will send a sufficient quantity of each kind free to give a thorough trial.

THE GARTON-DANIELS COMPANY, of Keokuk, Ia., reports that since April 1, the sales of Garton lightning arresters have been over double what they have been in the same period of any previous year. The company, in order to keep up its stock, has recently doubled its force of employees, and states that it will be able to meet any requirements for prompt shipments. The new Garton-Dainels kicking-coils and lightning arresters for the protection of small motors, fans, etc., are meeting with a large demand.

FRANK H. MONKS, of 35 Congress Street, Boston, is becoming well established as an expert in the examination of street railway properties in all parts of the country. Mr. Monks has had over fifteen years of practical experience in street railway work, and his reports are of exceptional value to bankers and others desiring to know the exact condition of individual properties. Mr. Monks will be remembered by many as the former general manager of the West End Railway Company, of Boston, now the Boston Elevated Railway Company.

DICK, KERR & COMPANY, of London, Eng., have just secured the order for eighty cars with their complete electrical (Walker) equipment, to be sent to Liverpool, for municipal tramways in that city, and have also secured an order for thirty car bodies for Sheffield. The 110 car bodies will be made by the Electric Tramway & Carriage Company, of Preston, and the Walker motors will be made in America, although a little later they will be manufactured by the new works of Dick, Kerr & Company, to be located also in Preston.

GEORGE A. PARMENTER, of Cambridgeport, Mass., manufacturer of the well-known car fenders, reports that his device continues to give entire satisfaction wherever it is used. In fact, he states that there has not been a single case of fatal accident, or even broken bones, with cars equipped with this guard. Among recent contracts received are one from the Anacosta & Potomac Railway Company, Washington, D. C., for double equipments, and contracts from four companies in the State of Vermont, this fender having been recommended by the Railroad Commissioners of that State.

THE TAUNTON LOCOMOTIVE MANUFACTURING COMPANY, of Taunton, Mass., announces that hereafter its Wainwright department will be represented in New York city by Charles H. Paine, with offices in the Singer Building, corner of Broadway and Liberty Street, and it assures its customers that they may count on prompt and courteous attention to any business intrusted to its care. This company's Catalogue E, for 1899, containing illustrations and descriptions of its feed water heaters, surface condensers and expansion joints, is now ready for distribution, and will be gladly sent on application.

THE DEMING COMPANY, of Salem, Ohio, has published a special catalogue devoted to the subject of pumping machinery for various services, including triplex power pumps, deep well pumping engines for operation by steam engine, gas engine, gasoline engine, oil engine, electric motor and water power. In designing these pumps, it has been the aim of the manufacturers to secure as nearly a uniform flow of water as possible, thus avoiding all shock to the pump parts and piping system. The Deming system of pumps, it is claimed, is somewhat of a departure from the usual type and contains numerous improvements.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has received a contract from the La Capital Tramway Company, of Buenos Ayres, Argentina, for a steel water tower, supporting a tank, and having a capacity of 7000 gallons. This is the fifth order received from the same company. The Berlin Iron Bridge Company has also received a contract for a new meter house from the Providence Gas Company. This building is to be 65 ft. wide and 110 ft. long. Also, an order for a purifier house, which is to be 40 ft. wide and 175 ft. long, and three stories high. Also, for a gas holder building 184 ft. in diameter. The entire construction will be of steel framework, absolutely fireproof.

THE BROWN HOISTING & CONVEYING MACHINE COMPANY, of Cleveland, Ohio, is sending out a 175-page illustrated pamphlet describing its various lifting and moving devices, including hand and power traveling cranes of all descriptions, jib cranes, tram rails and trolleys, transfer tables, etc. This firm has had many years of experience in the designing and building of implements of this character and its engineers have made a special study of the best methods of raising and moving heavy pieces of machinery, metal work, etc., in power plants, railroad construction and engineering work of all kinds. The catalogue contains a large number of fine engravings, showing the many different types of cranes doing the work for which they are designed.

JAS. BONAR & COMPANY, of Pittsburgh, Pa., reports orders for Pittsburgh feed water heaters and purifiers for shipment to the following parties: Herman Krels, Knoxville, Tenn., 200 h.p.; Danville Artificial Ice Company, New Orleans, La., 160 h.p.; Oliver Wire Works, Pittsburgh, Pa., 150 h.p.; Duquesne Forge Company, Rankin, Pa., 600 h.p.; J. H. Denhelm & Son, Pittsburgh, Pa., 200 h.p.; Pittsburgh Horse Shoe Company, Glassport, Pa., 600 h.p.; Baker Forge Company, Ellwood City, Pa., 200 h.p.; Pittsburgh Brick Company, Briggston, Pa., 200 h.p.; York Manufacturing Company, York, Pa., 160 h.p.; James H. Baker Manufacturing Company, Tarentum, Pa., 250 h.p.; W. H. Herr, Altoona, Pa., 150 h.p.; Pittsburgh Steel Foundry, Glassport, Pa., 400 h.p.; Altoona &Logan Valley Street Railway Company, Altoona, Pa., 1000 h.p.

THE NEW PROCESS RAWHIDE COMPANY, of Syracuse, N. Y., is meeting with unusual success in the manufacture of its rawhide pinions, and the demand for these supplies is constantly increasing. The company has recently received the following letter from Charles H. Mayer, treasurer of the York Street Railway Company, of York, Pa., which speaks for itself: "I have shipped to your address by Adams Express a rawhide pinion (single reduction—W. P. 30) that has been in use on our road for fourteen months, averaging 105 miles a day. It is one of a lot purchased from you during May, 1897, all of which have given most satisfactory results. Its wearing qualities have been almost equal to that of a steel pinion, the teeth being worn to a knife edge without a break, at the same time leaving the gear with which it was used in as good condition as it was when the pinion was put on."

THE AMERICAN ENGINEERING COMPANY, of Philadelphia, Pa., has under course of construction the Newtown Electric Street Railway, extending from Newtown, Pa., to Doylestown, the county seat of Bucks County. This makes a through connection between Bristol, the largest town in the county, and the county seat. The work will be finished about June 15. The company is also building the Elmira & Senaca Lake Railway, running between Horseheads and Watkins Glen, a distance of 18 miles. The grading is nearly done, and abutments for several of the bridges are in place. The track laying will begin soon, and the road will be completed about the middle of July. The company also has under contract the line of the Michigan Traction Company from Kalamazoo to Battle Creek. Work on this line will begin before June 1, and be completed within ninety days. There is 27 miles of work.

GATES & RANDOLPH have taken the offices and warerooms at 13 and 15 Monadnock Building, Chicago, on the ground floor, formerly occupied by Sargent & Lundie. They are handling the apparatus of the Triumph Electric Company, of Cincinnati, Ohio,

for direct current work; the Warren Electric Manufacturing Company, of Sandusky, Ohio, for alternating work; the Empire Electrical Instrument Company, of New York, portable switchboard, alternating and direct current instruments; F. A. La Roche & Co., of New York, switchboards, circuit breakers and switches, and Sterling Arc Lamp Company, of New York, enclosed arc lamps for all circuits. It is the purpose of this firm to operate a miniature electric lighting plant in its new warerooms, using a Triumph motor running a Warren alternator through a La Roche switchboard, with Empire instruments and transformers, etc., with arc and incandescent lamps and motors running through the same circuit. Gates & Randolph will not only handle electrical apparatus, but will undertake entire contracts for street railway and lighting plants.

MESSRS. P. R. JACKSON & CO., LTD., of Manchester, England, are sending out their new general catalogue and price list, which is a very well printed and splendidly gotten-up book, handsomely bound, and containing about 400 pages, profusely illustrated with good cuts. The volume is not too large for the great field it covers. The earlier sections contain gear wheels of every description, including the well-known double helical-toothed wheels in which this firm was pioneer, and to whom the largest share of credit is due in introducing them into general practice. Pistons and piston rings form another section, while the remainder and the most elaborate part of the book is taken up by the electrical section, including dynamos, motors, traction plant, switchboards, arc lamps, and instruments of every kind. Too high praise cannot be given to P. Slater Lewis, M. M. Inst. C. E., who has compiled a publication which possesses such excellent qualities. Many valuable hints to purchasers are given, and other useful information which should prove of practical value to the English and foreign buyer. The price of the book is 7s. 6d.

THE CONSOLIDATED CAR FENDER COMPANY, of Providence, R. I., reports that orders for car fenders have never been so large as during the past month. It is now supplying fenders to the Metropolitan Street Railway Company, New York; Omaha Street Railway Company, Omaha, Neb.; Ottawa Car Company, Ottawa, Ont.; Des Moines City Railway Company, Des Moines, Ia.; Paterson Railway Company, Paterson, N. J.; Troy City Railway Company, Troy, N. Y., and Union Depot Railroad Company, St. Louis, Mo. It has also shipped a large number of parts of equipments to City Electric Railway Company, Port Huron, Mich.; Hartford Street Railway Company, Hartford, Conn.; Staten Island Midland Railroad Company, Stapleton, N. Y.; Meriden Electric Railroad, Meriden, Conn.; Fair Haven & Westville Railroad Company, New Haven, Conn.; Auburn City Railway Company, Auburn, N. Y.; North Hudson County Railway Company, Hoboken, N. J.; North Jersey Street Railway Company, Jersey City, N. J.; Middletown-Goshen Traction Company, Middletown, N. Y., and Utica Belt Line Street Railway Company, Utica, N. Y.

THE PNEUMATIC SUPPLY & EQUIPMENT COMPANY has been organized under the laws of the State of New York, and has opened an office at 120 Liberty Street, New York. It is the purpose of this company, as its name implies, to deal generally in compressed air equipment, and it will make a specialty of the installation of complete plants, eliminating the division of responsibility which has heretofore existed in the trade. The company is bringing out several specialties in the compressed air line, such as pneumatic oil rivet forges, quick acting hose couplings, and has in addition closed agencies for several standard types of compressors. J. W. Duntley, the president of the Chicago Pneumatic Tool Company, is the president of the new company; E. B. Gallaher, formerly with Patterson, Gottfried & Hunter, is the vice-president and engineer, and W. P. Pressinger, formerly manager of the Clayton Air Compressor Works, is secretary and treasurer. The rapidly widening scope of compressed air application opens a large field of usefulness for the new company, and the character of its incorporators is an assurance of its ability to meet the requirements of the trade.

THE CHRISTENSEN ENGINEERING COMPANY'S shops are overrun with work to such an extent that increased facilities are an immediate necessity, and will shortly be made. From the orders now going through the shops it appears that it is far from correct to suppose that it is the foreign, and not American, street railways which are taking up with air brakes on a large scale, for among these orders are those for a greater or less number of brakes from the following companies: Northwestern Elevated Railway Company, of Chicago; Brooklyn Elevated Railway Company; Twin City Rapid Transit Company, of Minneapolis; Union Railway Company, of Providence, R. I.; Quincy & Boston Street Railway Company; Union Traction Company, of Anderson, Ind.; Brockton (Mass.) Street Railway Company; Detroit, Lake Shore & Mt. Clemens Railway Company; Dayton, Xenia & Bellebrook Street Railway Company; Hingham (Mass.) Street Railway Company; Albany Railway Company; Wason Manufacturing Company, Springfield, and Montville Street Railway Company, Norwich, Conn. All these orders are for independent electric motor compressors and track equipment, and this seems to be the type which is almost universally preferred for city and interurban street railways.

New Publications

History of the Union Traction Company. By Frederick T. Chandler and Percy M. Chandler, of Philadelphia. Paper. 31 pages. Published by the compilers.

This is a descriptive and statistical analysis of the consolidation and development of the street railway properties of Philadelphia. The pamphlet contains a statement of the capitalization of the constituent companies, comprising the Union Traction system, together with the statistics of operation, interest, taxes, etc. A large inset map of Philadelphia showing the complete system is also included.

Red Manual of Statistics. Published by Haven & Stout, New York city. 580 pages. Illustrated.

This manual contains statistics of great value to investors in stocks and bonds, giving, as it does, financial information regarding all the principal railroad, street railway, industrial and other corporations whose securities are handled on the leading stock exchanges in America. This information includes a statement of the capital stock and funded debt, comparative earnings and names of officers and directors. A large number of maps, together with a statement of the high and low record of the securities for the past year, are included.

Liquid Air and the Liquification of Gases. By T. O'Connor Sloane. 365 pages. Illustrated. Price $2.50. Published by Norman W. Henley & Co., New York.

Dr. Sloane is well known as the author of a number of books on electrical subjects, and he has treated his subject in the new book mentioned above in his usual clear style. The entire history of the liquification of gases is given from the earliest times to the present, and the later experiments, particularly of Tripler, are given in great detail. It is difficult at present to gage exactly the commercial value of a cheap method of liquifying air, but the process has wide possibilities of application to the arts, as well as possessing great scientific interest. The book is well illustrated.

Trade Catalogues

Pumping Machinery. Published by the Deming Company, Salem, Ohio. 33 pages. Illustrated.

Cranes. Published by the Brown Hoisting & Conveying Machine Company, Cleveland, Ohio. 175 pages. Illustrated.

Catalogue. Published by the Simonds Manufacturing Company, Pittsburgh, Pa. 15 pages. Illustrated.

Amusements. Published by the Frank W. Mead Amusement Company, Boston, Mass. 32 pages. Illustrated.

Catalogue. Published by the New York Safety Steam Power Company, New York. 40 pages. Illustrated.

The Clayton Air Compressors. Published by the Clayton Air Compressor Works, of New York. 90 pages. Illustrated.

Various Catalogues. Published by the General Electric Company, Schenectady, N. Y.

Various Catalogues. Published by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

In the Great Northwest

The Northern Pacific Railroad, whose headquarters are at St. Paul, Minn., has ready for circulation its annual publication describing the regions tributary to its system. Its book this year is known as "Wonderland '99," and contains a most entertaining story of the beauties of this region. Many of the principal resorts are mentioned in detail, and the best fishing and hunting points are charmingly described. The book is full of beautiful half-tone engravings, bringing out more forcibly than a mere description the wonderful scenery and resources of the "Great Northwest."

Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, JULY, 1899. No. 7.

SYSTEM OF THE UNITED TRACTION COMPANY, PITTSBURGH

The United Traction Company, of Pittsburgh is a typical example of the tendency developed during the last few years of combining in one corporation a large number of individual electric railway systems, and the history of the company exhibits in a striking way the advantages in the direction of economy derived by such consolidation. The company was chartered July 27, 1896, and has purchased all the rights and franchises of the Second Avenue Traction Company, the North Side Traction Company and the Pittsburgh, Allegheny & Manchester Traction Company. It includes all of the electric railway lines in the city of Allegheny, as well as the important Second Avenue line of Pittsburgh, which parallels the Monongahela River as far as McKeesport, with branches to East Pittsburgh and Wilmerding. Included in the Allegheny lines is the original system of the Federal Street & Pleasant Valley Railway, which possesses historic interest from the fact that it was one of the first, if not the first, of the electric conduit railways in America to be operated commercially. This line was changed to the trolley system, however, a number of years ago.

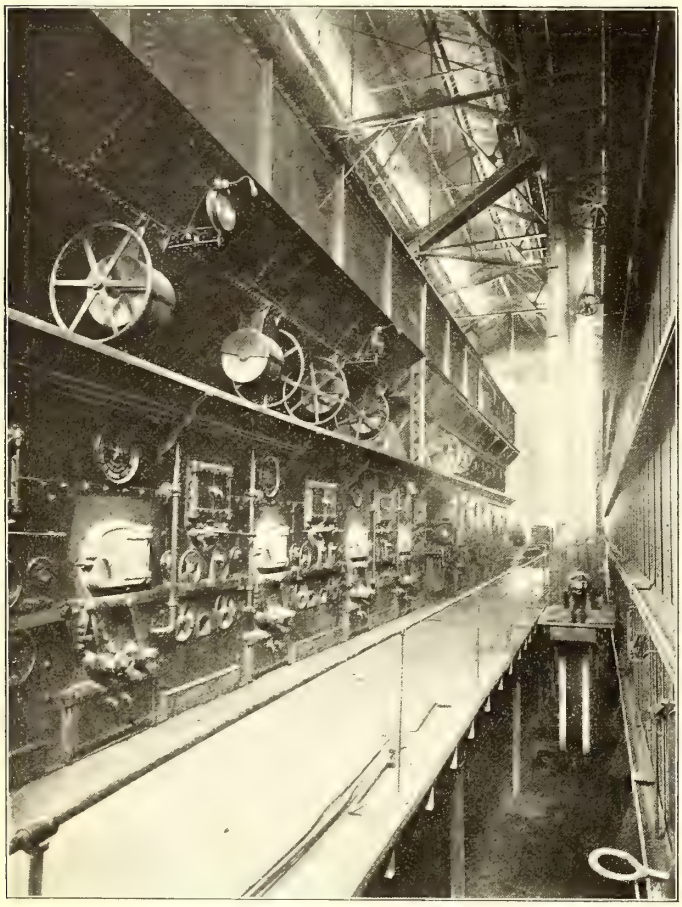
With the consolidation of the various lines the company found itself in the possession of a number of power houses, of which one only, that at Glenwood, which operated the Second Avenue system, was of modern construction. This fact, together with the extension of its lines east and west following the consolidation, made the subject of power generation and distribution an important question, and one requiring immediate consideration.



VIEW IN POWER STATION OF UNITED TRACTION COMPANY, PITTSBURGH

The system, as shown in the map on page 423, possesses a resemblance to an extended Y, with the Allegheny system near the base of the letter. It was finally decided to concentrate the generating power plant at two points, viz., at Glenwood, at the apex of the Y, and at Juniata Street, in Allegheny; and to have a third distributing point, *i. e.*, a storage battery booster station, at Dravosburg, near the McKeesport terminal, to be supplied with power from the Glenwood station. The need of three distributing points

was accentuated by the topography of the line, as steep grades are frequent. The steepest grade is on Pennsylvania Avenue, on the Manchester division, and averages

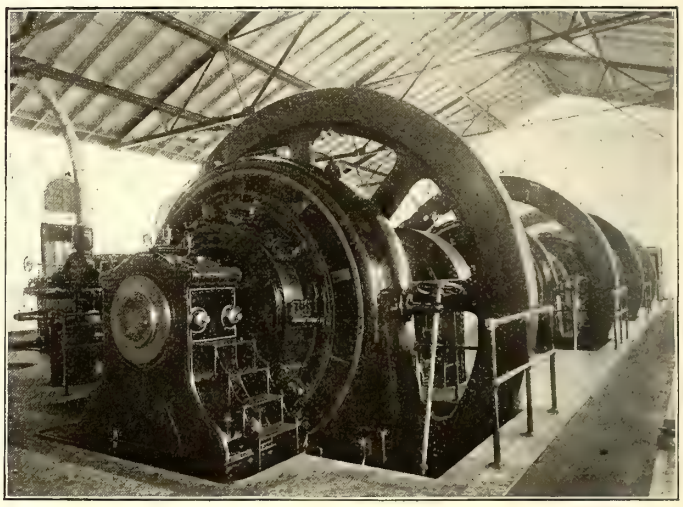


INTERIOR OF BOILER ROOM

13 per cent for a length of 900 ft. On the Dravosburg branch there is a grade of 6 per cent for 8000 ft., and on the Perrysville branch one of 11 per cent for 500 ft. In addition to these many other steep grades are encountered in ascending and descending the precipitous banks of the Allegheny, Monongahela and Ohio Rivers in the neighborhood of Pittsburgh.

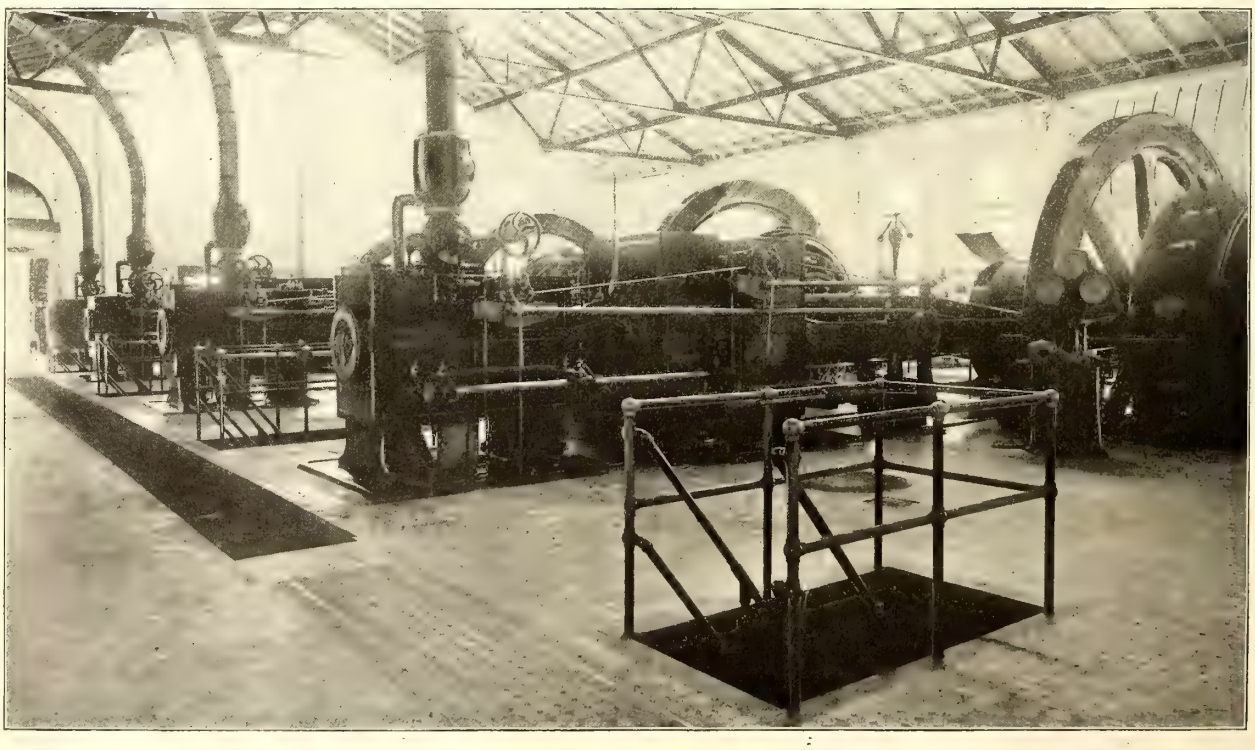
As now constituted the company possesses 117 miles of track, all electric, and 298 cars, of which 259 are motor cars and 39 trail cars.

In selecting a site for its new power station to take the place of the stations then existing in the western end of the system, the location of the existing station of the Pittsburgh, Allegheny & Manchester Traction Company, one of the constituent leased companies, was selected. This point seemed desirable in every way, as fuel could be delivered at the station doors from either of two railroads, or, at a slight expense for conveyor machinery, from the river barges, and as the station was near the "center of gravity" of the Allegheny section of the system. This station was



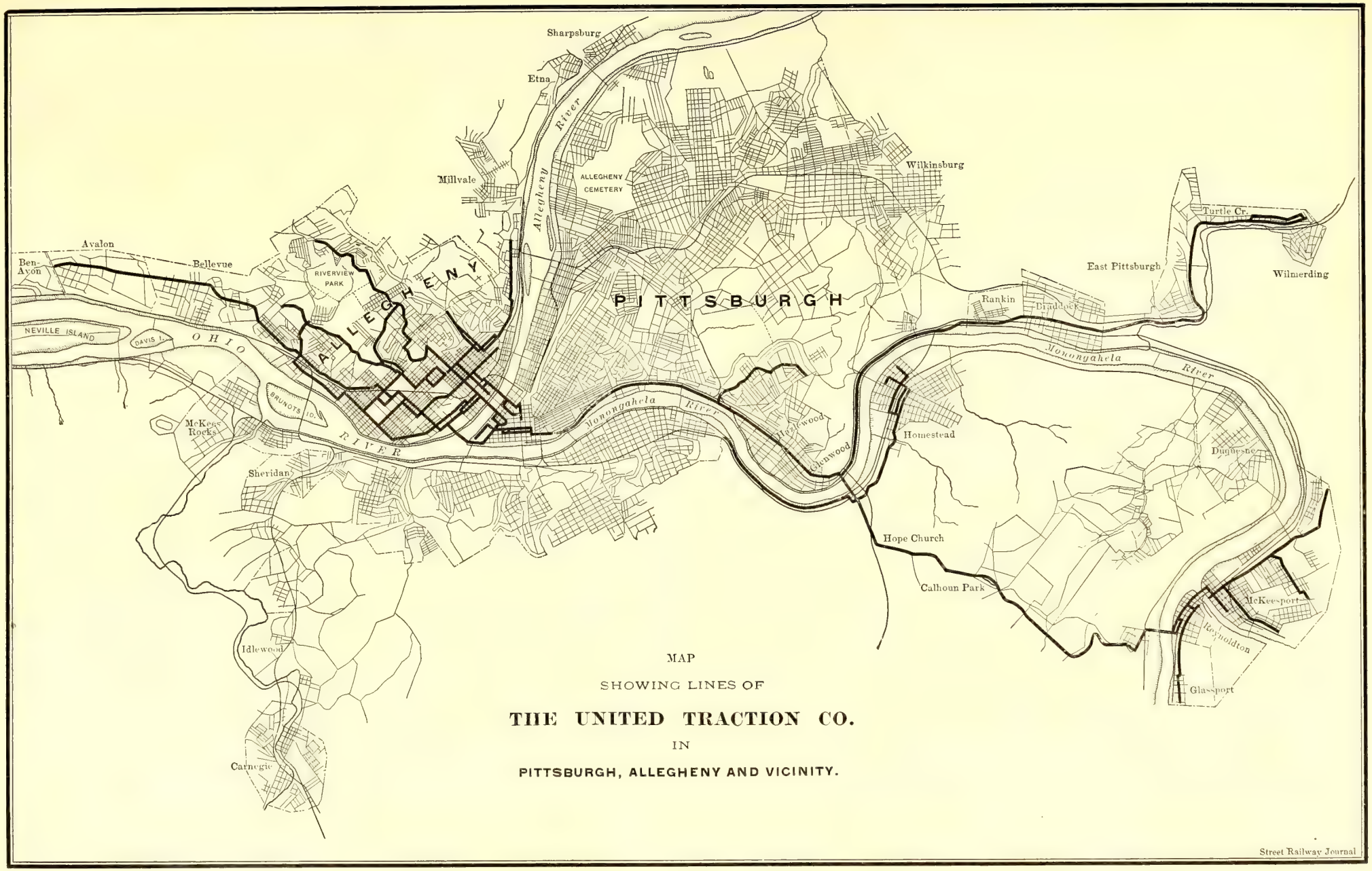
GENERATOR END OF ENGINE

on Juniata Street, Allegheny, and close to the banks of the Ohio River.



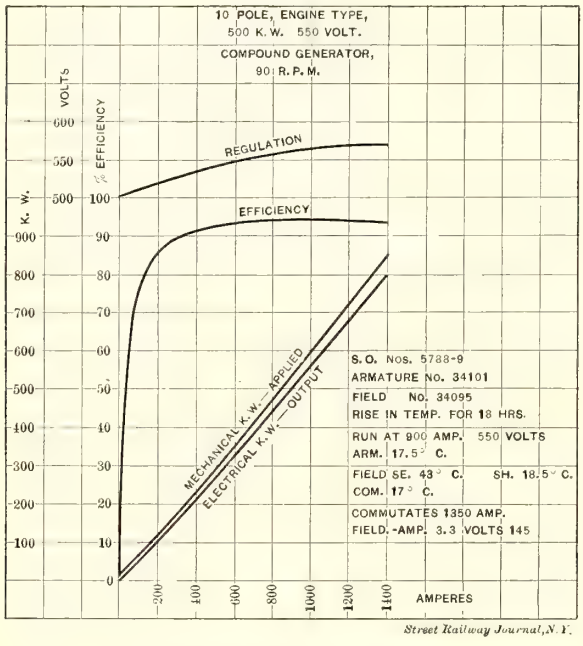
VIEW OF ENGINES

The old engine room gave abundant space for four direct connected units, although formerly all the available


Sharpsburg
Etna
Millvale
Allegheny River
ALLEGHENY CEMETERY
Wilkinsburg
Turtle Cr.
East Pittsburgh
Wilmerding
Avalon
Ben-Avon
Bellevue
RIVERVIEW PARK
ALLEGHENY
PITTSBURGH
Rankin
Braddock
NEVILLE ISLAND
DAVIS I.
OHIO
Monongahela River
GRUNOTS I.
McKees Rocks
RIVER
Sheridan
Hazlewood
Glenwood
Homestead
Duquesne
Hope Church
Calhoun Park
McKeesport
Idlewood
Glassport
Carnegie
MAP
SHOWING LINES OF
THE UNITED TRACTION CO.
IN
PITTSBURGH, ALLEGHENY AND VICINITY.
Street Railway Journal

space had been occupied by half the same capacity in belted machinery. The boiler capacity, however, was inadequate, so that a new boiler house was added, adjoining and just west of the existing station. Reconstruction was commenced late in 1897, and, owing to the continuous demand for power, the new generating apparatus and boilers had been installed singly, so as not to interfere with the continuous operation of the plant. Gradually all of the old machinery was removed, and the existing station now represents a harmonious arrangement, and one fully up to date as regards modern methods of electric engineering. There is not a piece of machinery now in the station that was there when the installation of the new machinery began. The difficulty of the changes can be appreciated when it is stated that current to the former capacity of the plant was furnished continuously for the operation of the road during the progress of the installation.

One of the chief considerations which had to be borne in mind by the designing engineers was the changes in water level produced by the rise and fall of the Ohio River at different periods. The difference in the water level between

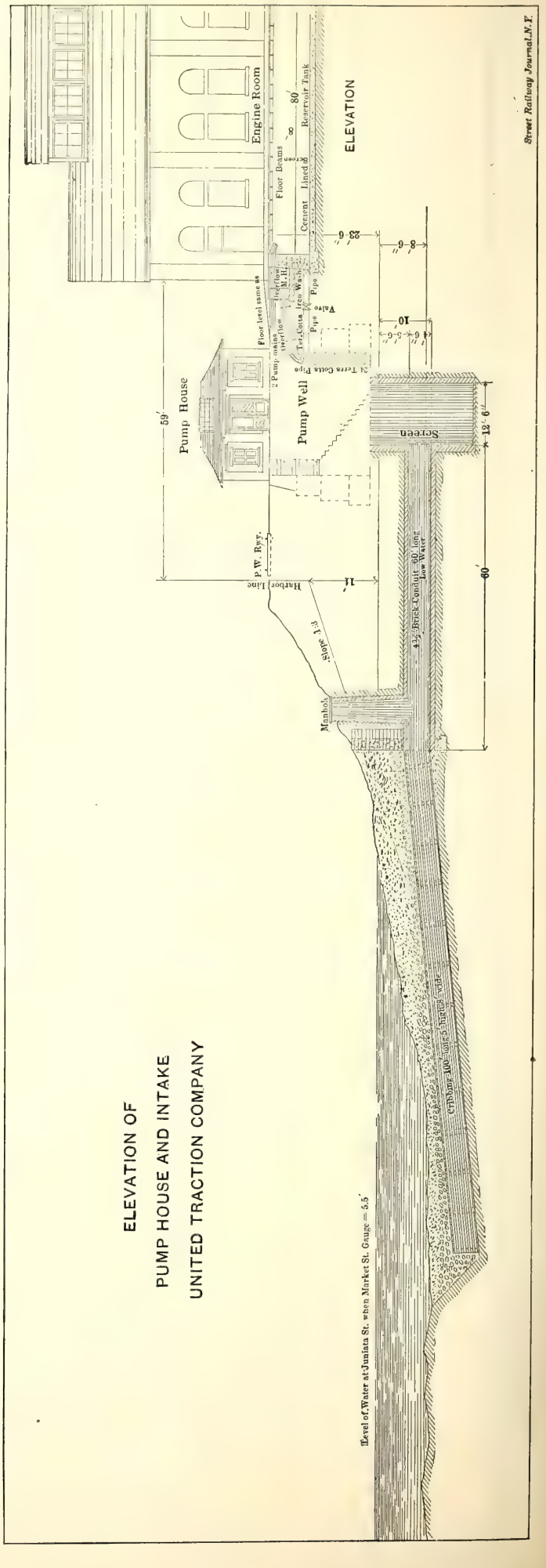


GENERATOR DATA CURVES

high and low water mark amounts to about 30 ft. The extent of this rise and fall can be seen graphically from an inspection of the diagram on this page, in which the low water mark is given, while the high water mark is close to the tracks of the P. & W. Ry., or within a few feet of the engine room floor.

The rise and fall of the river level necessarily affected also the location of the condenser pumps, which, as will be seen by the diagram already referred to, are located in a well. From this point they lift the water 20 ft. above the lowest water level, and then force it 8 ft., discharging it into a cistern, from which point it is pumped to the condensers.

The same diagram also shows the construction of the crib, which was an important feature in the installation of the plant, as the feed water is also taken from the river. It was found that the river water itself was too muddy for use directly in the boiler, but if filtered somewhat it was amply good for the purpose. The crib is made up of hemlock plank laid 2 ins. apart, with a transverse plank every 8 ft., and measures 100 ft. long x 8 ft. wide x 5 ft. high. The top is from 3 ft. to 5 ft. below the natural bed of the river. It was then covered, first with broken stones and



ELEVATION OF
PUMP HOUSE AND INTAKE
UNITED TRACTION COMPANY

brickbats, and afterwards with gravel and sand, which provided an excellent filtering material.

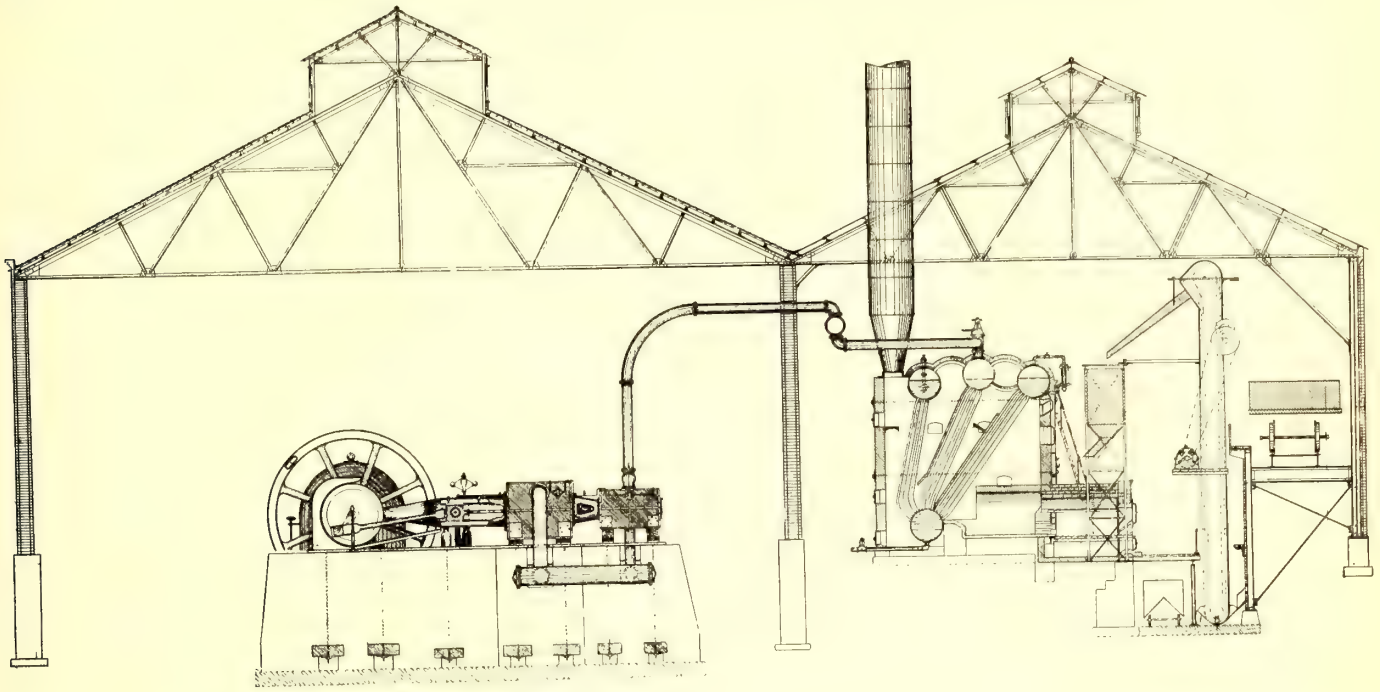
The engine room illustrated on page 421 presents a light and attractive appearance from the fact that the walls are painted white and are furnished at their bases with a dado of white glazed tiles with green stripes. The floor is laid with white unglazed tiles.

The engine room contains four tandem compound Green engines, the cylinders of which measure 28 ins. and 38 ins. x 48 ins. stroke. They are operated at 100 r.p.m., and are rated at 750 h.p. nominal, with capacity for 50 per cent overload. The flywheels weigh 60,000 lbs., and the steam pressure used is 125 lbs. These engines have shown on test an economy of 14 lbs. of water per h.p. hour. They were supplied by the Providence Steam Engine Company, of Providence, R. I.

Each engine has its own pump and separate jet condenser, which is of the Laidlaw-Dun-Gordon type. These condensers are located in the basement, and obtain their water supply from the crib system already mentioned.

The generators were built by the Westinghouse Electric & Manufacturing Company, are of 500-kw. capacity each, but are guaranteed to run up to 625 kw. continuously, with no part rising in temperature more than 40 degs. C. above the surrounding air. A load of 750 kw. for two hours, or of 875 kw. for ten minutes, is permitted under a guarantee that there shall be no injurious sparking or heating, and no necessity for shifting the brushes from the no load position. If the armature shall be placed 1-16 in. out of center there shall be no vibration, heating or sparking. All of these guarantees were easily fulfilled in a recent test.

The generators are of the well-known Westinghouse "engine type" construction; the field has ten poles, with



CROSS SECTION OF POWER STATION

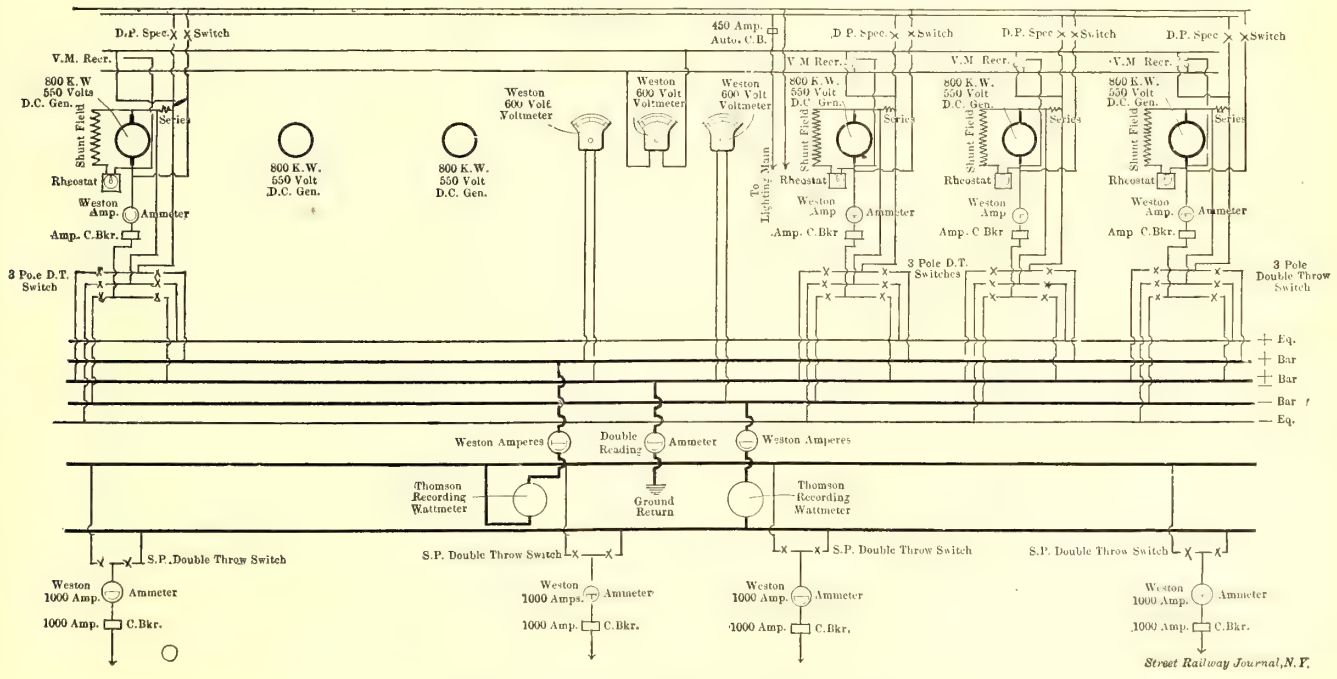
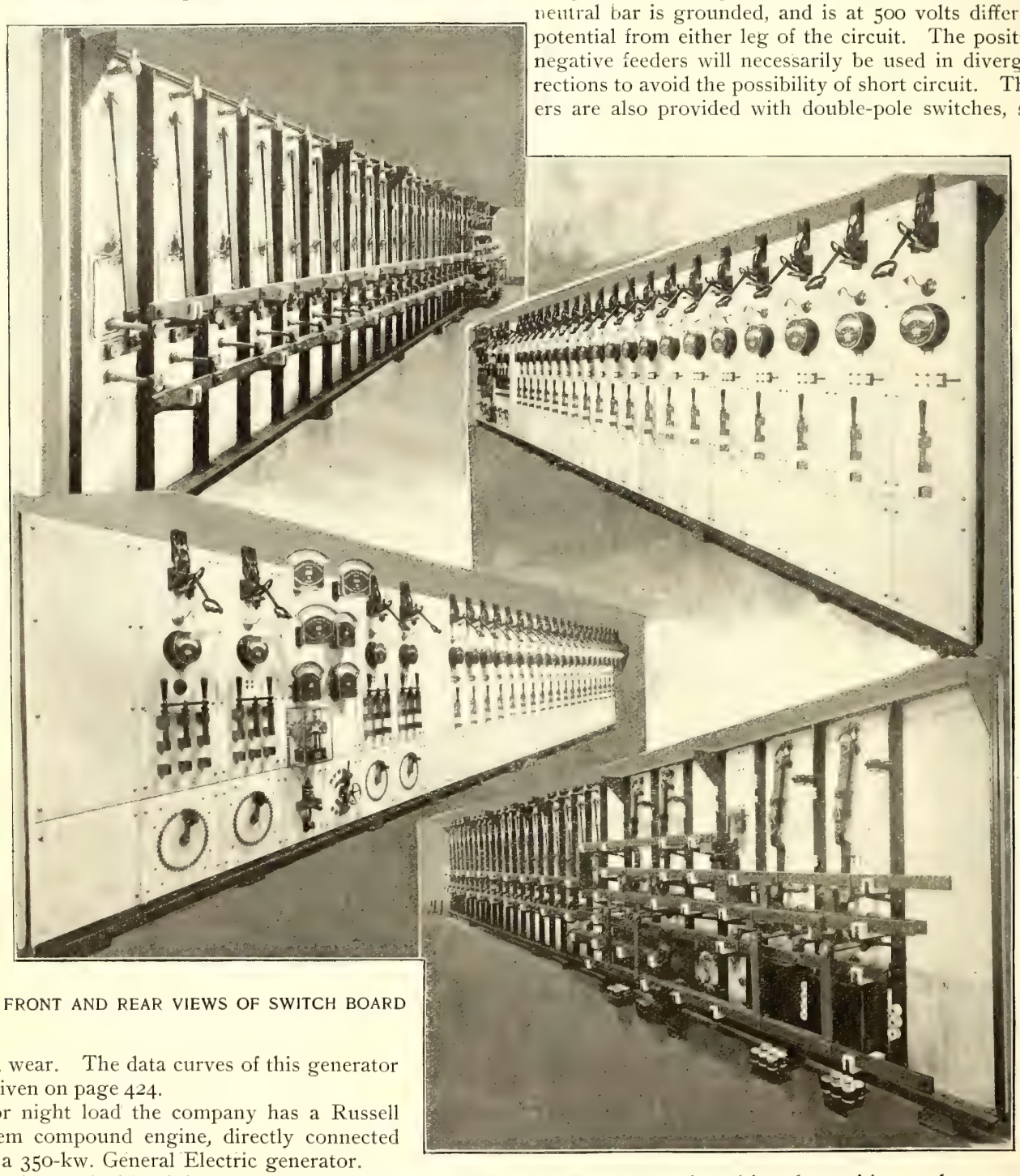


DIAGRAM OF SWITCH BOARD CONNECTIONS

series and shunt coils, wound and insulated separately, giving excellent ventilation. The pole pieces are of laminated steel, cast into a massive cast iron yoke. The field frame is split vertically and rests on a wedge-shaped bed plate, by means of which it can be raised or lowered 1 in. The armature is of the ironclad type, and has no bands, the coils being held in place by fibre wedges driven into notches near the top of the slots. The armature winding is of copper bars bent to proper shape, and then insulated. The commutator has ample surface, and the bars will stand 2 ins. wear. The data curves of this generator are given on page 424.



FRONT AND REAR VIEWS OF SWITCH BOARD

For night load the company has a Russell tandem compound engine, directly connected with a 350-kw. General Electric generator.

On the south side of the station is a switchboard, which for a number of reasons possesses unusual interest. One of these is that it has the largest three-wire street railway panel switchboard in the world. While the company has not yet commenced the operation of its lines on the three-wire system, and has no immediate plans for changing to this system at any stated date, the advantages of that method of operation were considered so great as to warrant the installation of the necessary apparatus on the switchboard for making the change at any time in the future. A general diagram of the connections is given on page 425, and the actual location of the apparatus and equipment on each panel on the opposite page.

By means of double-pole generator switches any generator can be connected to either side of the three-wire system, or all may be used on one side of the system, in which case the station would operate as a two-wire plant. When run three-wire, the difference in potential between the positive and negative bus bars is 1100 volts, while the neutral bar is grounded, and is at 500 volts difference of potential from either leg of the circuit. The positive and negative feeders will necessarily be used in diverging directions to avoid the possibility of short circuit. The feeders are also provided with double-pole switches, so they can be connected to either the positive or the negative bus bars, which will facilitate the balancing of the two sides of the three-wire system.

The construction of the switchboard is the standard Westinghouse No. 5 type, the slabs being white Italian marble and having the standard angle and channel iron frame. There are four generator panels, one double-load panel and twenty feeder panels, with space for two more generator panels.

The generator panels are 1200 amps. capacity each, and each is supplied with a standard rheostat panel below. The double-load panel has a normal capacity of 10,000 amps. at 1100 volts. The necessary Weston ammeters are supplied for indicating the station load in each of the three circuits, and Weston voltmeters are provided for reading the generators when changing the light circuit from one machine to the other.

The feeder panels are 900 amps. capacity each, and each ammeter is fitted with a double-throw switch to reverse the ammeter leads when changing the feeders from the positive to the negative bus bars, or vice versa, to prevent

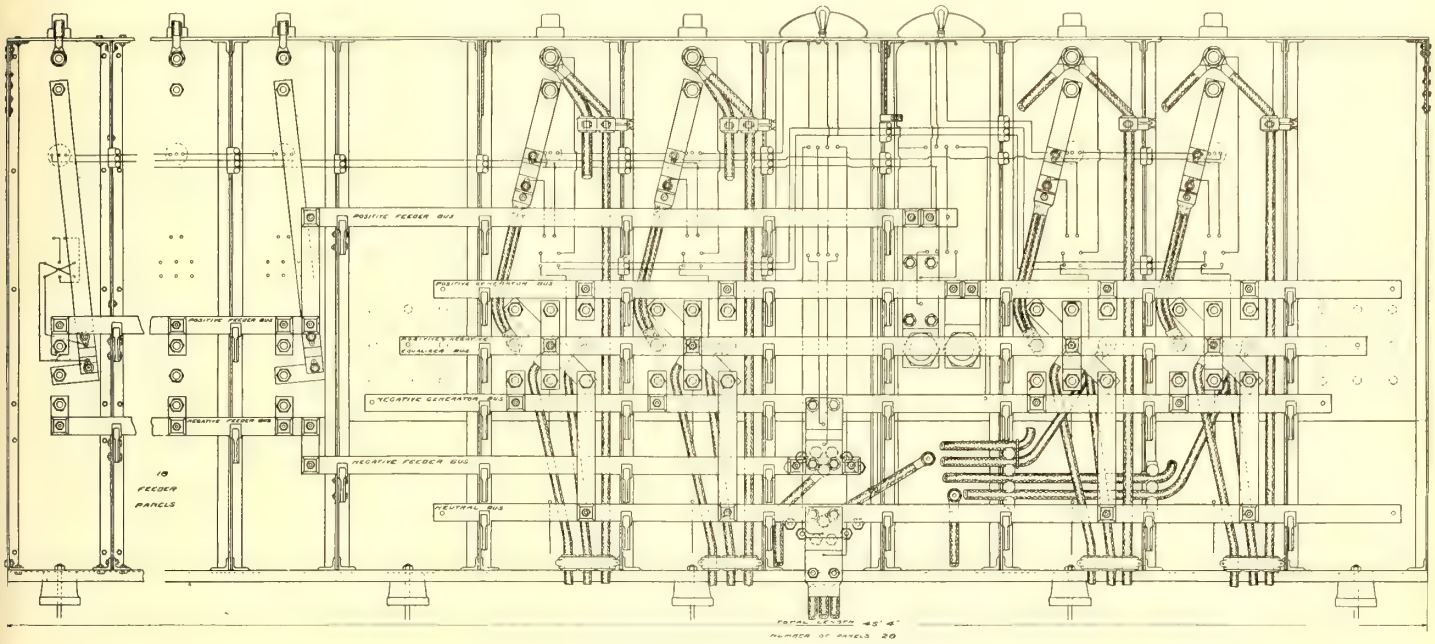
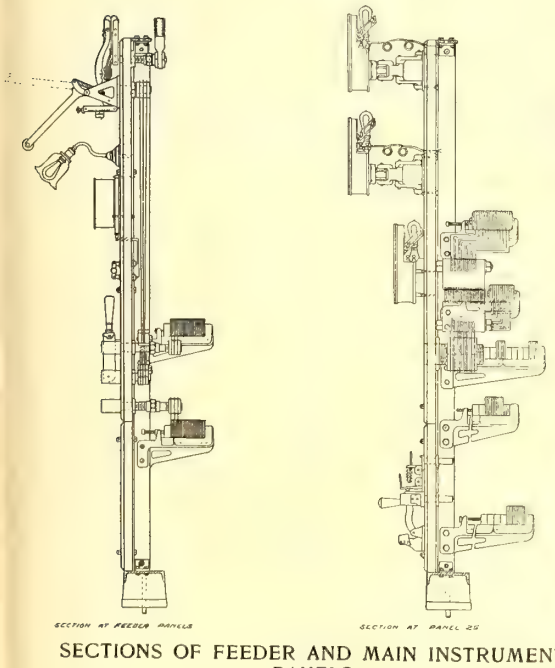


DIAGRAM OF SWITCH BOARD CONNECTIONS

the bus bar potential when the machines are run in multiple or series. The voltmeters are mounted on swinging brackets, so that they may be readily seen from the ends of the switchboard; in addition a Thomson recording wattmeter of 10,000 amps. capacity is provided for use when running as a two-wire system.

The lighting switch situated beneath the load panel is

reversing the current in the ammeter. On each feeder panel is a 1000-amp. ammeter, a single-pole double-throw switch, and an 800-amp. Westinghouse circuit breaker. There is also a small double-pole double-throw switch for reversing the ammeter connections when the feeder is thrown from one side of the three-wire system to the other. This switch can also be used for opening the ammeter circuit when the engineers desire to put a temporary overload on the feeder for burning out a short circuiting wire, or for any other purpose.



SECTIONS OF FEEDER AND MAIN INSTRUMENT PANELS



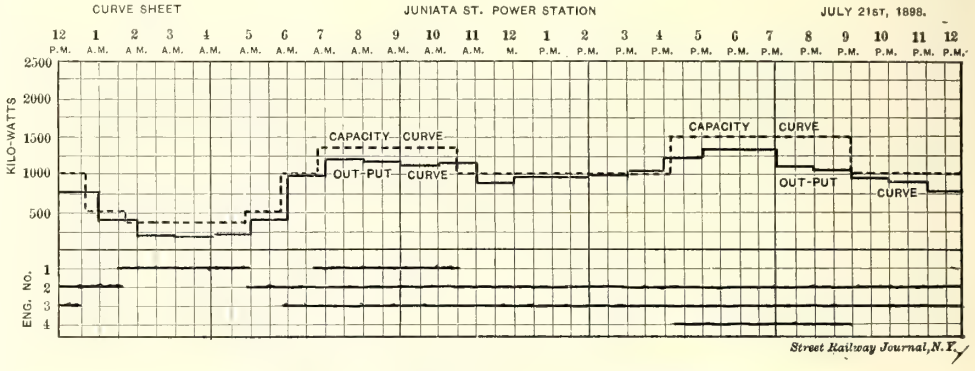
PAYMASTER'S CAR

so connected to the generators that the light circuit may be taken from any machine in the station and the lights will not be affected by the opening of the main circuit breakers. The small circuit breaker beside this switch is directly in the main lighting circuit. The switch is special, and made so as to interlock and prevent short circuiting

The circuit breakers are of the Westinghouse "brush" type, and are placed at the top of the board. This type of breaker is one of the latest productions of the Westinghouse Electric & Manufacturing Company. The switches are made entirely of copper, are of the "washer" type, and are all double-throw, as noted.

The large capacity of this board, together with its complicated set of connections, made it difficult to place the necessary copper conductors on the rear, and the engraving of the back of the board shows the construction which was used. In order to get the necessary cables to the instrument studs on the switchboard the rheostats were placed separately, being connected to their face plates by conductors carried in a hose.

The bus bars are of bare copper, being made up of individual bars of 3 ins. x $\frac{1}{8}$ in. section, with $\frac{1}{8}$ in. space between for ventilation. The positive, negative and neutral bus bars each consist of twenty-three of these bars, and each total bus bar is of sufficient carrying capacity for six 500-kw. generators operating on the same side of the three-wire system. As the bus bars are laminated and tapered, the maximum carrying capacity for the least amount of copper is obtained.



FORM FOR KEEPING STATION RECORDS

The connections between the generators and switchboard consist of two 650,000 c.m. rubber-covered cables in parallel, for positive, negative and equalizer. These cables are supported by special porcelain insulators to the I beams forming the ceiling of the 10-ft. basement and the floor of the engine room.

The switchboard itself rests on large wooden blocks, which are carried on 10-in. I beams, which in turn rest on



INTERIOR PAYMASTER'S CAR

brick piers built up from the basement floor. The latter is of concrete.

The boiler room contains four Stirling batteries of 400 h.p. each, and one battery of Babcock-Wilcox boilers. A special stack is provided for each battery, and each boiler is equipped with Murphy stokers.

The freight cars carrying the coal are run on a trestle into the boiler room, and discharge their loads into a large iron bin of thirty carloads capacity, in front of the boilers. In front of this bin is a track, on which runs a coal conveyor or elevator consisting of an endless chain of buckets, driven by an old Sprague No. 6 motor, which has been changed over to shunt winding. These buckets can be filled at any point along the bin, and raise the coal to a height where it can be shot down into the hoppers above the Murphy stoker with which each boiler is equipped. The ashes are discharged from the boilers into hoppers located in the basement, and are taken out by a small car drawn by a cable operated by an electric motor situated just outside of the boiler room proper. A National feed water heater completes the equipment of the boiler room.

For feed water the company is using the overflow from the condensers, and although there is naturally a slight admixture in it of oil from the cylinders, no trouble has been experienced with scales in the boiler tubes. The advantage of using this overflow is, of course, that water of a temperature of from 95 to 100 degs. is available. The heater is supplied with exhaust steam from the auxiliaries, and the feed water is forced into the boilers at a temperature of 212 degs.

A method of keeping engine and output records maintained at this station is illustrated in the accompanying form. An ordinary sheet of plotting paper is used, on the upper part of which is plotted the output curve, shown by the solid line, and below the hours during which the different engines are run. From the latter the capacity curve, shown by the dotted line, is drawn, superimposed on the output curve. These daily sheets show at a glance whether too many machines are being run for the work to be performed.

The Glenwood station, from which the power for the eastern end of the line is taken, was described in the Street Railway Journal for August, 1895. It contains two compound Russell engines, each coupled to a 500-kw. Westinghouse generator, and two Green engines of the same type as in the Juniata Street station, directly connected to 500-kw. Westinghouse generators. The company will also install two 800-kw. generators at this station in the future, but the contract for these has not yet been awarded. The station also contains two boosters; one for supplying the Wilmerding line, and the other for supplying the current to the storage battery station at Dravosburg. This battery contains 424 cells, has been in use about a year, and it is found in practice most satisfactory. Since its original installation its capacity has been doubled by adding the necessary number of plates to each cell. By its use the company has been enabled to shut down an auxiliary power station which it formerly used at McKeesport.

In its track construction the company uses a 90-lb. girder rail and Bryan bonds are used throughout. For its overhead line the company used a 7 in.-6 in.-5 in. tubular pole, with General Electric line material.

The standard car has a 20-ft. body, vestibuled, and it is mounted on a single Lord Baltimore truck, which is used

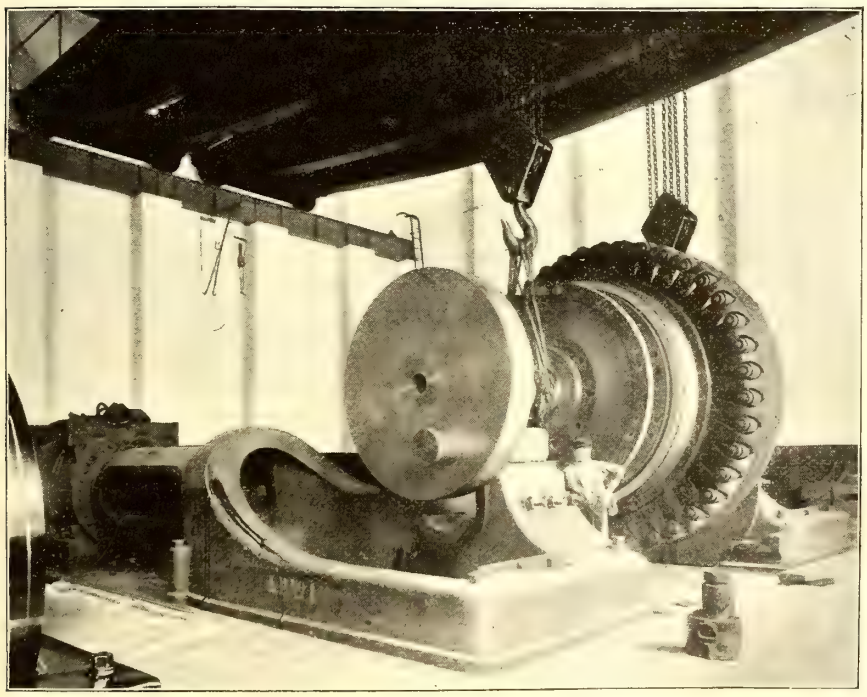
as a standard on this line, and is giving good satisfaction. The company has only one double-truck car equipment. The Sterling register is used throughout, and the gongs are carried on the hood, instead of under the platform. This is done because it is thought the sound is louder and clearer than when located under the platform. The gongs are rung by means of a strap which the motorman pulls by the same hand with which he manipulates the controller. All cars are equipped with illuminated signs on the hood.

A somewhat novel type of car is illustrated on page 427. This is a car used by the paymaster, and is fitted at one end with a safe and closed vestibule, in which the paymaster sits. The employees are paid off three times a month, and as they pass through the car they are given their envelopes by the paymaster.

The officers of the United Traction Company are: President, James D. Callery; secretary, J. H. Callahan; treasurer, John W. Taylor; superintendent and chief engineer, John Murphy. The mechanical engineer of the company is S. L. Tone, and constructing electrical engineer is P. N. Jones, of the Westinghouse Company.

Additional Equipment for Western Avenue Power Station of the West Chicago Street Railway Company

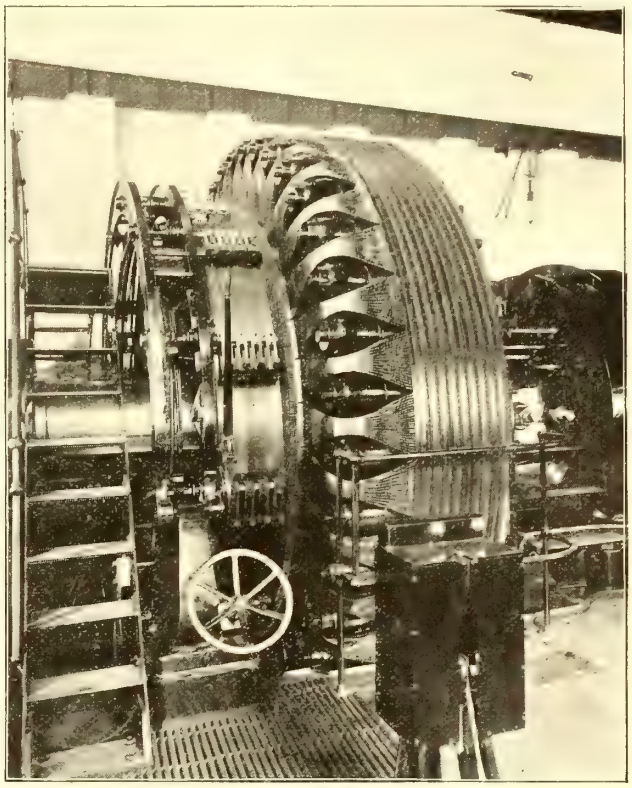
The accompanying illustration shows the armature and shaft of a 1500-kw. Siemens & Halske generator in the process of being installed in the Western Avenue power station of the West Chicago Street Railway Company. This is an additional unit to the five that compose the original equipment of the station. This armature has a specially designed commutator, as shown in the illustration. The armature is 14 ft. outside diameter, and is designed to run at 75 r.p.m. The shaft is hollow and 23 ft. 3 ins. in length, and is composed of fluid compressed steel made



PLACING ARMATURE AND SHAFT IN POSITION

by the Bethlehem Iron Works. It is 28 ins. in diameter at the wheel, while the bearings are 22 ins. in diameter and 46 ins. long. Each of the crank pins is 12 ins. x 12 ins.

The engine to which the generator is coupled is a cross-compound non-condensing machine, with cylinders 34 ins. x 54 ins. x 60 ins., and is rated at 2000 h.p. The flywheel is 25 ft. in diameter, and weighs 80 tons. The steam and exhaust valves are operated by separate eccentrics, while the valves are of the double-port type. The engine was



MODIFIED ARMATURE

designed and built by the Pennsylvania Iron Works Company.

When completed the total engine power capacity of the station will be 12,000 h.p. It is interesting to note in this connection that three of the original generators, which were also manufactured by the Siemens & Halske Company, have been redesigned, with the commutator placed on the side, and of smaller diameter than the armature. It will be remembered that in the first installation of the generators in this station the commutator bars were placed in the periphery of the armature, but owing to the high speed some difficulty was experienced in maintaining the bars in position. The remodeling consisted of introducing connections, thus reducing the diameter of the commutator. The equipment is now working in a highly satisfactory manner, although it has been loaded greatly above the rated capacity of the machines ever since it has been in operation. Current is not only supplied for operating the cars of the West Chicago system, but for operating those on the Lake Street Elevated Road. The voltage is 550, and the two systems are operated from the same bus bar.

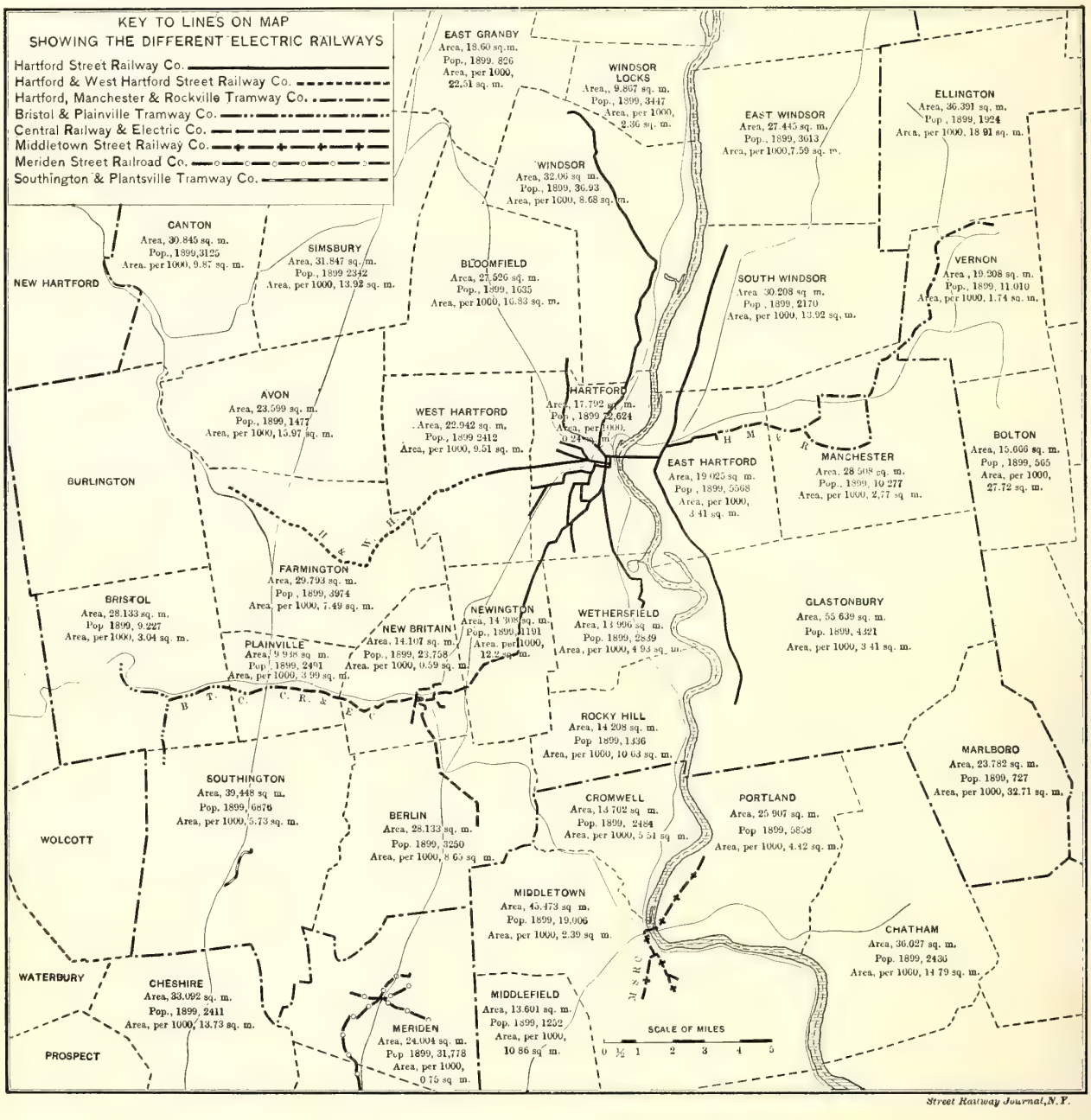
The steam equipment is being improved by the installation of automatic stokers. The boilers are of the Stirling type, and two of these, which are rated at 400 h.p. each, are each being provided with two American stokers, which are required to burn 1000 lbs. of Illinois coal per hour. One of the other boilers is being equipped with a stoker of a chain grate type, installed by the Greene Engineering Company, of Chicago. These two types of stokers are being installed

for the purpose of making a competitive test, with the view of deciding which type shall be employed for equipping the remaining boilers.

Electric Railways in Central Connecticut

Although possessing no city of 100,000 population, an electric railway system of considerable extent exists in the central part of Connecticut surrounding the cities of Hartford, New Britain, Middletown and Meriden. These systems are controlled by eight separate corporations, of which several form connecting links, while others are operated entirely independently of the others. The region through which these railways run is dotted with small manufacturing communities, and the inhabitants are, as a whole, quite prosperous, so that a study of the earning capacity of these railways per mile of track is of interest.

The accompanying engraving shows the location and extent of the different systems, with area of the several townships and area in square miles per thousand inhabitants. The earnings for the several systems, as given in the table below, are taken from the last report of the Railroad Commissioners of the State of Connecticut, and, owing to a change in the fiscal year of these commissioners, are given for nine months only. The final two columns give the proportionate increase for twelve months, derived from adding one-third to the nine-months' figures, but in reality the earnings would be somewhat in excess of this, as the earnings reported to the Railroad Commissioners cover six winter months and three summer months. As will be seen, the earnings per mile vary from $2,200 to $8,300 per mile, the maximum figure being practically the same in the case of the Hartford Street Railway Company and the Central Railway & Electric Company:



EARNINGS ENDING JUNE 30, 1898.

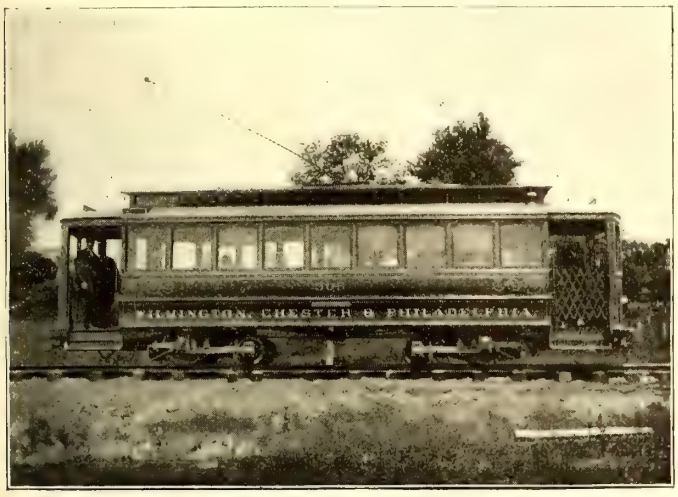
	Miles.	Earnings, 9 Mos.	Earnings per Mile Track, 9 Mos.	Earnings, 12 Mos.	Earnings per Mile, 12 Mos.
Middletown	7.9	18,403	2,329	24,537	3,106
Meriden	17.5	72,177	4,124	96,236	5, 99
Central Ry. and Electric	18.6	116,193	6,247	154,924	8,329
Hartford Street	70.3	438,069	6,230	584,092	8,309
Hartford and West Hartford	17.8	29,599	1,663	39,465	2,217
Hartford, Manchester and Rockville	18.7	61,183	3,273	81,591	4,363
Southington and Plainville	1.6	*2,252	1,434	4,504	2,868
Bristol and Plainville	7.9	44,384	5,618	59,179	7,491

* For 6 months.

Interurban Railway Between Wilmington and Chester

The connecting link between the electric railway systems of Wilmington, Del., and Chester, Pa., was put in operation March 22, and is now carrying a large number of passengers. This completes the through line of electric roads extending from Darby from just outside of Philadelphia, to Wilmington, all of which is under one management; the operating official is R. F. Fox, who is general manager of both the Wilmington City Railway and the Chester Traction Companies. Through cars are now run from the P., W. & B. R. R. station in Wilmington through Chester to Darby, a distance of $13\frac{1}{2}$ miles; at Darby the cars connect with the Darby division of the Union Traction Company of Philadelphia. The running time between these terminals is one hour. The cars have to conform to the running schedule of the city cars while within the limits of Wilmington and Chester, but between cities often run at a speed of 20 miles an hour.

The line between Chester and Darby, which was put in operation several years ago, has developed the traffic on the Chester Traction system enormously, as shown by



STANDARD CAR



LOADING BALLAST CAR AT QUARRY



STRAIGHT TRACK NEAR CLAYMOND



CATTLE GUARD



ON THE TOP OF THE RIDGE



CONSTRUCTION NEAR WILMINGTON

figures published in the Street Railway Journal for February, 1898, in which a table was given showing the average rides per capita per year for a number of towns, varying in population from 20,000 to 40,000. In this table it is shown that on the Chester lines the average rides per capita was 222; while in nine isolated cities of about the same population the rides per capita did not average much over 50. Statistics showing the increase in traffic, owing to the opening of the through line to Wilmington, are not yet available, but present indications point to a large increase due to the through traffic between the cities.

The line extends for a considerable distance on the top of a ridge which lies between Wilmington and Chester, so that the ride is a most picturesque one, with attractive views on each side, and one on which the pleasure traffic ought to be considerable. After leaving the lines of the Wilmington City Railway it extends over a private right-of-way about four miles in length to Claymond; then, for about 3800 ft. the line is built along the side of the turnpike, and then branches off into a private right-of-way for a distance of 2 miles until the Chester city line is reached.

The track is laid with 70-lb. A. S. C. E. rails in 60-ft. lengths. Churchill ties are used, and the rails are double bonded with No. 0000 protected bonds, supplied by Mayer & Englund. The ties, which are of oak and chestnut in equal proportions, measure 7 ins. x 6 ins. x 7 ft. 6 ins., and are laid 2 ft. centers. The track is ballasted with broken stone throughout, to a depth of from 3 ins. to 4 ins. below the ties, and in some places the ballast is considerably deeper. The company owns its own quarry and crusher, and all ballasting was done from a special car into which the broken stone is loaded at the quarry and from which it is distributed along the track.

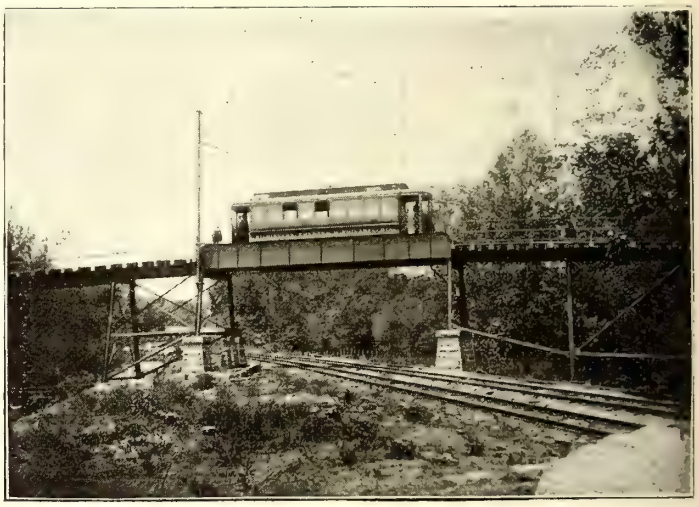
The grades are frequent, and on the section between Wilmington and Chester are in some places as high as 6 per cent. This portion of line is 10.3 miles long, of which .65 of a mile are in turnouts. Wharton frogs and switches are used throughout.

The poles are of chestnut, not less than 7 ins. in diameter at the top and 12 ins. at the butt. They are 30 ft. long, shaved and pointed, and set 100 ft. apart. The overhead line is partly of flexible bracket construction and partly span work. The H. W. Johns line material was used throughout. The trolley wire is a No. 00, supplied by Roebling.









BRIDGES AND VIADUCTS ON CHESTER-WILMINGTON INTERURBAN RAILWAY

The cars were built by Jackson & Sharp, and are extremely tasteful in design and finish. They are mounted on Brill maximum traction trucks, with 4-in. axles and 33-in. wheels, and are equipped with Westinghouse No. 38 B motors, with K-10 controllers. The company is also having six open twelve-bench cars built by the St. Louis Car Company, the equipment of which will be similar to that of the closed cars already mentioned.

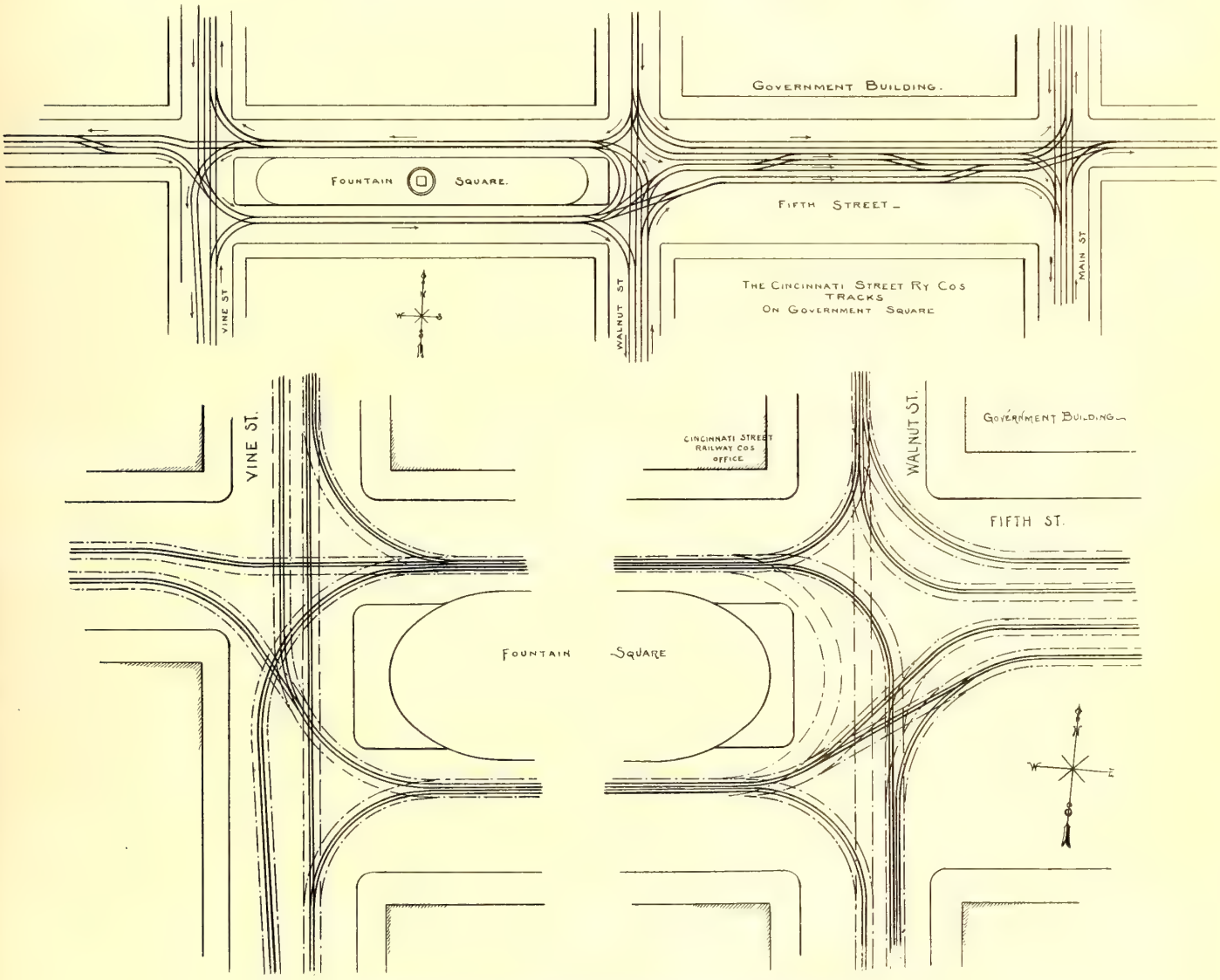
A half-hour service is conducted between Wilmington and Chester, except on Saturdays, when the cars are run every 15 minutes. Between Chester and Darby they are run every 17½ minutes. The fare between Wilmington and Chester is 20 cents; that of the railroad connecting the two cities is 33 cents. The line is supplied with power from the existing stations at Wilmington and Chester.

Track Construction of the Cincinnati Street Railway Company

In July, 1894, a description of the track construction of the Cincinnati Street Railway Company appeared in these columns, and the standard then employed in track work was described as follows:

"In the process of construction the pavement is removed and the surface excavated to a depth of 20 ins. The foundation is then rolled with a steam roller weighing 250 lbs. per lineal inch of surface measure. The oak ties, 6 ins. x 7 ins. x 8 ft., with joint ties, 6 ins. x 12 ins., are then placed with 2 ft. 6 in. centers. The rails are then spiked directly to the ties and the tracks surfaced up and supported on double track. This is claimed to be the most expensive street railway track that has ever been built for electric service in this country on so large a mileage."

The officials of the Cincinnati Street Railway Company were recently asked as to how the construction was standing up after nearly five years of service, and stated that it had been reasonably satisfactory. It has been found necessary, however, to shim up the joints two or three times, but as a general thing the foundations are still intact, except in some cases where the soil was porous. In these cases the concrete foundation has gone down, carrying track and all, so that for such conditions broken stone foundations are considered preferable. It should have been noted that the joints were united by means of heavy



TRACK AND OVERHEAD LINE CONSTRUCTION—FOUNTAIN SQUARE, CINCINNATI

wooden blocks. A foundation of concrete 6 ins. in depth is then placed under the ties and the space between the ties is filled with concrete and tamped. Where asphalt or brick is employed the concrete is placed above the ties, so that they are entirely inclosed in a pocket of concrete. With granite the concrete is brought to a level with the ties, above which are 2 ins. of sand to receive the blocks. On all paved streets a full grooved girder rail weighing 95 lbs. per yard is employed, and which, with granite paving, is required to be 8 ins. in depth. With asphalt and brick paving the same pattern of rail is employed, but the depth is only 6 ins. and the weight 86 lbs. per yard.

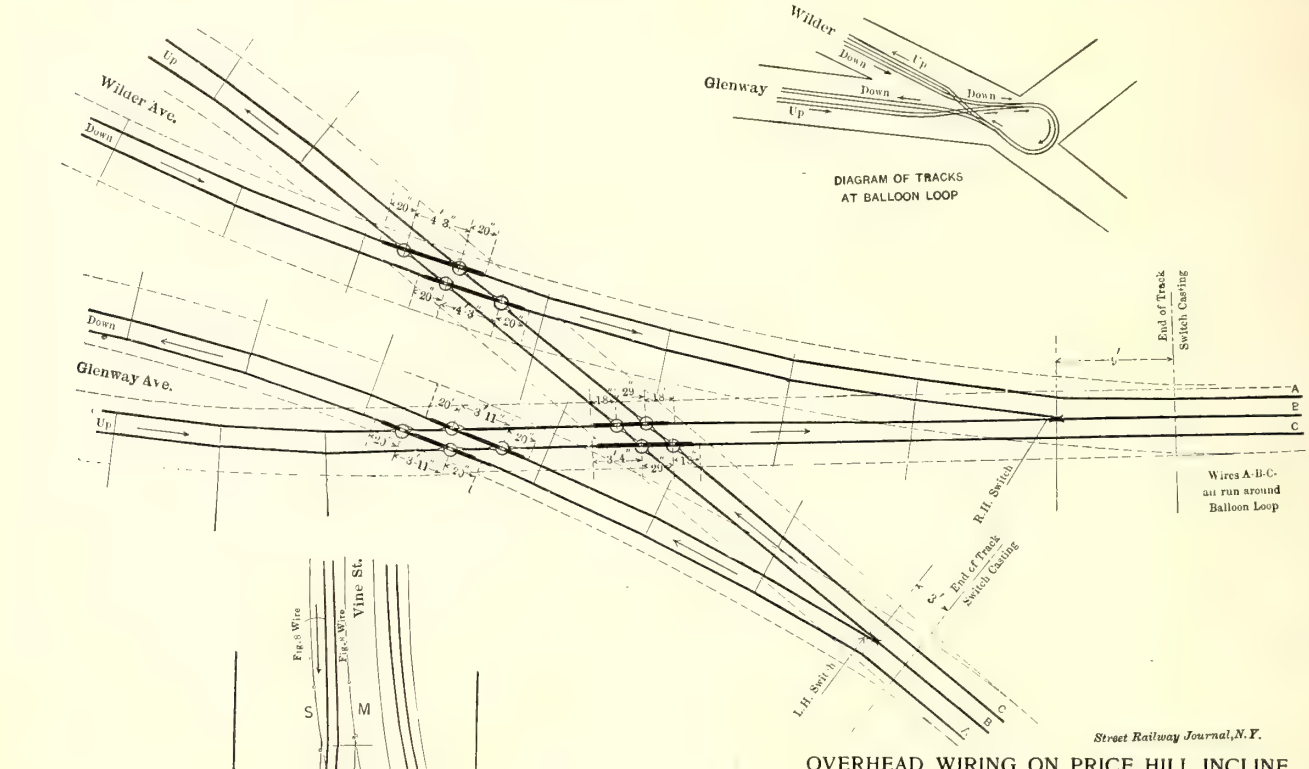
"The cost of the new track construction, including the repaving and renewing of the blocks that are worn out, is about $38,000 per mile, single track, or $76,000 for twelve-bolt fishplates, and that the base of the 8-in. rail was 5½ ins. wide, while that of the 6-in. rail was 6 ins.

The company's engineers estimate that it requires considerably more power to operate cars on the grooved rail, which is in general use in the city, than on a side bearing rail. As proof of this it was noted that after the Vine Street cable line was reconstructed with a grooved rail about 30 per cent. more coal was burned in the station to operate the lines than before the grooved rail was substituted. This line has since been changed to electric.

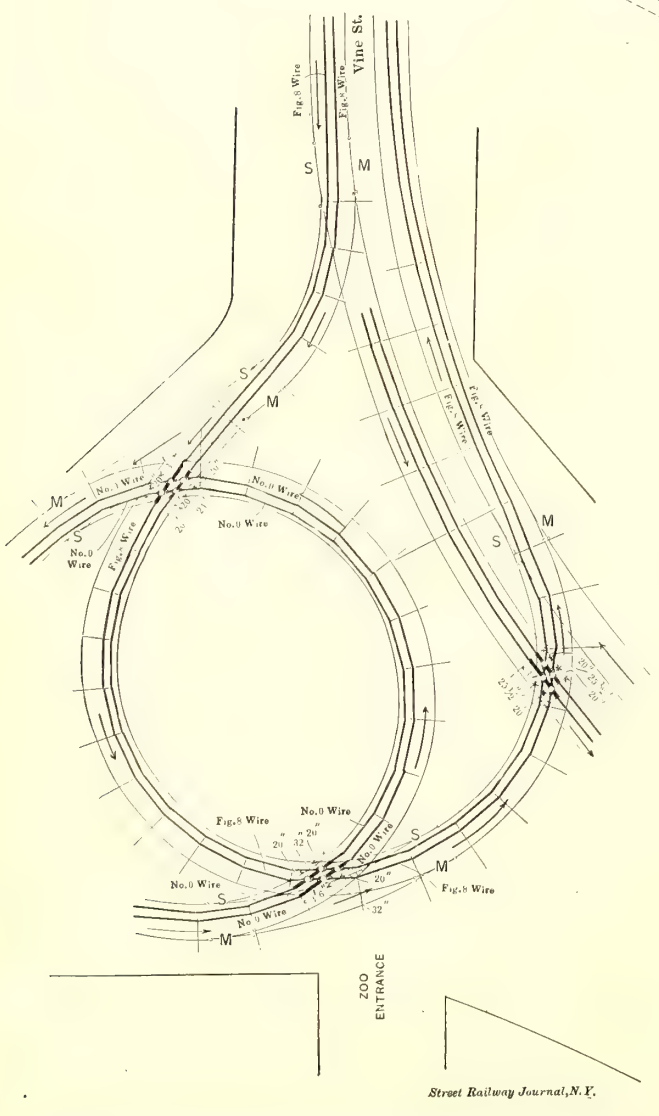
The one remaining cable line is that on Sycamore Street. This was formerly known as the Mt. Auburn Cable Railway, and will be transformed to an electric line in the near future. This change would probably have been made this season had it not been for the excessive rise in the price

of steel rails. This cable line operates over steep grades, one of which is 13 per cent, and contains a compound curve. In case the change is made to electric traction this grade will be cut down, or will be avoided by making a turn into an adjoining street.

In the operation of the system it is found necessary to clean the groove of the rails every day to prevent the wheels from riding upon the flanges. This is accomplished by means of a peculiarly formed hoe or scraper, which is attached to a long flexible handle, and which is manipulated from the rear platform of a car as it passes on its regular route. The attendant fastens a strap to the side and end of the platform and connects the other end of the strap to the hoe handle on a line with the floor of the car. He then stands on the platform and holds to the end of the handle, which comes above the dash and rests against it. By this means the hoe is pressed into the groove with sufficient force to rake out the accumulated sand and dirt as the car passes, and is also in position to be readily lifted at the crossings and switches.



OVERHEAD WIRING ON PRICE HILL INCLINE



OVERHEAD WIRING WITH FIG. 8 WIRE AT ZOO LOOP

Quite contrary to general expectation, a section of track extending for three or four squares that was laid with the duplex type of construction has stood up all the years as well, or better, than any other section of track. It will be remembered that this type of construction consists of a split rail, laid with broken joints, and supported on cast iron chairs, which, in turn, have broad bases and are supported on concrete pedestals.

The cast weld joints that have been employed are standing up well, except in some sections in which a light 6-in. rail was employed.

In connection with the track construction it should be noted that loops are provided at each of the terminals, so that the cars run the same end forward continuously. The loop at the entrance of the Zoological Garden is interesting in that two lines from intersecting streets have interlocking loops, that is, both lines circle around the same center, but not on the same track, as shown by the accompanying illustration. There is another interesting feature in the track construction on what is known as the Price Hill incline, where a section of track was built upon a long and steep ascent, on which the grades are about 11 per cent. The tracks make a loop in ascending this grade, but the up and down tracks are crossed at the loop, as shown in the accompanying diagram. The ascending cars use the outside tracks both before and after the turn, and the descending cars the inside tracks. This arrangement was adopted as a matter of safety, as it is thought that should a car become derailed on a down grade it would not be so likely to topple over the bank. The accompanying illustrations show the overhead wiring and switches for the

double trolley at this loop, as well as the track arrangement.

Nearly all the cars of the system and those of the Covington & Newport (Ky.) system which enter the city, circle around or pass on one side of Fountain Square, which is in the business center of the city, and in busy hours a large number of cars may be found rounding the various corners. The illustrations on page 431 show the arrangement of overhead wires and switches at Fountain Square. In some cases there are four wires on the streets approaching the curve, so that a trolley may be shifted from one set of wires to another, thus avoiding difficult overhead switch construction. In arranging these switches there are certain dead sections over which the cars pass by momentum, the current being carried past these dead points by insulated cables above the switches. It is interesting to note that the double trolley has held its own in this city since electricity was adopted as a motive power on the principal systems, and that it is in favor with the management. It is claimed that it avoids the danger of electrolysis in the gas and water pipes. The system has recently been inspected by a number of foreign engineers, who have recommended the double trolley for use on some of the new lines in England and on the Continent, and the electrician of the company is frequently in receipt of letters from foreign engineers and municipalities asking as to the working of the double trolley. When people become accustomed to it, the double trolley is not thought to be much more unsightly than the single wire, with its supports.

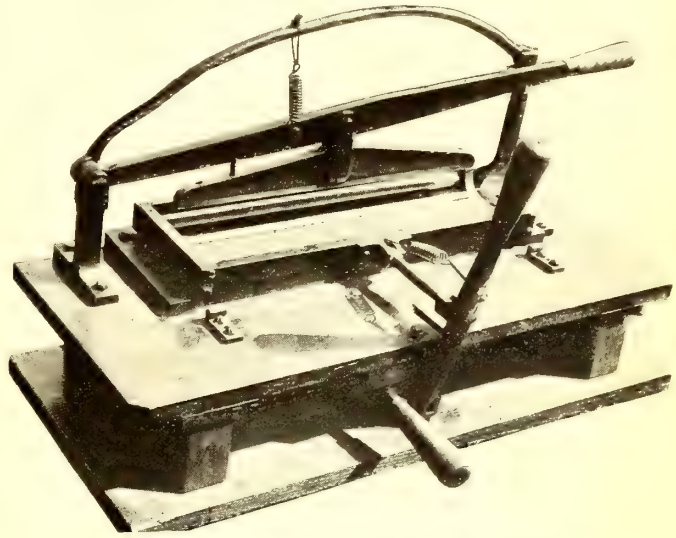
Notes on the Cincinnati, Newport & Covington Railway Company

An additional unit is being installed in the power station of the Cincinnati, Newport & Covington Railway Company, consisting of a cross compound condensing engine of the Corliss type, manufactured by the C. & G. Cooper Company. The engine is rated at 1200 h.p., and will be direct coupled to a 800-kw. Westinghouse generator, which will give the station a total capacity of 4000 h.p. The original capacity of this station consisted of four 500-h.p. vertical compound condensing marine engines, each of which drives by means of belting a generator of the M. P. type, rated at 500 h.p.

Since the former description of this power station in these pages in the issue of June, 1894, an additional unit of power has been installed, consisting of a Westinghouse vertical compound engine direct coupled to a Westinghouse generator of 375-kw. capacity.

The original boiler equipment consisted of six Stirling boilers and four of the B. & W. type, with a total normal capacity of 4250 h.p. Since the former description of this station the old type of stokers has been removed and those of the American type have been substituted. There has also been installed a mechanical draft appliance with economizers, which were provided by Westinghouse, Church, Kerr & Co. It is estimated that since the installation of the economizers and forced draft a saving of at least 10 per cent has been effected in the cost of coal. The steam pipes leading to the engines have also been changed, by which it is estimated a saving of 5 lbs. in steam pressure of the engines has been effected over that of the old method of piping. The boiler room is provided with cold storage bins and an automatic coal-handling apparatus. There has also been an important change made in the method of providing feed and condensing water. Formerly pumps were installed on a movable platform, which was supported by inclined tracks which led down the bank of the river, a distance of 800 ft. from the power station. The pumps were operated by steam taken from the boiler plant. In place of this a well, known as the intake well, has been sunk 20 ft. deep beside the river. On the bank not far from the power station a second well 50 ft. in depth has been dug. This well is about 20 ft. in diameter, with a brick and cement wall, and is provided with three duplex pumps of the Stilwell & Bierce type, having a capacity of one and three-fourths millions gallons each per day. The pumps are located on a level with the surface and housed in. This well is connected with the intake well, and by the new arrangements it is expected that a saving of $3,000 a year will be made in providing water, as in connection with the above described wells there are two settling basins, which have a capacity of 250,000 gals. This will provide feed water, as well as condensing water. Formerly the feed water was obtained from the city mains. With the various economical features installed in the station the daily coal consumption has been reduced from 44 tons to 25 tons.

What is now known as Soup Creek coal is employed for fuel, and is delivered by cars from C. & O. R. R. The entire power for operating the system is now derived from this station. The second, or auxilliary station, or what



ARMATURE COIL FORMING MACHINE

was the first electric station established by the company, has been abandoned. The old station was located at Second Street, near the end of the Suspension Bridge, and had a mixed equipment of engines of the Armington & Sims type and McIntosh & Seymour make, a 400-h.p. Corliss engine of the Lane & Bodley type, and a 500-h.p. vertical marine engine like those described in connection with the main power station.

CAR HOUSE AND REPAIR SHOP

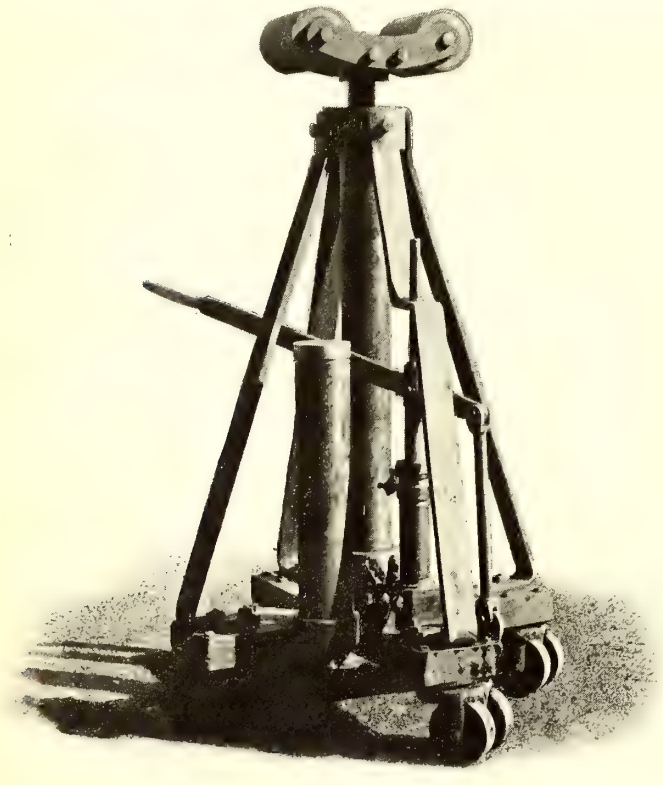
The company is building a new car house and repair shop, to be located near the main power station, which is at Newport, on the Licking River, near Eleventh Street. The car house has a ground dimension of 90 ft. x 375 ft., with a basement under the rear end for storage and possibly for light repairs. The front part of the building is two stories in height, and the second floor will be occupied by offices, drafting room and reading room for the employees. The repair shops consist of a machine shop, blacksmith shop, storeroom and office under one roof, 60 ft. x 180 ft., and a double building, to be occupied as a paint shop and woodworking shop. The ground dimension of each of the latter is 50 ft. x 110 ft. When finished the plant will be equipped with a full line of wood and metal-working tools, and with all the latest labor-saving devices that can be found, including dismantling pits, improved punches and

shears, cranes, hand lifts and pulleys, as many as may be required.

CARS

The standard closed car of the company is of the accelerator type, and those that were put in service on the lines in February, 1894, are still standing up and giving excellent satisfaction. The Peckham truck has been substituted on most of the cars for different types of trucks formerly employed. This is the extra strong No. 7 B, with a 7-ft. wheel base. The open cars with reversible and folding seats are also still the standard with the company. The duplicate brake equipment that was designed to operate the brakes on the inside of the wheels, and which was employed some years since, has been abandoned, as it was found that, used as an emergency brake, it was not necessary.

As the cars cross a number of bridges, the open cars are provided with a wire screen on each side, which is attached to the outside post, and which extends the full length of the car, so that the passengers enter and leave at the rear platform, as in closed cars. This is rendered necessary for



HYDRAULIC ARMATURE LIFT

the reason that a number of bridges are crossed and in a number of places there is a clearance of only 6 ins. between the cars and the bridge trusses.

MOTOR REPAIRS

For conveniently removing and handling armatures a 1000-lb. home-made hydraulic jack is provided, the pump of which has a stroke of $2\frac{1}{2}$ ins. The cylinder and plunger are supported by means of four flat bars, which rest on a square base, and which is provided with caster rollers, on which it is readily shifted about. The upper end of the plunger is provided with a pair of rollers in a curved base, which serve to receive and hold the armature. No track is provided in the pit for shifting this device, as the casters serve for this purpose. With this device the workmen are able to remove and replace the No. 3 Westinghouse armatures in twenty-five minutes. In connection with the repair department, an armature coil-forming machine is provided, which is illustrated on the preceding page. The application of this machine is apparent in its design, and does not require further description. The motor equipment of the system includes 107 of the Westinghouse No. 3 equipments and ten equipments of No. 49, with type K controllers.

WHEELS AND AXLES

The standard axle now employed by the company is $3\frac{5}{8}$ ins. in diameter, with a $3\frac{1}{2}$-in. journal, while the boxes are so designed that a 4-in. axle can be used if necessary.

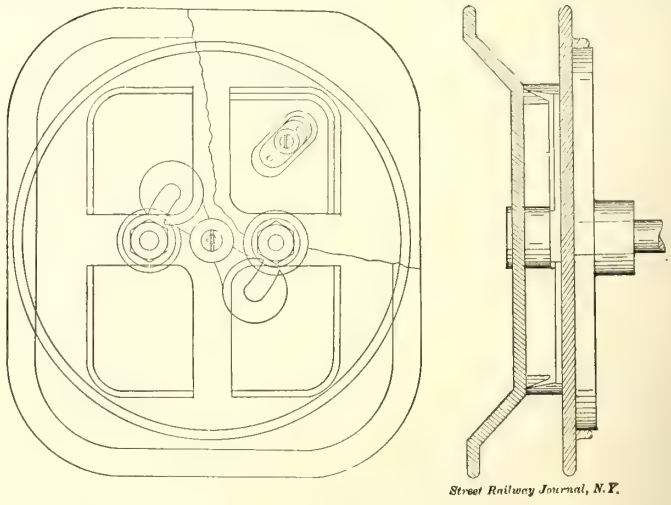
In fitting wheels, the practice is to turn the wheel to fit the axle with very little taken from the surface of the axle. In some cases the gears are pressed on the axles without keys. The gears are cast with large hubs and provided with large bolts and bored 1-3000 in. smaller than the axle. The wheels are put on axles under a pressure of 37 tons.

The personnel of the operating staff of the road has recently changed: J. C. Ernst is president; J. R. Ledyard, general manager, in place of Thos. M. Jenkins, who has recently resigned to accept a position as general manager with the St. Louis & Suburban Railway Company, St. Louis, Mo., and A. C. Harrington, as superintendent of motive power and electrical engineer.

Convenient Coil Form

Several types of field coil forms have been illustrated in the Street Railway Journal, but all have been quite different from the one shown herewith. It is employed in the Kensington repair shops of the Union Traction Company of Philadelphia, and has been found so convenient that it is employed for all the motor field winding on that large system.

The form is of iron, as that has been found to keep its shape better than wood, and is made in two parts as illustrated. The two plates composing the form are held together by means of two studs. The studs are screwed firmly in the inner plate. The outer plate has two holes large enough to allow the heads of the studs to slip through. At the end of each of these holes is a short slot cut on the



FORM FOR WINDING MOTOR FIELDS

arc of a circle. To attach the outside plate to the inner the studs are first slipped through the holes in the outer plate and then given a short turn.

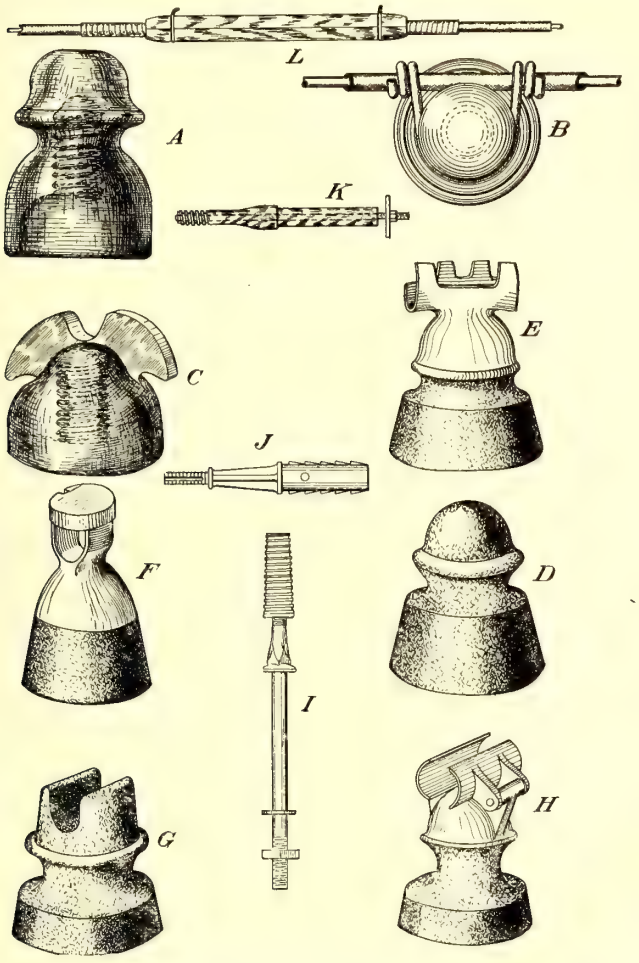
All that remains to be done now is to give the studs one or two turns, which will bring them down firmly on the outer plate. After the coil is wound it is another simple matter to loosen the studs, when the studs are slipped through the large holes, releasing the outer plate. This requires a few seconds only, and it is this ability to take the form apart quickly which makes it so convenient.

Overhead Line Construction II.

BY ALBERT B. HERRICK

THE INSULATION OF THE FEEDER

In addition to the insulation covering on the feeder wire, a second insulation should be introduced between the feed wire and its mechanical supports. The materials generally used for this purpose are porcelain, glass and compounds



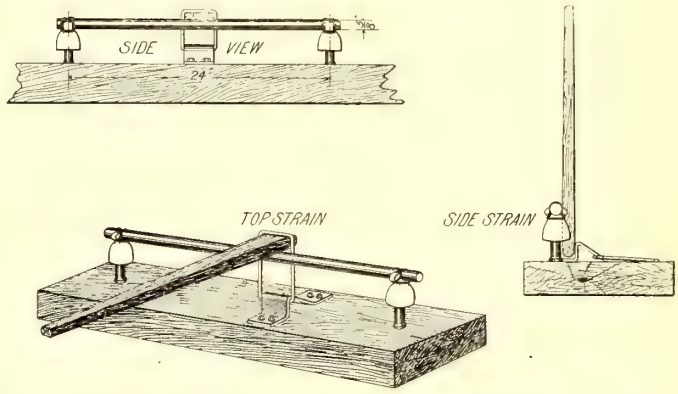
FORMS OF FEEDER INSULATORS

of mica and shellac, rubber and asbestos. The mechanical properties of this insulation should be such that it will stand strains without fracture, and that the surface will not absorb moisture. Glass or porcelain is generally used for No. 000 feeders or smaller, but for larger feeders with long spans, exceedingly strong insulators should be selected, especially where it is also necessary to use an iron pin. Porcelain has been greatly improved in strength during recent years, and the present method of firing it in the kiln has thoroughly vitrified the body of the insulator, still leaving it tough. The method of testing a porcelain insulator, to determine whether vitrification has taken place, is to break it and apply analine ink to the fractured surface of the broken portions of the body. If, after washing, a general discoloration of the porcelain is found, it has not been properly fired.

In the saddle form of insulator, shown at C, with butterfly wings, the portion of the insulator where the wire rests should be provided with rounded edges so as not to abrade the wire, if there is any movement of the feeder due to temperature changes. The flarings of the petticoat should not be too wide to allow water to spatter under them from the cross arm, or too narrow, as this condition invites insects to make cocoons and nests in them. Where a flaring petticoat is used, the top of the cross arm may be rounded and the edge of the insulators made helmet-shaped, so that the drip shall fall outside the cross arm, but these considerations are more pertinent in high tension transmission work.

The strength of insulators can be tested as follows: Place two of the regular pins 24 ins. apart in a wooden beam, 4 ins. x 6 ins., and tie down into the top of the side groove of the insulator a ⅝-in. rod of iron 28 ins. long. A strain by a lever that will give a permanent set to this rod should not fracture the insulator. A test should be given for both top and side strains. The method of making this relative strain test is shown herewith. No copper line can withstand such strains to an insulator as these tests impose. The strain of the copper conductor is a limiting mechanical factor beyond which it is not profitable to increase the strength of the pole line.

The composite insulator, which is formed of a metallic saddle for the feeder and a metallic bushing for the pin, is a form of insulator largely used. These two metallic parts are held together and insulated from each other by insulating material which is generally molded into place under heat and great pressure. The desirable qualities in the composition used are that it have sufficient mechanical strength and that the strength be maintained when the temperature of the insulator has been raised to 150 degs. F. The worst fault of these composite insulators is that they become plastic in warm weather and yield to conductor strains. This composite insulating material should not be affected by rain so as to dissolve any of the substances in



DEVICE FOR TESTING STRENGTH OF FEEDER INSULATORS

the composition, as a roughened surface will hold dirt and produce a leaky surface.

Where the line passes through trees it must be protected from contact with the latter, as the movement of the branches by the wind abrades the insulation of the wire.

For cases of this kind the split wooden sheath, shown in "L" on this page, is often used. This should be held firmly in position so as to not slip along the wire, but the really best protection, where it is possible, is to pull the feeder away by guying it to another limb. If a split porcelain insulator is used to enclose the feeder and the guy twisted around the porcelain insulator and some tension put on it to an adjacent limb, the tree and the wire are both free to move without any considerable strain.

THE MOST ECONOMICAL ARRANGEMENT OF FEEDERS

The next matter to be decided in line construction is the proper amount of copper to use and its most economical disposition. We will first view this question from commercial considerations; but returns in the way of investment in copper may be from several sources. The first and direct loss caused by a deficiency of the copper in a feeder system is in the loss of energy; second, in the increased depreciation of the equipment due to the higher temperatures

attained by motors operated by low voltages; third, in the added expense of operating more equipments where a given headway between them is maintained, due to the lower maximum speeds and slower acceleration under low voltages.

In connection with the energy it can be seen that the smaller we make the feeder for a given load, the greater the loss and the less will be the fixed capital charges against this feeder per annum. On the other hand, the cross section may be increased until the interest charges are largely in excess of the energy saved. Thomson determined that the most economical sized feeder to use was the one in which the annual interest charges were equal to the annual cost of the energy lost, and this is accepted as a general rule for the determination of the proper capital investment in the feeder. To the cost of feeder should be added the cost of its insulation and pole line or of conduit, and the interest charge can be fixed by local conditions.

The price per unit of energy generated in the station should be based on that charge on which a power station could sell all its output without loss, and the items which enter this charge should be coal, water, labor and all the supplies necessary to create this power; this cost should also include the interest charges for the power station upon its investment, taxes and insurance. The power station should also bear its proportion of general expenses, in the ratio which the capital invested in the power station bears to the total capitalization. In other words, the cost should be that at which this power could be sold without a profit or without a loss.

Calling this the prime cost the cost for the losses on the line will be some value less than this cost, per unit lost, depending upon cost of this additional production of energy, and the cost varies on each plant for this loss, but the cost of increasing a load 10 per cent on a station will make little difference in its consumption of coal, oil and water, except where an extra unit has to be operated to maintain the usual 25 per cent overload, allowed in operating capacity, and under these conditions the losses in this added unit are chargeable to the line losses. Strictly speaking, the fixed charges belong to that portion of the energy of the station which produces a revenue, and again the increased loading of a unit brings up its efficiency, and this line loss is reflected in decreased cost of the total output.

If these costs and current deliveries are determined for any road, it is very easy to construct a table in which the cost of the energy lost is compared with the capital charges, and this determines which size of wire can be most economically used. The next and most difficult question is the fixing of the current required to propel the car or cars which are fed by the copper to be supplied.

Assume the energy consumption as 1.2 kw. per car mile for level track, 28-ft. car body weighing 18,000 lbs., single truck, two G. E. 800 motors with K2 controller, and speed 10 miles per hour. This, with 500 volts, gives the average of 24 amps. per car for current delivery. On the first step the car would require 60 amps. at 500 volts; but, with this flow of current, a drop will occur over the copper conductors. Say the voltage fell to 450 volts with the controller on the first notch, then the current will be 54 amps. The second notch of the controller cuts out $4\frac{1}{2}$ ohms., and this should largely be taken up by the counter e.m.f. of the motors, which have started and commenced accelerating.

The speed gained on the first notch reduces the current obtained when the second notch is reached, and the greater the feeder drop the slower the acceleration. The greater the amount of energy required to bring the equipment to speed, the higher will be the temperature attained by the motors, and the greater the rate of equipment depreciation and the maximum demand on the power station. These losses and station investment can be reduced by greater line copper investment.

In this consideration, both the copper and ground return system have to be considered. Allowing 20 per cent drop, which means an effective voltage delivery of 400 volts to the equipment, the maximum current at starting, which will be on the second notch, can be assumed as about 90 amps. Say that 8 per cent drop is allowed for the ground returns, and 12 per cent for overhead copper; this gives a maximum feeding resistance of two-thirds of 1 ohm per equipment. The average demand then is 24 amps. per car, and the maximum demand 90 amps., for the case under discussion.

The effect of grades is to both increase the starting current and also the running current value. The chart here-

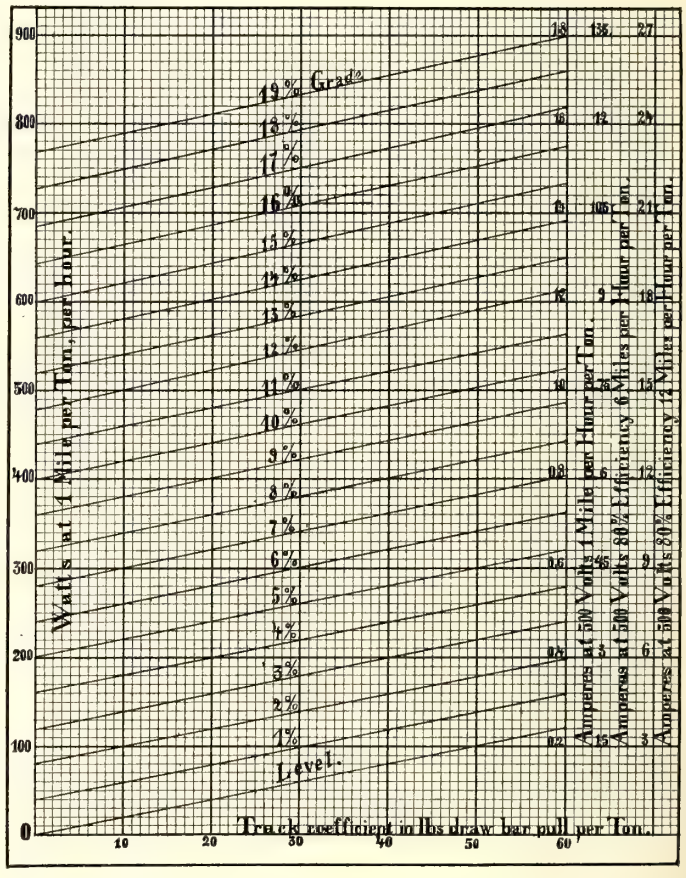


DIAGRAM SHOWING AMPERES REQUIRED PER TON WITH DIFFERENT SPEEDS, GRADES AND TRACTION COEFFICIENTS

with shows the relation which exists between the traction coefficient, which is plotted as ordinates on the chart, and the watts at 1 mile per ton per hour, which are plotted as abscissæ on the chart. Diagonal lines are drawn across the chart corresponding with grades from level up to 19 per cent, to assist in giving what is really required, i. e., the amperes flowing for different speeds and grades. On the right hand of the chart is given a scale in amperes, assuming the current delivery to the equipment is at 500 volts, for speed of one mile per hour. While the current delivery is not a rectlinear function of grade and speed, approximately proportional results can be obtained by multiplying the speed on grades by the weight of the car by the current given in this chart at the required grade, will give the total amperes required.

As an example, suppose we have a car weighing 18,000 lbs. climbing a 4 per cent grade at 10 miles per hour, with

a track coefficient of 25 lbs. Pass up the vertical line 25 until the diagonal line indicating 4 per cent is reached, then pass horizontally until the 1 mile per hour scale of amperes is reached; this gives 0.42 amps. per ton. For 9 tons this would be 0.42 (amps.) x 9 (tons) x 10 (miles) = 37.8 amps. The two other vertical columns at the extreme right of the chart, one 6-mile speed and the other 12-mile speed, give the current required, including 20 per cent loss on the line. For example, suppose an 8 per cent grade, 30 track coefficient, car weighing 20,000 lbs., running at 8 miles per hour, at 20 per cent transmission loss. This will give 5.7 amps. per ton, adding 1/3 more for increased speed and multiplying by 10 for weight in tons would give 5.7 x 4/3 x 10 = 76 amps. This, of course, is without any rheostat in circuit with the motors. The same problem can be worked out by the table given below.

It is extremely difficult to give the exact speed at which a car will ascend a given grade, for each equipment will fall in speed in mounting a grade until the counter e.m.f. of the motors has been reduced to such a point that the current is sufficient to propel the car up the grade. This point is variable, depending upon the equipment.

In considering the copper service on grades, the cars coming down grade require less current than those ascending, and generally above a 3 per cent grade a car will float with open controller after being started up to speed. It is very important to maintain potential at grades in order that the car can climb the grade at good speed, and to reduce the heating of the motors; and if the schedule can be maintained up grades the motorman will not be called on to make up time by coasting too fast down grade.

The usual practice of feeder taps from trolley to feeder every ten and eight poles on levels should, on grades, be reduced to six and four poles between each tap, in order to maintain the feeder pressure at trolley wire.

The headway of the cars will have to be known in order to get the average current demand, but the average demand is taken care of when provision is made for the maximum demand.

In the operation of a railway it is necessary at times to operate more cars over a section of track than are required by schedule, and fixing the maximum current demand is purely a local problem. The maximum demand is usually figured for a total drop of 140 volts where 500 volts are used at the station, and 150 volts with a 550 station voltage.

There are a number of ways in which copper investment can be reduced to handle this maximum load; one is to have a two-potential railway board, use a separate generator whose voltage can be raised to compensate for the unusual feeder losses and throw these feeders on to this higher potential bus, or a generator can be thrown in series with these feeders, and used to add voltage to that already supplied to the bus. In such a case this current would pass to the loaded feeders through the series field and the armature, when the dynamo becomes automatic in its action and boosts the current. By estimating the possible number of cars that could be massed together and using the constant given for each individual car, the maximum demand can be determined. On level roads the main ampere meter readings average 65 per cent of what would be acquired by assuming all cars operating at once. Where traffic is dense, and stops many, this is increased to approximately 70 per cent of figured maximum average demand.

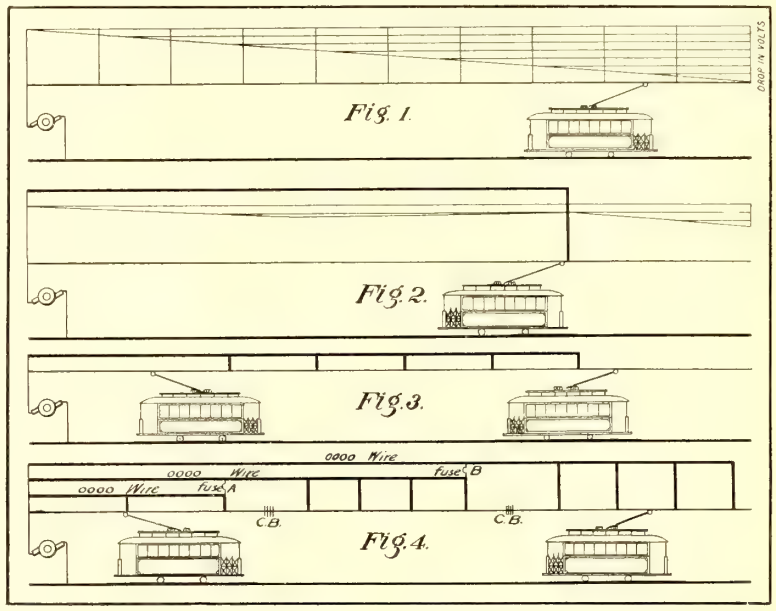


DIAGRAM SHOWING METHODS OF WIRING AND DROP IN VOLTAGE

Grades tend to increase slightly the average station de-

THEORETICAL WATTS PER TON OF 2,000 LBS. AND PER MILE PER HOUR, WITH VARIOUS GRADES AND TRACTION COEFFICIENTS.

PER CENT. GRADE	COEFFICIENT, IN POUNDS DRAW BAR PULL PER TON										
	12	13.5	15	18	20	25	30	35	40	50	60
0	23.9	26.9	29.8	35.8	39.8	49.7	59.7	69.6	79.6	99.5	119.4
1	63.7	66.6	69.6	75.6	79.6	89.4	99.5	109.4	119.4	139.2	159.1
2	103.4	106.4	109.4	115.4	119.4	129.3	139.2	149.2	159.1	179.0	198 9
3	143.2	146.2	149.2	155.2	159.1	169.1	179.0	189.0	198.9	218.8	238.7
4	183.0	186.0	189.0	194.9	198.9	208.9	218.8	228.5	238.7	258.6	278.5
5	222.8	225.8	228.8	234.7	238.7	248.7	258.6	268.3	278.5	298.4	318.3
6	262.6	265.6	268.5	274.5	278.5	288.4	298.4	308.3	318.3	338.1	358.1
7	302.4	305.4	308.3	314.3	318.3	328.2	338.1	348.1	358.1	378.0	397.9
8	342.4	345.1	348.1	354.1	358.1	368.0	378.0	387.9	397.9	417.8	437.6
9	381.9	384.9	387.9	393.9	397.9	407.8	417.8	427.7	437.6	457.5	477.4
10	421.7	424.7	427.7	433.7	437.6	447.6	457.5	467.5	477.4	497.3	517.2
11	461.5	464.5	467.5	473.5	477.4	487.4	497.3	507.2	517.2	437.1	557.0
12	501.3	504.3	507.2	513.2	517.2	527.2	537.1	547.1	557.0	576.9	596.8
13	541.1	544.1	547.1	553.0	557.0	567.0	576.9	586.8	596.8	616.7	636.6
14	580.9	583.9	586.8	592.8	596.8	606.7	616.7	626.6	636.6	656.5	676.4
15	620.7	623.6	626.6	632.6	636.6	646.5	656.5	666.4	676.4	696.3	716.2

EXAMPLE.—Given a car weighing 12,000 lbs. loaded; the grade at the point where we wish to know the current is 4 per cent.; speed required is 7 miles per hour; traction coefficient on this track is, say, 20 lbs.; motor efficiency is 80 per cent; current delivered at 500 volts. The current taken at this point will be equal to watts in table, shown at intersection of 4 per cent grade and 20 coefficient, multiplied as follows:

$$\frac{198.9 \times 7 \text{ (miles per hour)} \times 6 \text{ (tons weight)}.}{.80 \text{ (efficiency)} \times 500 \text{ volts (pressure)}} = 20.88 \text{ amps.}$$

mand, but types of equipments, trucks and weight of car, and motorman, are all variables entering into this problem, and they require careful consideration on new roads; but on old roads, where the copper has to be reinforced, these variables can very readily be given fixed values, and the profit or loss for additional copper can be easily figured.

There are a number of methods by which current is supplied at a given potential along a trolley wire. In some the trolley wire is divided up for safety, a method which largely increases the copper cost of delivering current at a given potential. The simplest system consists of a single trolley, fed at one end; in this the car gradually loses potential as it passes away from the station. With a 12 per cent drop, the distance in feet which the car can go and not exceed the fixed drop is the product of resistance per foot of trolley multiplied by the current demand, divided into the drop in volts allowed on the trolley. A double trolley will give twice this distance, if the current demand remains the same. Fig. 1 shows the drop in volts at each point on the trolley.

After this distance has been reached the trolley has to be reinforced by a feeder leading from the station. Fig. 2 shows the redistribution of potential due to such connection. A car located between the station and trolley tap will now be fed two ways; one through the trolley direct, and the other through the feeder. The drop will now be due to two conductors in multiple, which will be the product of the resistance of the trolley wire from the station to the trolley wheel multiplied by the sum of the feeder resistance, plus the trolley wire resistance from the wheel to feeder connection. If this product is divided by the sum of these resistances, it will give the resistance of these conductors feeding in multiple, which multiplied by the current required by the car will give volts drop, which is the quantity sought. It will be noticed in this consideration of feeders that the farther from the station the current has to traverse the trolley in order to reach the feeding point, the less effect the feeder has on the potential delivery to the car. Fig. 3 shows taps at frequent intervals between the feeders and the trolley, gaining the maximum usefulness out of the feeder.

It has been the practice to isolate feeding sections by placing line circuit breakers in the trolley wire and providing independent feeders, so that if the trolley falls or a feeder becomes grounded it will not shut down the whole system. Other simple means can be used for the same effect and yet obtain the multiple feeding effect of all feeders, as by introducing between the terminal of one feeder and the feeder connecting an adjacent section, a safety catch or automatic circuit breaker, mounted in a box located on a pole. In Fig. 4 the car with open independent feeding sections will have a drop of 150 volts with a 300 amp. maximum, and connecting feeders, together with automatic devices as shown, will reduce the drop to 30 volts with the same load, or one-fifth the single feeder drop.

Judge Miller has handed down an important decision in one of the tax cases of the city of Louisville against the Louisville Railway Company. The amount involved is $151,824, this sum being claimed by the city as unpaid franchise and personal taxes due from the street railway company for the years 1894, 1895 and 1896. The company claims these taxes were uncollectable, owing to new ordinances passed by the City Council, and also that the taxes are excessive. The court holds that under the present laws of the State no corporation can acquire, by contract or otherwise, an exemption from the burdens of taxation, and that the payment of a license tax cannot be pleaded in bar of an ad valorem tax.

The Possibilities of the Trolley Excursion Business in Eastern Massachusetts

BY ROBERT H. DERRAH

It is surprising that until the last two years comparatively nothing had been done in Boston in the way of conducting excursions on the electric cars of the city and the neighboring country. Probably in no portion of our country can be found a greater variety of scenery and places of historical associations than in Eastern Massachusetts, and the whole district has been covered with electric railways. But, apart from running out a special car whenever it was ordered, and purchasing a couple of parlor cars, which have been in more or less demand for theater parties or on the occasion of the annual football games, practically nothing had been done by the companies which were to secure the greatest returns. When, in 1896, I began the publication of the "Street Railway Guide," telling people how to reach the points of interest on the electric lines of Eastern Massachusetts, I became firmly convinced that there was a vast amount of "pleasure travel" on the railroads which brought in a tremendous amount of business to the companies. Since then I have seen plenty of evidences that such was the case, for the circulation of the "Guide," which was designed to be primarily of benefit to people who wish to travel on the electric cars for pleasure, has increased so much that it is evident that the travel of this kind has increased enormously within the last two or three years. Recent developments have made it possible to make the trolley excursion traffic an important factor in the street railway business of Eastern Massachusetts.

In the first place, attention is called to the facilities for special excursions on the street railways in this part of the country. These form the largest connected system of street railways in the world, running from Nashua, N. H., on the north, through Boston to Newport and Providence, R. I., on the south, a distance of 130 miles. Eastward they extend to the tip end of Cape Ann, some 45 miles, and westward to West Warren, Mass., some 80 miles. All this district is covered with a network of electric lines.

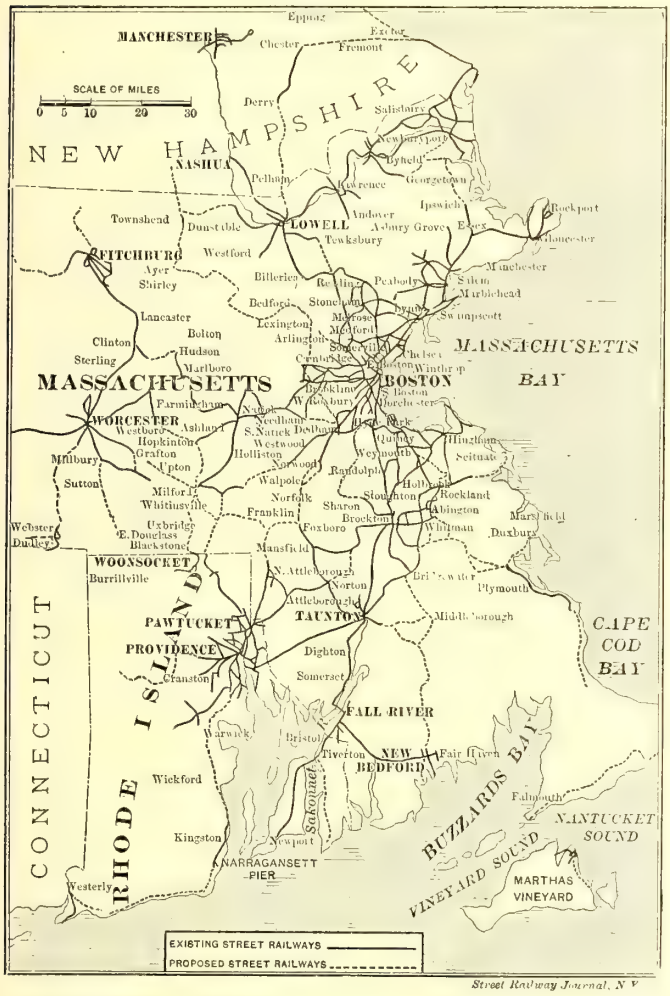
Heretofore one of the great difficulties of conducting trolley excursions, except of limited extent, has been the fact that special cars of one company were not allowed to run over the lines of another. Even in cases where this prohibition did not exist, tracks of different companies were not actually connected, so that a change of cars was compulsory. For this reason each company was obliged to run its own special cars to provide for any long trolley trip that might be planned. For the past three years these suburban roads have had, and are having, these missing links connected up. At the present time, it is unreasonable to expect a large corporation like the Boston Elevated Railway, operating some 1200 cars in a congested city like Boston, to assume the responsibility of allowing the cars of ten suburban street railways which connect at its various termini to run over its tracks, but I feel certain that within the near future all the street railway lines within a radius of at least 50 miles of Boston will be virtually under one management, and when it has reached that point some satisfactory arrangement can doubtless be made whereby special cars can be run over each other's tracks to the advantage of both companies.

A gentleman representing some 250 Sunday-school children called in reference to their annual picnic. I handed him a list of the several picnic grounds within easy reach of Boston especially adapted for that purpose. He selected one, and after visiting the place, stated that although

he had lived in Boston nearly all his life he had not believed there were such beautiful scenery and trolley rides in New England. This is an example of how little the people know of the beauty of the country that surrounds them.

The trolley excursion business in this section of the country has a much broader field than in other parts where it is operated on a very large scale, such as Brooklyn, for example, they have Coney Island, Bergen Beach, North Beach, Jamaica, Flushing, etc., while we have numerous beaches, the finest in the country, where a great many wish to go; on the other hand, we also have inland parks and country for those who wish to spend a quiet outing.

There are many disadvantages at the present time, resulting from the fact that the roads are run independently;



MAP SHOWING ELECTRIC RAILWAYS IN EASTERN MASSACHUSETTS, RHODE ISLAND AND NEW HAMPSHIRE

for instance, cars frequently do not make good connections, and if a special car followed a regular car on a single track, and the regular car is behind time, a half-hour wait is often necessary at the terminus, as the country lines frequently run on a half-hour schedule. The consolidation of the various lines will obviate this difficulty.

Another factor which has prevented the development of the trolley excursion business in this part of the country has been the lack of suitable cars. Except for the two parlor cars owned by the Boston Elevated Railway, there have been no cars which were especially adapted to excursion business. Regular open or closed cars were run out as might be needed, but these are not well adapted to the use of trolley parties. I think the time is not far distant when Boston will be the foremost in the trolley excursion business, under the management of a separate company, with cars especially equipped for this class of traffic, built on a plan to combine buffet and parlor car, fitted with all conveniences. Each car would have its own motorman and conductor, with an experienced man serving as a guide, if desired. With these cars a party could go over the different railway lines, visiting points of interest and stopping wherever desired, traveling for a week or more without going over the same country twice, as the lines connected make up a system of more than 1200 miles.

It would seem that the possibilities of such a business are practically unlimited. It only remains to secure the cars and acquaint the 2,000,000 people with the advantages of this form of excursion. Compared with railway excursions they might be made cheap, and the passengers would have the advantage of seeing the best, rather than the most uninviting, of the country traversed. Taking their own time, stopping when and where they pleased, the trolley excursionists making up a party have at their disposal the resources of all the electric companies for only an extra fare on each line, or even less. Short-distance excursions have been for years popular in London and the large cities of England, and in a country where there is so much to be seen, and an endless diversity, the prospect for this class of business is an attractive one. Special knowledge of street railroading is, of course, necessary to successful management, but the passenger has no need to know anything more than where he wishes to go. A series of trips can be arranged covering a diversity of points of interest, for a half-dollar or a dollar, providing a whole day's outing, and giving the passenger an intimate knowledge of the country about him. Within a short time this business is likely to develop into an important one, and nowhere is there a better field for its operations.

Shop Wrinkles

BY J. F. HOBART

Repair shops now frequently get into the habit of using the slowest possible speeds on any machine. A lathe is often back-geared when not necessary, and when a faster speed would not only do more work for the owners, but would actually make the work easier for the operator!

A case of this kind comes to my mind, of a shop where about eighty men were employed in all branches of car work. The shop had been for a long time under the control of an easy-going mechanic of the old school. When a new management took hold of the road a young mechanic, with more modern ideas, was put in charge of the shops. He made the attempt to have faster speeds used on all the machines in the shop, but had very poor success in so doing. As long as he was present the faster speeds would be used, but tools would break or get dull quickly, and some excuse was surely found for putting the work back on the old speed again.

One Sabbath day the foreman of the shop went quietly to work and speeded up the line shaft, so that all the machines were brought up to about the required speed. This act caused a vast howl of indignation, and sixteen men threw up their jobs and left. But the high-speed line shaft stayed, the high-speed machines did likewise, and the tools stopped getting dull or breaking, proving that the slow speed of the men, not the high speed of the machines, had been the cause of trouble in that direction.

The scheme is a good one to apply to a large number of existing shops, thereby improving both the quantity and the quality of the work turned out. Aside from speeding up the main line shaft, it is frequently profitable to speed up the steam engine. Then, not only will the speed

be increased, but the power developed by the engine will be increased also.

With small throttling engines there is usually no reason why the speed should not be increased at will, but with Corliss, or other engines with large pulleys, the safety of the wheel at the proposed speed should be passed upon by a competent mechanical engineer before making a change. This precaution is necessary, because many such engines are already running close to the speed limit.

STRAIGHTENING AXLES

A good many slightly bent car axles can be made as good as new (nearly) by judicious straightening. It does not answer well to straighten axles cold. Thus treated the metal seems to have taken a "double set," and will bend much quicker than before either the first or second bend was made. Axles should always be straightened hot. Thereby the strains are removed, or neutralized, and the metal is almost, if not quite, as stiff there as at any other part of the axle.

To properly test the straightness or crookedness of an axle it should be placed between centers. In no other way can an exact test be made, although a close approximation of the center method may be arrived at by placing the axle on friction wheels, said wheels being placed at the extreme ends of the axle. An old lathe bed placed close to the straightening forge is about the best rig for testing axles. A pair of old tailstocks may be rigged on, stout enough to stand a rap from the sledge upon a hot axle when necessary.

MILLING AXLE-BOX HOUSINGS

Jig-work is the passport to economy in street railway machine-shop work. When hundreds of castings are to be milled in two or three places, then drilled and tapped, it does not pay to do the work under an ordinary drill press, using an end-mill for the surface work, and locking up the casting for the drilling and tapping. If only a few dozen castings need drilling the hand method is well enough, and the castings should be laid into a face-plate vice, one at a time, after being milled or planed ready for drilling.

A short iron level should be laid across the milled upper surface of the casting, but if necessary a very short level may be used, placed upon a parallel piece of metal which is long enough to reach across the opening in the casting. Two parallel bearings below the vise will allow the casting to stand upright between the vise jaws. Then the level is applied, the casting adjusted until it is level both ways when the vise is closed, the level being kept in place to reveal any possible movement which might throw the casting out of true.

The drilling may now proceed, the holes having been previously laid out and marked by circle and four center-punch witness marks. After starting the drill it is brought central by the usual method of chipping out one side of the hole with a small three-cornered or half-round chisel, so as to draw the drill over.

All this work and loss of time would be dispensed with if a template had been provided, into which the casting could have been fastened at the beginning by a turn of a lever or screw. Then it could stay there during both the milling and the drilling, thereby causing all finished surfaces and holes to be in line with each other, and requiring no leveling or hole chipping.

IRON AND STEEL CUT TO LENGTHS

Among the unprofitable work often done in car shops, smithies and machine shops is that of cutting up round and flat bar iron into the lengths required. Merchant iron and steel can now be bought in lengths required (cut up at the mill) at a very trifling advance, if any, over the price of regular bar material. When a man and machine are seen day after day working in slow moderation, and with still slower efficiency, to mangle material into short pieces, the contrast becomes too great. The iron cut at the mill is smooth and square, and of exact length—much more than can be said of the haggled-off stuff cut in the average car shop.

This idea may well be carried further than to merchant iron. Many shops keep men and machines running continually on standard bolts. It may be a surprise to some shop managers to learn that manufactured bolts can be bought in quantity at a very slight advance over the price they are now paying for the iron to make bolts of. In a number of shops this has been found to be true, reckoning the iron and bolts pound for pound.

Repair Shop Accounting on a Small Road

The Wilmington City Railway Company, of Wilmington, Del., is employing a convenient and systematic method of keeping repair shop accounts, the invention of Joseph Kuen, master mechanic of the company. While not elaborate, it answers perfectly the needs of the company in determining the life of the apparatus used on the road, and takes but little time to keep up.

The form below is that used in the shop, and gives exactly what apparatus is changed, as the shop foreman checks off on the list any part which has been renewed:

WILMINGTON CITY RAILWAY COMPANY.

MECHANICAL AND ELECTRICAL DEPARTMENT.

Overhauling Report.

Date.....189 .

Car No.....	Truck No.....
Arm. Bear. No. 1	Right Hand Shoes.....
" " No. 2.....	Left " " .....
Axle " No. 1.....	Car Wheels No. 1....
" " No. 2.....	" " No. 2.....
Arm. out No. 1.....	Axle out No. 1.....
" in No. 1.....	" in No. 1.....
" out No. 2.....	" out No. 2.....
" in No. 2.....	" in No. 2. .....
Gear Wheel No. 1.....	Truck Overhauled.....
" " No. 2.....	.....
Pinion " No. 1.....	.....
" " No. 2.....	.....
Motors Overhauled.....	

Signed,.....

This report is sent to the master mechanic, who enters the date and extent of the changes in a truck record book, in which a page is given to each truck. Each truck is given a number, and the pages are numbered in consecutive order, corresponding to the truck number, and the date of removal is given opposite each item.

Truck No. —— (Car No. ——)

Arm. Bear. No. 1.....	Gear Wheel No. 1...	Wheels No. 1.....
Arm. Bear. No. 2.....	Gear Wheel No. 2...	Cause for change....
Axle Bear. No. 1.....	Pinion No. 1...	Wheels No. 2.....
Axle Bear. No. 2.....	Pinion No. 2...	Cause for change....
Arm. put in No. 1....	R. Brake Shoes.....	Axle in No. 1.....
Arm. put in No. 2....	L. Brake Shoes.....	Axle in No. 2.....
Motors Overhauled..		Truck Overhauled...
		Into Service.....
		Out of Service.....

Truck and Motor Changes.....

The car body repairs are entered in a separate book, which also contains data relating to the equipment of the car body, so that a glance at this book will tell the purchasing agent just what parts and equipment to order for

repairing. These data are grouped under the following headings:

Length over bumpers.	Style of seats.	Heaters.
" " all	Size of side glass.	Controllers.
" " body.	Size of vestibule glass.	Trolley base.
Number of windows.	Register.	Rheostat.
Color panel and coves.	Chandeliers.	

The company also has a third book, called an "Armature Book," which contains a page for each armature. All armatures are numbered, and all repairs on the same armature are entered under the proper serial number. This book is written up from the armature winder's day book.

Mr. Kuen says it is his usual custom to allow the reports to accumulate for some days, and then to enter them into the above books at one time. It requires only about a half an hour for one man to enter in this way the work of one week in the repair shops.

Accident Blanks

The accident blanks given below are those in use on the Brisbane Tramway Company, of Brisbane, Australia, the general manager of which is J. S. Badger, who is well known in America. These present several features which are somewhat novel, and are, at the same time, complete and compact.

Two forms are used. The first is a single sheet, shown in Form 2, and is intended to cover minor accidents. That in Form 1 is more complete, and is intended for reporting more serious accidents. It is filled out by the conductor in ink after he has returned to the car house, and has four pages. The blanks are abbreviated somewhat in the re-

PRIVATE.

Brisbane Tramways Company Limited.

ACCIDENT REPORT—FORM NO. 1.

N.B.—This report is furnished for the information of the Company's solicitors, and must be treated as Strictly Private and Confidential.

INSTRUCTIONS.

Employees must report every accident to any individual or to or in connection with any car or vehicle belonging to the Company or any other company or person, which occurs within 14 paces or steps of the tracks or cars belonging to the Brisbane Tramways Co., *no matter how trivial* it may seem, or even if the person states he has received no injury. You must at once obtain all the facts connected with the accident, the names and addresses of persons who met with the accident, and of all witnesses whether on or off the car. If any policemen should be present be sure and take their addresses and numbers, and in any case it is important to get as many witnesses as possible. All the addresses must be obtained in full, with district, street and name of house, or if it has none, then its vicinity to some cross street, or hotel or other business. The most important duty of employees, in case of accident, is to secure the names and addresses of the largest number and the most intelligent and reliable witnesses. In case of a serious personal accident, when persons who saw the accident will not give their names, some employee of the Company should stay with the witness and follow him until he finds out the accurate name and address.

Employees, after having an accident, resulting in damage to person or property, must report same verbally to the first inspector they meet, and also report the same *at once* by telephone to the head office, during ordinary business hours, or to the Cash Receiver's office at Petrie's Bight when the head office is closed.

Accident reports must be filled out in ink and handed to the Yard Foreman before the conductor and motorman leave after turning in the car.

Employees must not under any circumstances, tell any one who their witnesses are in any case of accident, or make any statement with reference to the accident, except to an official of the Company.

Conductors will fill in the diagram on the fourth page of this blank, showing the exact location of car or cars, vehicle or person connected with the accident, naming streets, and cross streets.

Car No. ..... Date ..... 189- Exact time ..... { a.m. / p.m.

Line ..... To ..... From .....

Exact place of accident .....

Speed of Car in miles per hour ..... { Down Grade. / Level Grade. / Up Grade.

At instant of accident brake was { on. / off. } Power was { on. / off. } Controller was { forward. / reverse.

What distance did car run after { brake was applied ..... paces. / power was reversed ..... paces.

How far did Car run after striking object ..... paces.

Measured by ..... Witnessed by .....

State of Weather ..... Condition of Track .....

Names and addresses of persons meeting with accident .....

PAGE 1, ACCIDENT BLANK

Nature and extent of injury, if any .....

Were injured persons removed from place of accident? If so, by whom and where to? .....

License No. and kind of vehicle damaged .....

Nature and extent of damage to same .....

Direction in which vehicle was going at time of accident .....

Speed at which it was travelling .....

Name and Address of owner of vehicle .....

Name and Address of driver of vehicle .....

Damage to Car, if any .....

No of passengers on Car, ...

Names and Addresses of witnesses, with position on car or street .....

PAGE 2, ACCIDENT BLANK

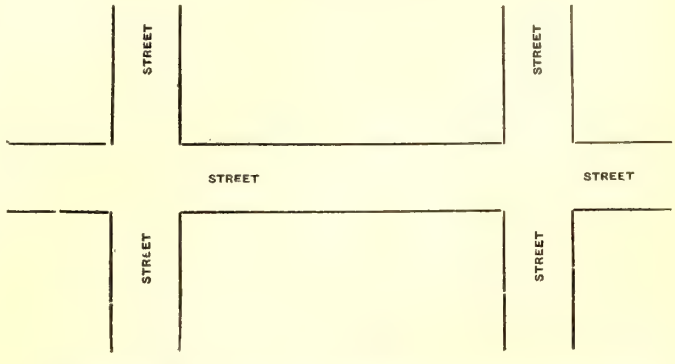
GENERAL DESCRIPTION OF ACCIDENT WITH FULL PARTICULARS:

Accident reported verbally to Inspector ..... at ..... { a.m. / p.m.

Conductor ..... Motorman .....

Badge No. ..... Badge No. .....

PAGE 3, ACCIDENT BLANK



The Conductor will fill in the above diagram, showing the exact location of car or cars, vehicle or persons concerned in the accident, giving names of streets and cross streets

PAGE 4, ACCIDENT BLANK

PRIVATE

BRISBANE TRAMWAYS COMPANY, LIMITED.

ACCIDENT REPORT—FORM 2.

Report on this blank such minor accidents as the following:—Car off track, car missing points, trolley leaving wire, broken lamp chimneys, broken headlight glasses, broken trolley wheels, any troubles with motors or other fixtures or appliances about the car, insulators off the line, obstructions on track or any obstructions to traffic, and in general any breakage or defect of the Company's property in which the public are not in any way concerned or connected; also all disputes with passengers over payment or non-payment of fare, offence against the by-laws, ejection of drunken or disorderly persons, etc.

Car No. ..... Date ..... 189 Exact time ..... a.m. / p.m.

Line ..... From ..... To .....

Exact place occurrence happened .....

Name and address of persons concerned .....

Names and addresses of witnesses—

Nature of trouble, with full particulars—

Conductor ..... Motorman .....

Badge No. ..... Badge No. .....

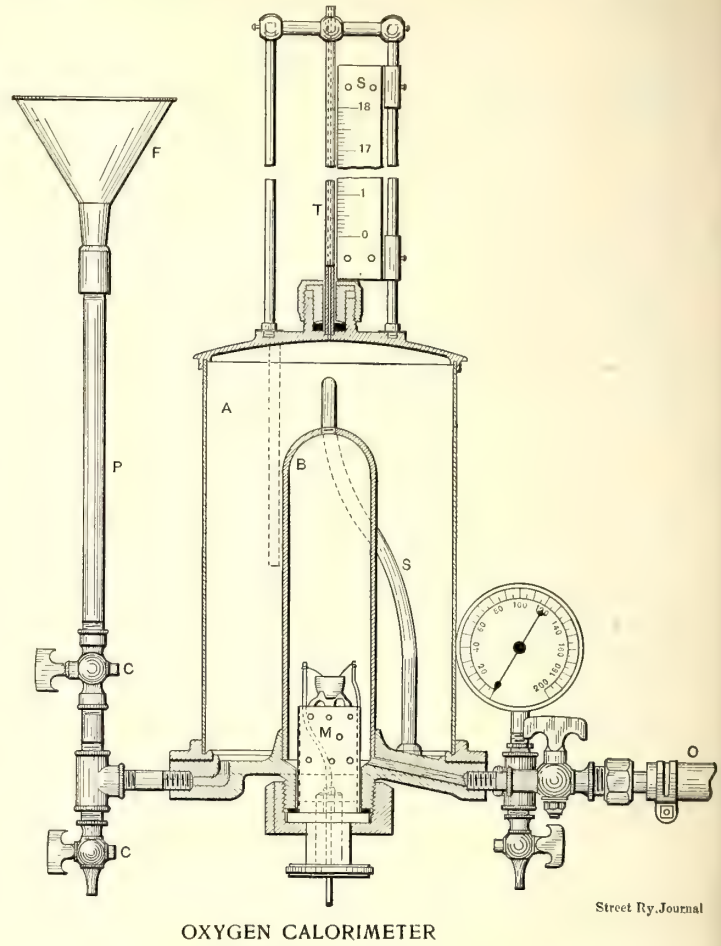
FORM 2, ACCIDENT REPORT

production herewith by the omission of a number of blank lines in the page where a general description of the accident is requested.

An Apparatus for Testing Coal, Fuel Oil and Other Combustibles

An oxygen calorimeter for testing fuel oil, coal and combustibles has been constructed by J. R. Chapman, chief electrician of the North Chicago Street Railroad Company, along lines suggested by articles appearing in certain technical papers a year or two ago. The construction of Mr. Chapman's apparatus will be made clear from the accompanying illustration and the following description. A large vessel, *A*, water sealed at the bottom and connected with a pipe fitted with cocks, *CC*, and a funnel, *F*, by which it may be filled and emptied, is also connected with an open glass tube, *T*, extending vertically from the top some 20 ins. or more, and paralleled by a graduated scale, *S*. Inside the vessel, *A*, is a closed retort, or bomb, *B*, into the bottom of which passes a metal plug, *M*, carrying on its top a little cauldron, or "charcoal pot." The bomb is connected at its base with an inside source of supply, *O*, through which oxygen gas may pass into the bomb, expelling the air before it through tube *S*.

The apparatus works as follows: The plug *M* is removed, and one gramme of fuel oil, coal or other combustible to be tested, is placed in the cauldron, and a platinum wire connected with an outside electric battery is immersed in the combustible. The plug is then screwed into position, the vessel *A* is filled with water to a point such that the water in *T* is approximately at *O*. The water is allowed to assume the temperature of the room as nearly as possible, as determined by a thermometer, oxygen is passed into the bomb until the pressure reaches a predetermined testing point, and when all the temperature conditions are stable and uniform, connection is made between the battery and the platinum fuse, the combustible is ignited, and combustion takes place with great rapidity in the oxygen atmosphere. The air in the bomb becoming heated, the walls of the bomb expand, forcing the liquid in *A* further up into the tube *T*, and the maximum point reached by the water is noted on the scale. The initial point having been previously noted, the differences between these readings are compared with the readings found by the combustion of pure graphite, or charcoal, and the relative efficiencies of different fuels are thereby obtained. The whole apparatus is extremely simple, and



OXYGEN CALORIMETER

should be quite accurate within desired limits, and the apparatus can be made in any street railway machine shop without great difficulty.

Milwaukee Accident Report System

The Milwaukee Electric Railway & Light Company carefully classifies all its accidents, both as to their character and, in the matter of payment, as to the year in which the accidents occurred. The classification is as follows:

Collision with vehicles.
Collision with persons.
Collision with animals.
Collision with bicycles.
Collision with cars.
Cars leaving track.
Employees injured when on duty.
Center pole accidents.
Alighting or boarding moving train.
Alighting or boarding stationary car.
Fell in, on, or off car.
Fell off car on curve.
Trouble on account of fare.
Disturbance on car.
Ejectment from car.
Frightened horses.
Electric shock to horses.
Electric shock to animals.
Damage to company's property.
Unusual occurrences.
Miscellaneous.
Power plant.
Lighting.

In the auditor's accident report blank the accidents for each of these classifications for the month and year to date are reported, and the payments are entered in separate columns for the year in which they occurred, so that the total monthly and yearly payments to date appear in both

classifications. The legal expenses connected with accidents are also presented in a number of subdivisions, classified in the same way as are the payments on claims.

System of Uniforming Men in Milwaukee

The accompanying diagrams and specifications of uniform coats, vests and overcoats for the Milwaukee conductors, motormen, station masters and inspectors will be found worthy of study, as they represent a very careful effort on the part of the management to standardize a system of uniforming their employees in such a way as to make it possible for the latter to employ any local tailor, while purchasing the cloth at cost from the company:

GENERAL NOTICES TO EMPLOYEES

Standard uniforms will hereafter be made to conform with the following diagrams and specifications:

Uniform cloth, "Slater" No. 311, for suits, and No. 958, for overcoats, will be furnished by the company at cost, and may be obtained from the storekeeper on order, issued by superintendent of transportation. Failure to procure uniforms within twenty days after issuance of order on storekeeper will be sufficient cause for suspension.

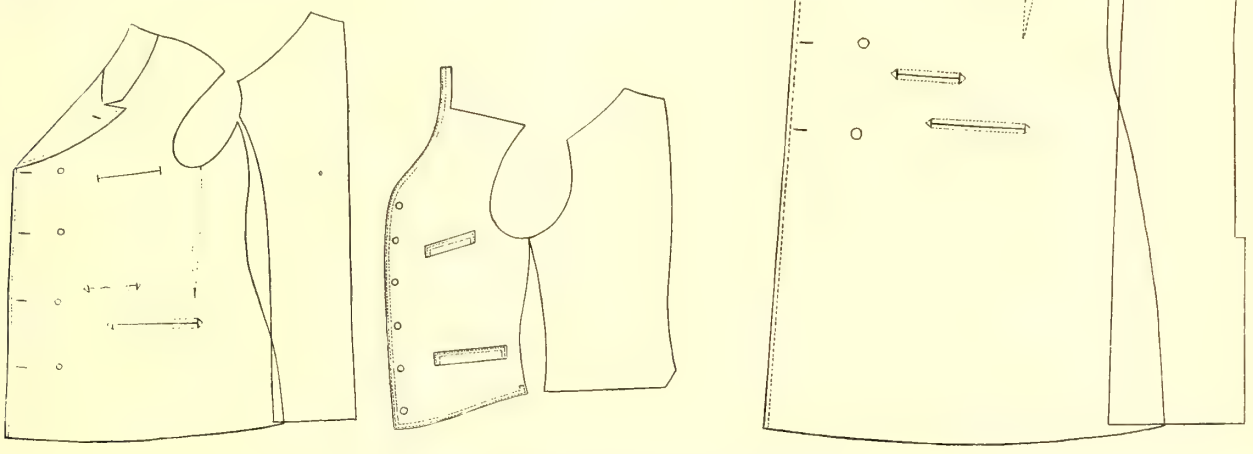
The uniform for patrolmen will consist of a regulation suit made as per diagram *A*. Material to be of corduroy, as furnished by the storekeeper on order of line foreman or superintendent of construction and maintenance of way.

Employees can have uniforms made by any good tailor.

All uniforms must be inspected and approved by station masters or superintendent before being worn on duty.

The winter weight uniform cap for conductors, station masters and inspectors is of blue cloth, stiffened with haircloth, with straight peak and two gold uniform buttons; price $1.50.

Motorman's cap, same as above, but with vizor peak and two silver buttons; price $1.50.



PATTERNS FOR UNIFORMS—MILWAUKEE

The summer cap is of the same general description as the winter weight, but is covered with indigo blue duck; price $1.

The uniform cap for patrolmen is of corduroy to match uniform, yachting pattern, vizor peak, with two silver buttons; price $1

All uniform caps must bear the stamp of the maker, but employees are permitted to purchase their uniform caps from any reputable dealer.

Summer or winter caps may be used at pleasure of the wearer.

GEO. M. KUEMMERLEIN,
Superintendent of Transportation.

Approved, T. E. MITTEN,
General Superintendent Railway Department.

COAT (FIGURE A)

Coat for conductors, motormen, station-masters and inspectors:
Coat, ———. Double breasted, square corner sack, lapel collar. Velvet collar for station-masters and inspectors only.
Length, ———. To extend 4 ins. below the crotch seam, with five buttons on each side.
Edges, ———. Double stitch, ⅜ ins. wide.
Cuffs, ———. Three ins. deep, imitation stitch to match edge, two buttons.
Pockets (outside), ———. One breast, plain finish, two skirt, and two ticket, to be leather corded. (Recommended to be of leather or heavy linen duck, well stayed to prevent sagging).
Body lining, ———. Triple warp, black serge.
Sleeve lining, ———. Extra durable cotton stripe.
Cloth, ———. To be furnished by the company; 3½ yds. required for full suit.
Buttons, ———. To be furnished by the company; silver for motormen and patrolmen; gold for all others. (Recommend all buttons to be sewed firmly in place).

VEST (FIGURE B)

Vest, ———. No collar, six buttons, opening 13 ins. to first button.
Edges, ———. To correspond with coat.
Pockets (outside), ———. Two upper, two lower.
Lining, ———. Extra durable cotton twill.
Back, ———. Triple warp black serge.
Cloth, ———. To be furnished by the company.
Buttons, ———. To match diagram *A*.

TROUSERS

Two top or side pockets; two hip and one watch pocket. Cloth to be furnished by the company; 1⅜ yds. required.

OVERCOAT

Coat, ———. Double breasted lapel, five buttons on each side.
Length, ———. For motormen, 8 ins.; all others 6 ins. below the knee.
Collar, ———. For conductors and motormen, cloth collar, 5 to 6 ins. deep; station-masters and inspectors, velvet collar of ordinary depth.
Edges, ———. Same as diagram *A*.
Cuffs, ———. Same as diagram *A*.
Pockets (outside), ———. Two skirt, two ticket, two hand pockets; all leather corded. (Recommended to be of leather or heavy linen duck, well stayed to prevent sagging.)
Body lining, ———. Blue or black. (Recommend cassimere interlined with blanketing.)
Sleeve lining, ———. Best quality lusterine.
Cloth, ———. To be furnished by the company; 2¾ yds. required.
Buttons, ———. Same as diagram *A*.

In no direction can a railway company save money, or increase dividends more rapidly than by having its equipments thoroughly inspected by competent men, working systematically under intelligent direction. From paper at the Boston Convention, 1898.

STREET RAILWAY JOURNAL

JULY, 1899.

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, BEARD BUILDING, 120 LIBERTY STREET.

BRANCH OFFICES:

CHICAGO.....Monadnock Block.
PHILADELPHIA.....929 Chestnut Street.
LONDON.....39 Victoria Street, Westminster.
PARIS.....50 Boulevard Haussman.
COPENHAGEN.....V. Faber-Madsen, 9 Valby Langgade.
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ST. PETERSBURG.....Alexander L. Lineff, Ligovka, 67-22.

Long Distance Telephone, "New York, 4044 Cortlandt."
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / 25/ / 31 fr

Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

NOTICE.

Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, accounting, finance and invention.

Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

Address all communications to

The Street Railway Publishing Co.,
Beard Building, 120 Liberty Street, New York.

There have been so many important happenings in the transportation field during the past three months that it is difficult to keep pace with the progress of events, or to deal with them adequately within the limits of any publication. From all over the country and from foreign lands as well come reports of transportation projects which bid fair to tax home and foreign manufacturing facilities far beyond their capacities, and immediate expansion of these facilities seems a necessity of the most urgent kind, if grave disappointments on the part of customers are not to be realized. It appears probable that new realms are on the point of being conquered by mechanical motive powers, and that the horse will soon be displaced from cab and wagon service in our cities, and from many pleasure vehicles. New York city is to secure real rapid transit at last. Almost the entire transportation system of Brooklyn, surface and elevated, is now under one control, which may also secure the extensive steam railroad which controls the traffic of Long Island. Steam is to be as much a thing of the past in elevated railroading as are the horse and cable systems in street railroading. Foreign cities all over the world are yielding to a desire for better transportation facilities. Everywhere is found activity, energy, engineering enterprise, skill—and extraordinary indifference to investment costs if the ends to be achieved appear desirable.

Schedule speeds, car frequencies, operating expenses and net profits to stockholders are very closely related, and the street railway manager who appreciates this fact and makes a study of each of his lines with a view to increasing speeds and reducing frequencies, still giving due service to the public, will, all other things being equal, give a better account of his stewardship than will he who runs his cars slowly and too frequently. The advantage of high speeds is a double one. The same service can be given with less cars, and, therefore, less transportation wages; the power station cost per car mile is usually, within limits, somewhat reduced, and the gross receipts should be increased, owing to the greater inducement offered to the people to save time by riding. In more than one case, to our knowledge, the increase of car speeds has been the most potent influence in effecting the financial rehabilitation of street railway properties, turning a deficit into a comfortable surplus. In one instance, where higher speed was accompanied also by a longer time interval between cars, gross receipts per car mile were increased in two years about 33 per cent, with hardly 5 per cent increase in operating expenses, and the net earnings per car mile applicable to return on investment was increased 150 per cent. There is no doubt that not a few street railway companies have given to the people a service too frequent to be profitable to stockholders. Statistics show that in nearly every case where electricity has displaced horses, the immediate effects of the change have been a substantial reduction in the gross receipts per car mile. It is true that this has been brought about partly by the building of extensions in new territory and the consequent pulling down of averages, but it has also been caused in part by the great increase in the number of trips per hour and per day. We do not say that the service to the public should not have been bettered in this way—in many cases this betterment was a "franchise tax" in disguise—but a little less liberality with the people would quite surely have increased dividends.

The trustees of the new Massachusetts Electric Company, which controls thirty-one street railway and several electric lighting properties in Eastern Massachusetts, north, west and south of Boston, are fortunate in that the public resident in the territory served by their lines has not been educated to a too frequent car service, while the territory, being suburban in character, is such that high speeds—higher even than at present—can be easily obtained. A consolidation of this kind is more than likely to prove a decided public benefit, through reductions of fares, unification of policies, etc., while at the same time, in spite of the heavy overcapitalization which in these days

always accompanies a transaction of this kind, it seems possible to hope for materially increased profits. The Washington consolidation is a happy solution of a very difficult financial and administrative problem. The numerous suburban lines of Washington ought to be feeders of a central system, and not independent properties. The Chicago consolidation of the Yerkes properties is a simple and self-evident step, which would doubtless have been taken years ago had important franchise questions been settled. Capital has many times tried to effect a consolidation of the many street railway systems of St. Louis, and that it has finally been effected is a cause for congratulation, certainly to the people of St. Louis, and is, very likely, also for the capital invested. There is much talk of a consolidation of the surface and elevated railway systems of New York, but no rumors have thus far been verified, and there are, doubtless, serious obstacles in the way, but capital is, in these days, used to overcoming obstacles of almost every kind, and we should not be surprised at any time to learn that the apparently impossible has been accomplished.

The real and most serious difficulty which capital finds in carrying out these great consolidations is in obtaining the right men to handle the properties. There are hardly a dozen men in the country who are generally recognized in the industry as strong, forceful and thoroughly capable administrators of large street railway interests. These men are "placed," and cannot be shifted, for their associates will not let them go at any cost. A new list must be created from those who have hitherto successfully managed smaller street railway properties, or from the general business world, and the success of capital in fulfilling its promises to the investor will depend very largely upon the men to whom the operating responsibilities are given. The best managers are cheap at any price.

One feature of many of these new consolidations deserves special mention and thoughtful consideration. In Massachusetts the new consolidated company will own eighteen railway and electric lighting power stations. In Washington the two electric lighting companies of the city are consolidated with the railway companies, and plans are on foot for transmitting water power, and otherwise greatly improving the power station proposition. In New York the railway and lighting companies are largely owned in common, and further consolidations are in the air, while in many other cities the tendency is toward similar blending of interests. It is certain that through these consolidations electric power will be generated at much less cost in the future than in the past, and the utilization of that power will be far more general. The average load of an electric lighting station rarely exceeds 25 or 30 per cent of its maximum capacity, and the load factor of a railway station is hardly 10 per cent more. The mere union of these two interests will not in itself greatly improve matters, for the heavy loads of both lighting and railway service usually occur at about the same time of day, but the installation of large storage batteries in the power stations will make it possible to bring the load factor up to 60, 80, or even 100 per cent, provided that a market for the stored current can be found. That this market exists is a certainty. Consider, for example, the possibilities of the electric vehicle business—that infant industry which has just now cast off its swaddling clothes. One difficulty with electric vehicles heretofore has been their comparatively short radius of action. Before long—in Eastern Massachusetts, for example, with its thirty or forty power stations, located in every city, village and town of that great area, and with its magnificent roads—electric vehicles can take on a battery at Boston, exchange it for another at Lynn, for another at Gloucester, another at Newburyport, etc. In Washington, an electric cab and carriage service will doubtless be inaugurated with a similar plan of action, and in other cities wherever pavements are good the future for automobiles is assured. We must again point out to street railway managers how important it is that they should in some way obtain a hold upon this new and promising industry, which should immediately add to revenue, and at the same time act to prevent disastrous future competition.

A correspondent has written to us suggesting that the electric railway companies should publish maps of the different sections of the country showing their routes, so that persons, on pleasure bent, wishing to tour through any district, can lay their plans for traveling by electric cars. While the possible traffic to be secured in this way may seem to some to be rather small, there is no doubt that many electric railways, particularly those in the suburbs of large cities, could develop a considerable amount of pleasure riding by running through cars over connecting roads, especially where it is understood that such cars could be chartered to carry special parties. Among other territories where such traffic could be made popular the following might be mentioned: Around Boston, in the northern part of New York city, the Newark, Orange, Paterson region, the suburbs of Philadelphia, Chicago, and, in fact, of most all large cities where the suburban cars do not now run to the center of the city. The possibilities of following this plan in Eastern Massachusetts are discussed elsewhere in this issue, but while the treatment in that article is intended to cover a particular case, there seems to be no reason why the suggestions made are not equally pertinent to other districts

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The Street Railway Purchase Plan in Detroit

It is impossible to deny to Governor Pingree and his political associates the merit of ingenuity and persistence, however much we may criticise their judgment and sincerity. They have devised a plan for securing municipal ownership of street railways in Detroit, which, though somewhat complicated, would certainly seem to accomplish the main object, which is to secure to the city the possible profits from street railway operation without imposing on it any of the risks and burdens of actual ownership. The plan in its elements is this.

1. The Street Railway Commission is to organize a new company, to which is to be transferred all of the present properties in the city. The new company is to be granted a consolidated thirty-year franchise for the operation of these properties, in place of the present franchises under which they are working, which expire from ten to twenty-five years hence. The new franchise provides for a general three-cent fare on all lines, and for special low priced labor and school tickets in addition.

2. The new company will join the old in mortgaging the present properties and future extensions (made by the new company) for the sum of $17,500,000, represented by fifty-year, 4 per cent gold bonds. As a further valuable asset behind these bonds, it is proposed that the city shall grant to the new company an additional "security franchise," so called, which provides that in the event of default in the interest or principal of the bonds, leading to foreclosure of the mortgage, the purchasers of the property under foreclosure shall have the right to operate the system during the remainder of the thirty-year period and for eighteen years beyond, upon terms and conditions nearly the same as those under which the present companies are now working, which include a five-cent fare with six tickets for twenty-five cents, with somewhat lower rates during the heavy hours of the day.

3. A sinking fund is to be established out of earnings sufficient to provide for the retirement of the bonds in fifty years.

4. Of the $17,500,000 of bonds thus secured by the present properties, the future extensions, and the security franchise, the old companies are to receive $16,800,000, and the new company is to retain $700,000 to provide for extensions, improvements, etc.

5. The stock of the new company is to be held by the Street Railway Commission as trustees, and if, later on, it is decided that the city can legally accept this stock for its treasury, it is to be formally turned over to it, but if not, then the city is to have the power, by a clause in the franchise granted to the new company, of so taxing the latter as to prevent it from making any profits whatever, i. e., the city can impose a tax equal to the entire net profits from operation, after paying interest on bonds and providing for the sinking fund.

It will be seen that the present street railway companies thus surrender control of their properties without a penny in cash, and without the benefit of the city's endorsement of the bonds. In other words, if the new company is unsuccessful, and the interest on the bonds is not paid, the bondholders can do nothing more than take back their property, but they will have as an additional asset a franchise terminating forty-eight years hence at remunerative rates of fare. The scheme is, as above stated, ingenious, plausible and not, perhaps, unfair to any of the interests involved. The experiment of three-cent fares can thus be carefully tried under most favorable conditions for its success and without putting the risk of the experiment upon private capital.

The method of arriving at an appraisal of the property upon which the $17,500,000 bond issue was based seems to be reasonably fair, though it is not, as is locally believed, unduly favorable to the street railway companies. In the first place, the physical assets of the present companies were appraised on the basis of "cost of duplication" by M. E. Cooley, J. D. Hawks, Gilbert Wilkes and others, all men of reputation and special ability in different departments. Their estimates coincided quite closely and led to the determination by the commission that the sum of $8,000,000 represented a fair valuation of the tangible assets. As auditor, E. B. Hutchinson, an expert accountant, went through the books for four years past, and determined that the true net earnings of the property last year were $805,000. As actuary, Prof. Edward W. Bemis, of the Kansas State Agricultural College, then determined the valuation of the franchises and fixed it at the sum of $8,478,564. Prof. Bemis arrived at this sum in the following way.

1. He first scaled down last year's earnings from the auditor's figures, $805,000 to the sum of $750,000, the difference being accounted for, as he claimed, by probably insufficient charges for depreciation.

2. He next assumed an average increase in net earning power of 4 per cent per annum during the remainder of the franchise life of the different properties. This figure was considerably less than the increases of the last few years, but it was deemed by him, as protector of the city's interests, conservative.

3. Having obtained in this way an estimated net revenue for each of the remaining years during which the franchises were to run, he deducted from this revenue, interest at 4 per cent on the cost of the tangible assets, thereby obtaining for each year what he calls the "monopoly earnings," or earnings due to the possession of a franchise over and above the fair return on the actual capital investment.

5. He then discounts these earnings, at 4 per cent, in order to find their present value.

6. The sum of the present values of the estimated "monopoly earnings" of all the years for which the present franchises are to run, becomes, therefore, according to his theory, the value of those franchises above that of the tangible assets.

The effect of a valuation theory of this kind is, of course, to capitalize future earnings, and, temporarily to increase the interest and sinking fund requirements of the new company. This fact is recognized by Prof. Bemis, and he recommends that the sinking fund be created in such a way as to follow the city's ability to pay, the payments of the first few years being less than those of later ones.

The whole investigation of the Detroit situation has been carefully made, and is, in principle, scientifically correct, but that fact is not fully recognized by the people, who see in the plan only the price which the street railway companies are to get for their properties, forgetting first that a 4 per cent bond of that character will quite surely have to be sold at a considerable discount, and second, that the 4 per cent rate of increase in net earnings assumed by Prof. Bemis is probably considerably less than would be realized by the present companies were they to continue in the possession of their properties.

The Street Railway Commission in Detroit proposed to refer the whole matter of purchase to the people for action, but on June 27 the whole question was laid upon the shelf by a unanimous vote of the common council sustaining the action of its committee on streets and ordinances in unanimously declining to recommend any steps toward city ownership at this time, in view of the facts, first, that no bargain could be made with the railways if three-cent instead of five-cent fares are specified in the security franchise; second, that no legal authority can be found for obtaining a special vote of the people on the subject; and, third, that litigation seems assured if any favorable action should be taken.

Too much care cannot be given to the sizing and alignment of wheels and the pressure with which they are forced on the axle. At least 50 per cent. of the wheel removals throughout the country are caused by broken or sharp flanges, or a broken wheel. From paper at the Boston Convention, 1898.

The New Railway, Light and Power Enterprise in Sao Paulo, Brazil

Comparatively few North Americans know that in the southern part of Brazil, hardly 300 miles southwest of Rio de Janeiro, lies one of the richest and most rapidly growing cities of South America, the capital of the State of Sao Paulo, and most advantageously located as regards climate, elevation, railway connections and seaport facilities. The city of Sao Paulo is situated about 40 miles from the seacoast, directly under the Tropic of Capricorn, 23½ degs. south of the Equator. At a point about 5 miles from the ocean hills rise abruptly to the height of 2000 ft., and from this point a table land extends inland for many miles. Sao Paulo is one of the highest points on this table land, its elevation being 2500 ft. above sea level. The climate is, for a tropical country, cool, bracing and healthful, and is not characterized by that depressing tropical humidity which is felt in the seacoast cities of Brazil. The latest estimates place the population at not less than 250,000, the growth having been extremely rapid during the past ten years.



BIRD'S-EYE VIEW OF SAO PAULO, BRAZIL









VIEWS IN THE CITY OF SAO PAULO

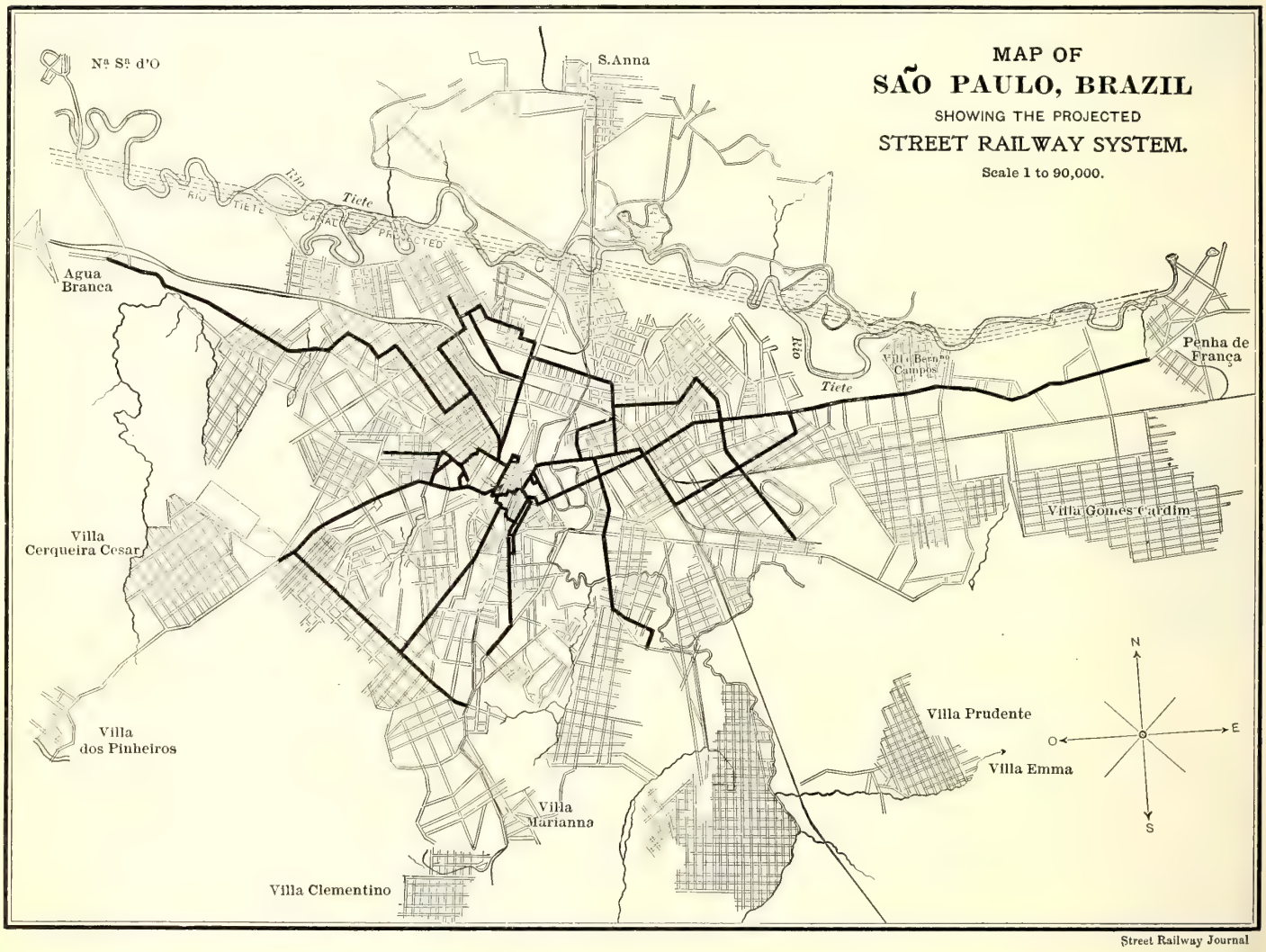
It is to this city that the attention of a number of New York and Canadian capitalists has been directed for some time, with the result that a syndicate has been formed, consisting of F. S. Pearson, chief engineer of the Metropol-

itan Street Railway Company, of New York; William McKenzie, who is largely interested in many street railway properties of Canada; B. F. Pearson, of Halifax, and others, to develop the street railway, light and power interests of Sao Paulo. Franchises have been obtained for street railway lines covering all desirable routes in the city, including a few miles of street now traversed by an antediluvian mule railway, which has been in existence for some years. R. C. Brown, whose management of the Halifax (N. S.) property was such as to win him the entire confidence of its owners, Messrs. Pearson, McKenzie and others, sailed on June 5 for Sao Paulo with a large consignment of electric railway apparatus, and will be in full charge of construction, equipment and, temporarily, of the operation of the system. He is accompanied by F. S. Pearson, who will determine the main outlines of the installation, locate power stations, etc.

The State of Sao Paulo is the principal coffe producing State of Brazil, and is one of the leading and most populous in the entire republic, the production of coffee being a very profitable industry in this climate and under the conditions found here. Forty miles away from the city lies its seaport town, Santos, which gives the name to the coffee produced in the State. The manufacturing industries connected with the coffee trade and supplies for the State have been established in the city of Sao Paulo, which has thus become quite a manufacturing center. The city is obliged to be largely self-supporting, as it is 240 miles away from Rio de Janeiro, and is connected with a railroad running through a hilly district not favorable for the transportation of freight.

The city is quite cosmopolitan, having about 70,000 Italians, and a large number of German, French, English and American residents, and as a result of this foreign mixture there is less opposition to the introduction of foreign customs and enterprise than is found with the people of the Portuguese and Spanish towns of South America. Many of the local enterprises, including the Sao Paulo Steam Railroad Company, the mule tramway company and the gas company, are all of English origin, though a considerable portion of their stock is held locally.

The "old town" of Sao Paulo, which was founded in 1554 by the Jesuits, was built upon a bluff, the sides of which were quite steep. This part of the city is of small extent, but in it are the chief business houses, especially of the retail dealers. The streets are narrow and crooked, but are well paved, and the sidewalks are kept in good



Street Railway Journal

order. Generally speaking, most of them are not, even in this old town, any more hilly than in the average city of the North, but two or three of the approaches thereto are upon streets which are wholly inaccessible to teams or cars, while others have considerable grades, running as high as 9 per cent, though these are short.

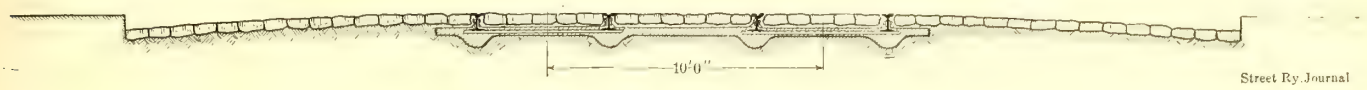
Radiating from the side of the old town, the city has grown outwards quite uniformly, although the development has perhaps been more rapid to the northwest. On the west side, to a distance of 1½ miles from the old town, and considerably above its level, are found some of the finest residences of the city. These districts have, however, very poor and inconvenient transportation service into the center of the city. Northwest of the old city, and quite near it, are thickly populated districts, one of which is so densely populated that electric lines will be well patronized for short distance riding. The present mule

tramway lines are so circuitous that time can often be saved by walking.

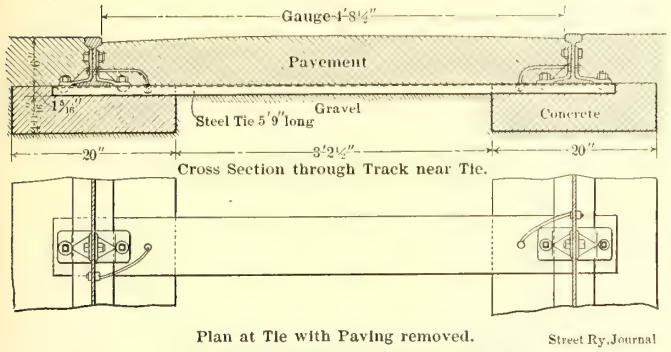
The Pearson-McKenzie syndicate has obtained a concession for the lines shown on the accompanying map. These are laid out in such a way as to give the whole city a good service, but it is not believed that the development of the system will stop with the completion of these lines, for there are desirable suburbs to be reached.

Coal in Sao Paulo sells for $10 per ton, and wood is equally costly. As a consequence, the price of gas and electric lighting is high, and none of the city lighting is as yet done by electricity. Five thousand commercial incandescent lamps are, however, supplied from the present station. The electric light service begins at sundown and, except for a few large customers, extends only until ten o'clock in the evening.

About 20 miles west of the city of Sao Paulo is the only large water power near the city, with a probable minimum supply of 10,000 h.p. to 20,000 h.p. This has been secured by the Pearson-McKenzie syndicate, which intends developing power and transmitting it to Sao Paulo for furnishing the lighting, railway and power service. The introduction of cheap power into a city where steam power at present costs from $100 to $150 per annum will mean a great deal to the industries of Sao Paulo, and to the lighting and railway enterprise. The right to build a transmission line has been obtained, and this line will pass through the town of Augua Branca, where there are at present several factories.

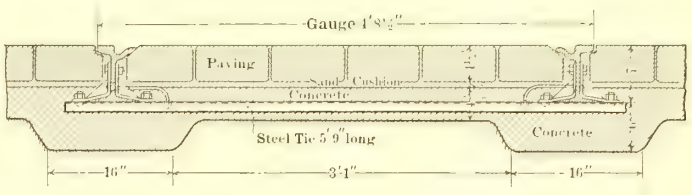


SECTION OF ROADWAY

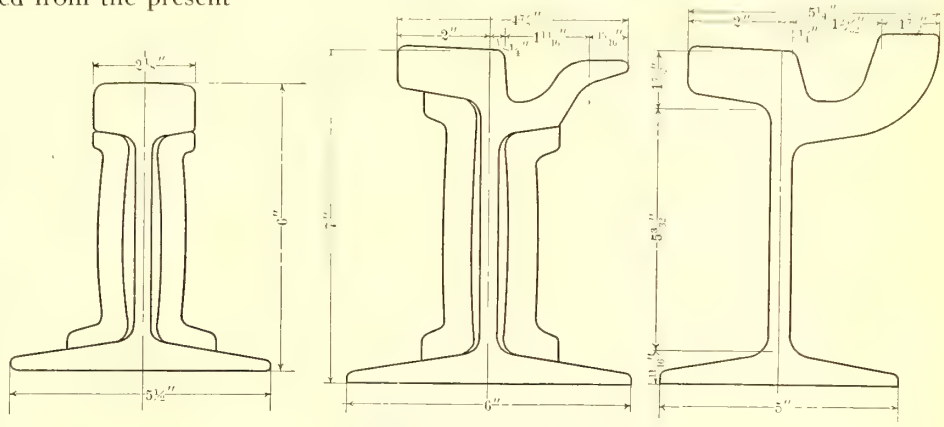


SECTION AND PLAN AT TIE OF T-RAIL CONSTRUCTION

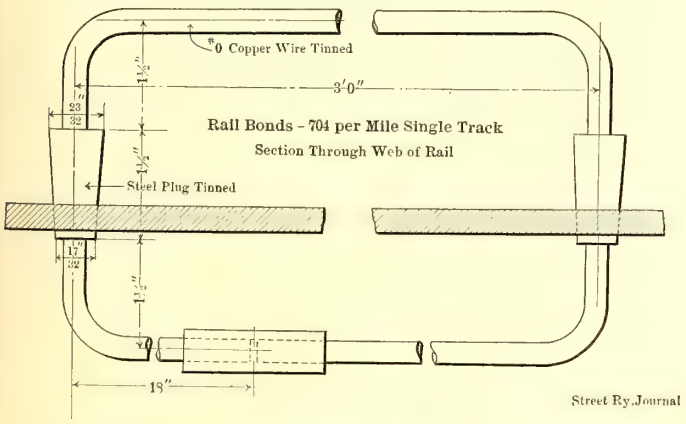
The new syndicate has obtained the government approval for a type of street car, which is almost an exact duplicate of the Broadway (N. Y.) car, and also for a modification of the rail section to the "Trilby" section shown in the accompanying drawing. At present there has been shipped to Sao Paulo 10 miles of track, with necessary ties and other railroad iron, furnished by the Pennsylvania Steel Company; fifteen Brill cars, Broadway pattern; two 225-kw. General Electric generators for direct connection with the Robb Engineering Company's engines, and Cahall boilers. By the end of the year it is expected that 35 miles of track and seventy-five cars will be in Sao Paulo, and within a short time thereafter the temporary steam power station, now building, with apparatus described above, will be replaced by power electrically transmitted from the waterfalls by the three-phase system. At this waterfalls a brick and cement dam, 40 ft. high and 400 ft. long, will be constructed.



SECTION OF GIRDER RAIL CONSTRUCTION



SECTIONS OF STANDARD RAILS



METHOD OF BONDING

The method of track construction used by the company is illustrated in the accompanying engravings. The standard 7-in. girder rail, which is used for city streets, weighs 90 lbs. per yard and is mounted on steel ties spaced every 10 ft. The ties are set in concrete, the latter being carried a distance of 4 11-16 ins. below the base of the rail. The rails are connected with the ties by clips, and are bonded to them, making a cross connection. The joints are also bonded by the Anderson West End bond, illustrated herewith. The guard rail weighs 110 lbs. per yard, and the T-rail for suburban service 62 lbs. per yard.

Ash seems to be most universally used in post and light framing of cars. This is probably due to the difficulty in securing the grade of oak necessary; the lighter the weight of the ash the greater ease with which it is worked. In spite of these difficulties, oak is far preferable, being stronger and more elastic, and will give a far longer life. From paper at the Boston Convention, 1898.

Power Station of the Northwestern Elevated Railway of Chicago

This plant, which is one of the large power stations in Chicago, is nearing completion. It is located on Fullerton Avenue, 3000 ft. west of the elevated structure, and about midway between the ends of the line. The outside dimensions are 255 ft. x 112 ft., the engine room being 57 ft. 7 ins. wide, and the boiler room 50 ft. 2 ins.

The building is of brick, with concrete roof and checkered steel plate floors. The basement, extending under both engine and boiler rooms, is 12 ft. 4 ins. high, with concrete floor, finished in granitoid. The engine room basement contains all steam and exhaust pipes, separators, receivers, as well as the electric cables to and from the switchboard. The boiler room basement contains the smoke flues and the entire system of feed and blow-off piping, ash conveyors, etc. The boiler feed pumps are also located in the basement, on the side of the chimney.

The latter is a prominent feature of the building. It has a 16-ft. flue, and the top is 203 ft. above the street level. It is 27 ft. square at the base, and rests on a foundation of piling, driven 30 in. centers. These piles carry a concrete footing 31 ft. square and 5 ft. thick.

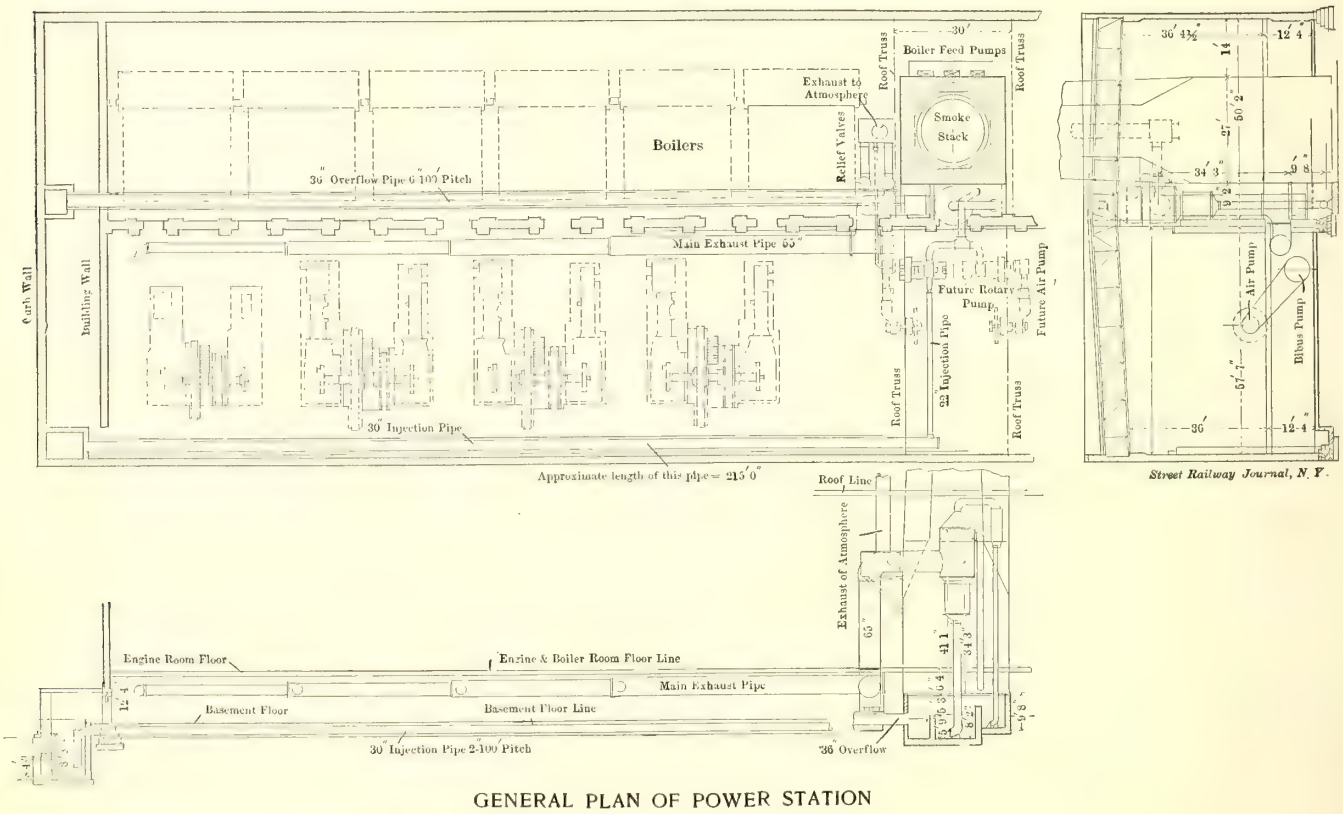
The plant will contain three engine and generator units of 1500 kw. capacity, and one of 750 kw. The engines are cross compound, of the Allis-Corliss type, and are direct connected to Siemens & Halske generators with the internal armatures. The cylinders of the 2000-h.p. machines are 30 ins. and 60 ins. x 60 ins. stroke. Those of the 1000-h.p. machine are 23 ins. and 46 ins. x 48 ins. stroke. The diameters of the flywheels on the two engines are 25 ft. and 20 ft., operating at 75 r.p.m. and 80 r.p.m., respectively.

The plant will contain twelve batteries of Babcock & Wilcox water tube boilers, set in batteries of two boilers, and equipped with twenty-four Murphy automatic smokeless furnaces. In connection with the furnaces there will be storage bins, conveyors and chutes, which will deliver the coal into magazines, from which it will be fed automatically into the furnaces. The conveyor system will be of the gravity bucket type, and will be so arranged that the buckets will receive the ashes in the basement and carry them to the ash bins outside of the building. The coal, after going through the cracker, will either be distributed by the conveyors along the length of the outside storage bin, or else distributed in bins above the furnaces.

The main steam header, to which all boilers are connected, is located in the boiler room above the boilers, and is made of 28-in. lap-welded wrought iron pipe, with the flanges welded on. The header is made in three sections, each section being connected by four 8-in. "U"-shape steel pipes. A 6-in. separate header is provided for the auxiliary machinery. The maximum working steam pressure will be 160 lbs. per sq. in.

All the live steam valves are extra heavy-ribbed, bronze-seated gate valves of the Chapman manufacture.

The boiler feed water will be supplied by three vertical duplex feed pumps of the admiralty type, manufactured by Henry R. Worthington Company. The water, before entering the boilers will pass through two heaters of the Berryman type, with a capacity of 2000 h.p. each. All exhaust steam from the auxiliary machinery is taken into these heaters.



GENERAL PLAN OF POWER STATION

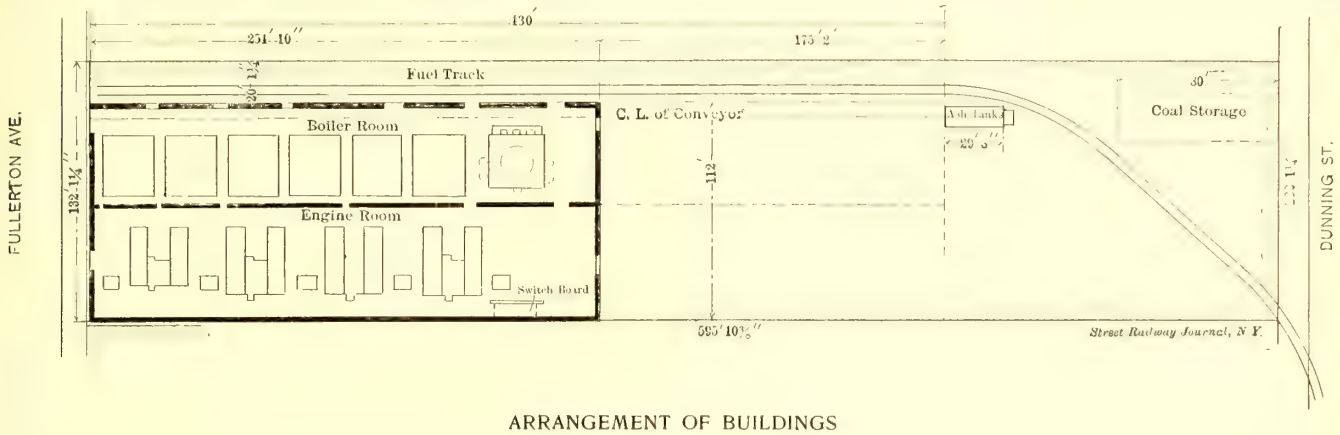
In place of the usual arrangement of an independent condenser for each engine in the power house a central condenser of the Weiss counter-current type, built by the Southwark Foundry & Machine Company, is being installed by Edward M. Hagar & Co., the Western agents for this device, to condense the steam from all the engines in the power house. The condenser vessel being installed has a capacity sufficient to take care of the ultimate capacity of the station, that is, 14,000 h.p. The auxiliary machinery, consisting of a steam engine driving tandem

The city has a 12-ft. brick tunnel from Lake Michigan, which flushes the north branch of the Chicago River. This tunnel runs in Fullerton Avenue directly in front of the power house, and arrangements have been made with the city whereby all water used in the station for condensation and other purposes is supplied from this tunnel through a 30-in. pipe.

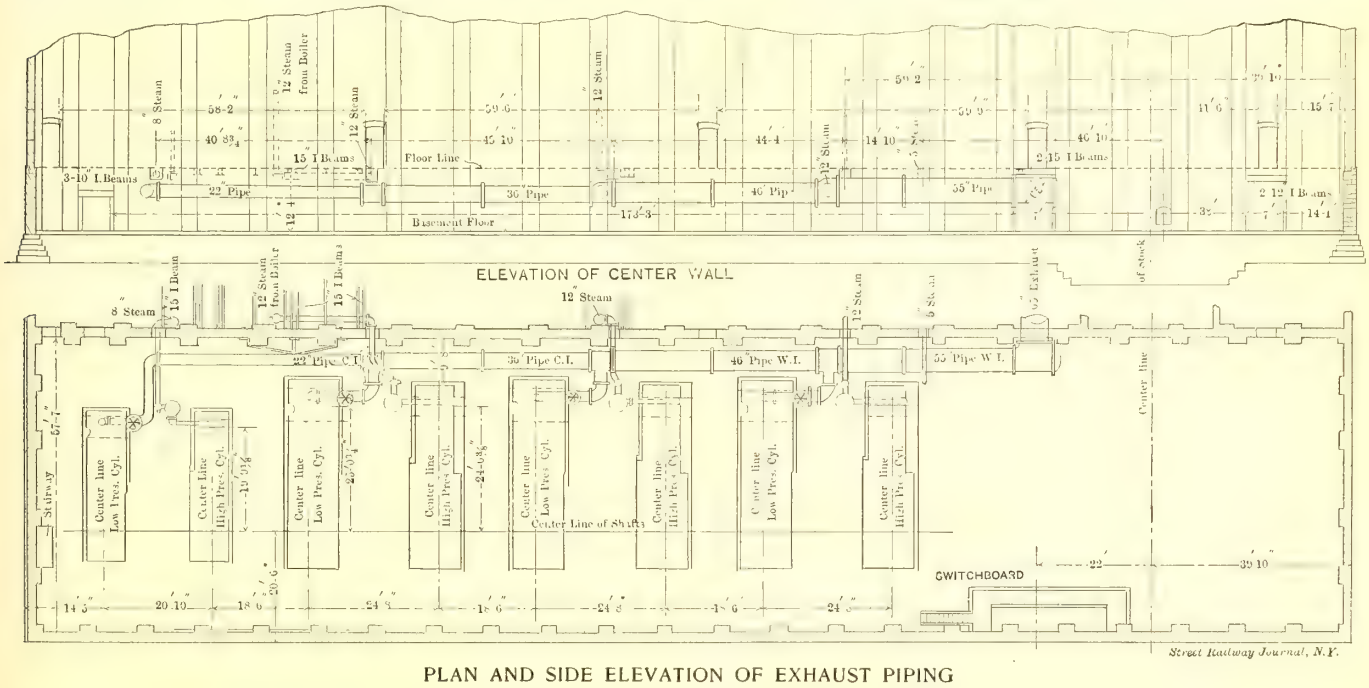
a dry air pump and belted to a Bibus pump of the rotary type, is of sufficient capacity to take care of the present installation of engines, which have a nominal power of 7000 h.p.

The air pump is an improved type of air compressor, with positive and automatic valve motion, working absolutely free from water. The circulating pump is of the positive type, of high efficiency, and both this and the air pump are driven by an economical engine provided with a capacity regulator. This circulating pump only handles the cold injection water, the hot water passing out automatically through a barometric column, or so-called water leg.

Many advantages are obtained by the use of this central condenser, and it is said that the amount of power required to drive the condensing machinery is only a fraction of that required by the usual jet condensers. It is also claimed that this condenser uses only one-half to two-thirds the amount of cooling water necessary for a jet or surface condenser, and again, the height that the condensing water has to be lifted is not so great in the Weiss condenser as it is in an ordinary condenser using a wet air pump, there being a "balance" due to the height of the water in the barometric tube or water leg. The hot well of this condenser is hotter than with any other, as the temperature of the overflow can be the same as that of the exhaust steam. In other words, it obtains without cost the same effect as would be produced by a feed water heater in the exhaust pipe. For these reasons, and on account of the simplicity of its construction and the positive regulation of the amount of the condenser water, the system seems particularly adapted for use with fluctuating loads and for central condensing plants. The reliability of the condenser comes from the fact that there are no valves of any kind, of contracted area or small openings for the air or water to pass through, which can become clogged or congested, causing a dropping of the vacuum. At the same time the amount of water fed to the condenser is automatically regulated by the positive displacement rotary pump, which is driven by the air pump engine. In the usual condenser a sudden increase in the load, or a leak, lessens the vacuum, which in turn reduces the quantity of water, causing a still poorer vacuum; whereas in the Weiss system the water is pumped in entirely independent of the vacuum. An increase of load, however sudden or severe, does nothing except slightly lessen the vacuum. A back flow of water from the condenser into the main engines can never occur, because the water flows out freely by gravity through the water leg, which is always of liberal size. The exhaust piping in a central plant using a Weiss system is also simplified, and a large number of cross-connections, gate and free-exhaust valves are dispensed with, as the exhaust main is run through the plant, and all engines attached to it. A free-exhaust valve located at the condenser vessel will lead the steam to the atmosphere should it be necessary at any time to operate the station non-condensing. The ability to maintain a good vacuum at the engines situated a distance from the



ARRANGEMENT OF BUILDINGS



PLAN AND SIDE ELEVATION OF EXHAUST PIPING

condenser comes from the fact that the air is removed separately from the water, thus taking care of any moderate leaks in the main exhaust pipe.

The switchboard panels are the General Electric Company's standard railway type. The generator panels are on the main floor, and the feeder panels on a gallery.

James R. Chapman is the chief engineer, and Z. E. Knapp, engineer in charge of the work.

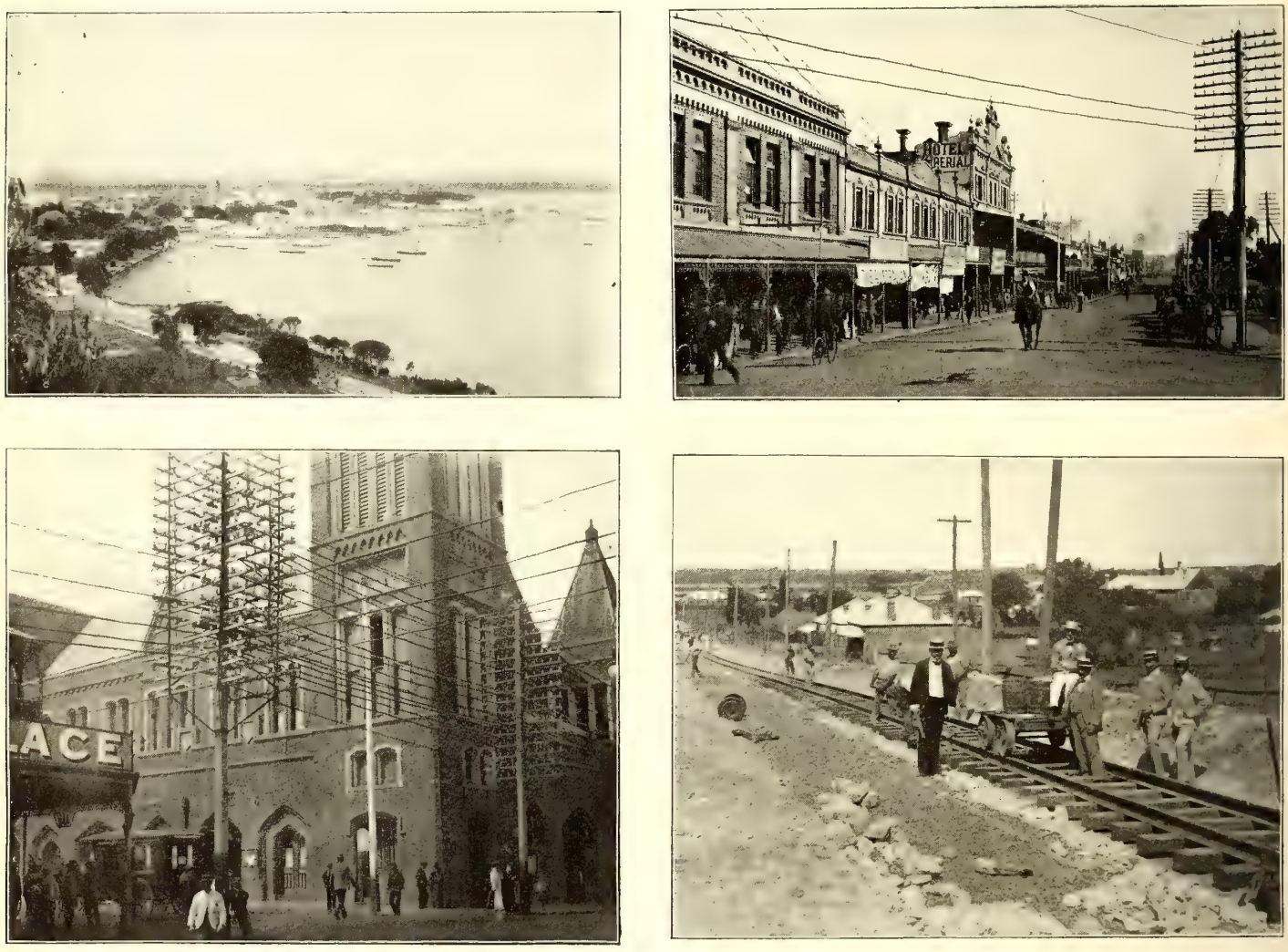
New Plant at Perth, Australia

The construction of a new complete steam and electrical plant for the Perth Tramways, Ltd., Perth, Western Australia, is progressing rapidly. The equipment for the station will be as follows: Two 250-h.p. Babcock & Wilcox boilers, with wrought headers; two 325-h.p. tandem compound engines built by the Robb Engineering Company, of Amherst, N. S.; two outside packed single cylinder double plunger feed pumps, each capable of feeding 500-h.p. of boilers; two 225-kw. direct connected railway generators, manufactured by the General Electric Company, together with switchboard and accessories. A complete system of steam exhaust feed water and drip piping will be installed, and all fittings in high pressure piping will be made of gun iron; all joints are of the Van Stone type, and each boiler is equipped with a No. 12½ Hayden & Derby double tube lifting injector. All the piping in the plant will be covered by H. W. Johns fire-felt covering; Chapman valves will be used.

The steel roof trusses and purlins for the car barn were furnished by E. B. Gumaer, Jersey City, and the corrugated roof covering was furnished by McCullough Iron Company, of Wilmington, Del. Ten new cars have been ordered from the J. G. Brill Company, of Philadelphia. These will be single truck, 18-ft. bodies, with cross seats and center aisle, and will be mounted on Brill 21-E trucks.

The 9-in. girder rail, with fittings for 2 miles of the system, was furnished by the Pennsylvania Steel Company. The remainder of the rails were shipped from Belgium. The special work of hard center construction was furnished by William Wharton, Jr. & Company, of Philadelphia.

J. G. White & Company, of New York, prepared the plans for the foundations and buildings, and all detailed drawings for temporary power house, car barn and power plant, and acted as the general purchasing agents in the United States for the London syndicate owning the tramways. W. E. Cooke, representing the London owners, has complete engineering supervision of the erection of the new plant.



VIEWS IN PERTH

Milford, Attleboro & Woonsocket Street Railway

The Milford, Attleboro & Woonsocket Street Railroad Company is building an important link, 33 miles in length, which will connect the terminals of ten electric railroads and pass by the depots of seven steam railroads. Upon the route are five well-known pleasure resorts, including Pearl Lake, where a natural amphitheater seats 3000 persons. One section of the line connects Hopkinton, Bellingham, Franklin, Wrentham and Attleboro. Another

section connects Caryville with Bellingham, Blackstone and Woonsocket.

The company will have two power stations. One will be equipped with two 250-kw. Westinghouse "engine type" generators, direct connected to steam engines working at 120 r.p.m. The other will contain two 325-kw. Westinghouse direct connected generators, working at 100 r.p.m Thirty-two new cars are being built for the service; one-half will be single truck, with two 30-h.p. Westinghouse railway motors, and the other half will be mounted on double trucks, and equipped with four 30-h.p. Westinghouse railway motors. The larger cars will be capable of maintaining a speed of 30 miles an hour.

History of the Cleveland Strike

The history of the strike of the Cleveland Electric Railway Company's employees is largely told by the following communications which have passed between the company and the men.

On June 9, the day before the strike was actually declared, the company sent out a circular letter to each of its employees at their home addresses, reading as follows:

To the employees of the Cleveland Electric Railway Company:

The company having learned that for the first time in many years dissatisfaction exists among its employees, which it believes is very largely due to mutual misunderstandings, desires to make a plain statement of its position, so that entire harmony may be secured.

It may be true that in the management of so large a system of roads, involving so many details, conditions at times exist which ought, for mutual benefit, to be modified, and the company stands ready to make every concession for the comfort and benefit of its employees which can reasonably be asked, or which can be granted consistently with the proper performance of its public duties.

This company is a common carrier, and has the entire burden of responsibility for the safe and proper carriage of its passengers. It cannot free itself from this burden, nor can it lawfully leave to others who have not this responsibility any direction or control in matters affecting the efficiency of its service.

It will be readily conceded that the company must make and rigidly enforce all rules which are necessary for the safety and comfort of its passengers. The company, however, needs and desires the hearty co-operation of its employees in the enforcement of rules, and stands ready to make modifications in its present rules, if any of them are unjust to its employees. Its attention has, however, only been called to three or four specific objections, such as the pay of men working short hours, lay-over time at end of routes and swing runs. The schedules at present in force were adopted after careful consideration, with a view to the most efficient transportation of passengers upon its cars. The forms of the schedules have not been changed, nor are there additional swing runs therein. The company has so far been unable to find any way in which to handle the increased traffic of morning and evening except by means of swing runs. It, however, desires to use no more runs of this character than are absolutely necessary, and it is possible that a readjustment of the time table may do away with some objectionable runs and modify the speed of others, as well as provide suitable lay-over time. In so far as this can be done, the company will make the necessary changes, if any feasible plan can be found which will obviate these difficulties.

With reference to wages of men working short hours, the distribution of extra runs and the pay therefor, the company will be glad at any time to receive any committee of its own employees for the purpose of considering these questions, as well as the other complaints which have led to the present situation, so that, so far as such complaints are reasonable, they may be corrected. If the company and its employees are unable to agree as to the reasonableness of such complaints and the proper redress thereof, the company stands ready to submit the same to disinterested arbitrators, to be chosen in the usual way.

By order of the board of directors.

The Cleveland Electric Railway Company,
H. A. EVERETT, President,
R. A. HARMAN, Secretary.

Cleveland, Ohio, June 8, 1899.

On June 10, the strike was formally declared, a strike in its essence one for the recognition of the street railway employees' union, and a demand that the company should employ only union men, and should compel all their present employees to become members of the union immediately.

On the afternoon of June 11, the following resolution was adopted by the board of directors of the company:

Whereas, The Cleveland Electric Railway Company has exhausted every effort to come to an amicable understanding with its employees; and

Whereas, In spite of such efforts its employees have inaugurated a strike upon its lines and have refused longer to perform their duties. Now, therefore, be it

RESOLVED, First, that all of the company's employees who desire to continue in its service are hereby required to report for duty at their respective stations on Monday morning, June 12, 1899, at 7 o'clock, and that the employment of those who do not so report be terminated.

Second. That the superintendent of the company post a copy of this resolution upon the company's bulletin boards at its different stations, and that the resolution be also published in the daily newspapers of the city of Cleveland, so that all employees have notice thereof.

By order of the board of directors.

R. A. HARMAN, Secretary.

On June 11, the State Board of Arbitration met in Cleveland and attempted to bring about a reconciliation of the differences between the parties, but after a conference with the labor leaders and President Everett, the following letter was received by the Board of Arbitration:

June 12, 1899.

Honorable State Board of Arbitration:

Dear Sirs—At a meeting of the board of directors just held, the following resolution, offered by Mr. Stanley and seconded by Mr. Andrews, was unanimously adopted, viz.:

RESOLVED, That the differences between the Cleveland Electric Railway Company and its former employees have substantially narrowed down to the proposition, upon which the company must stand, that it must hire and discharge men without the dictation of anybody. As already stated, it does not attempt, nor will it attempt, to dictate to its employees whether they shall belong to a union or not. It will not require them to join, nor will it discharge them for joining or refusing to join, at their pleasure. The company must reserve to itself the right to treat directly with its own men, to hire new ones as the needs of its service require, and to discharge inefficient men without accounting to anybody except to its directors.

Entertaining these views, it must respectfully decline to submit these questions to arbitration. Very respectfully,

R. A. HARMAN, Secretary.

The strikers' appeal to the public, issued on June 12, is as follows:

To the Citizens of Cleveland:

We, the undersigned employees of the Cleveland Electric Railway Company, earnestly request every citizen to co-operate with us in our time of need, to help us settle our differences between said company and its employees, as they are shipping in men from other cities by the carloads to take our places by misrepresentation, telling these men through agencies in other cities there is no trouble here, and as we are not asking anything but citizens' rights in our public streets, we want slower time, so as not to endanger the lives of the people of our community.

We have tried every means in our power to live up to said company's rules and protect our families and citizens, and found it impossible to do under existing rules and schedules, so we earnestly urge you to assist us in our trouble.

We have met with a flat refusal to treat with us in any manner, except as individuals. Now, as from past experience we have found that their verbal agreements have never been lived up to, we have determined among ourselves to accept nothing but a recognition of our association, believing that in union there is strength. This is not a matter of wages, but one of principle, and that principle is the right to demand humane treatment from the Cleveland Electric Railway Company.

We request all citizens and taxpayers to be present at the meeting of our City Council to-night, to urge upon that honorable body the immediate settlement of the existing differences. Signed

HARRY S. BRYAN, President,
R. S. THOMPSON, Secretary.

On June 17, the strikers issued this further appeal to the public:

To the Citizens of Cleveland:

We, the employees of the Big Consolidated, do earnestly petition the citizens of Cleveland to refrain from riding on the cars of the Big Consolidated lines which are now being operated by workmen imported from nearly every city in the Union. We claim they cannot give as satisfactory service as can be given by members of our union, who are citizens of Cleveland, and who have families whose whole interests lie in the betterment of one of the grandest cities in the country. Therefore, we once more appeal to every citizen who has the love of his flag, city and family at heart to help win an honorable battle for right and justice.

Respectfully submitted,

Executive Board, A. A. of S. R. E. of A.

The strike collapsed a day or two later, the strikers intimating their willingness to give up recognition of the union. On June 21, the following offer was made by President Everett to the committee of the Common Council, specially appointed to deal with the matter of the strike:

The memorandum proposal of the committee composed of late employees of this company, submitted by your honorable committee to the company, has been considered by the company's board of directors, and by order of said board the company begs to make the following statement to your committee:

The first and most difficult question presented is that of the status of the company's former employees. This company cannot restore the status quo existing previous to the strike, because its men left their employment and refused to operate its cars, and being required by law and its contract with the United States Government and the city of Cleveland to operate the same, it employed other operatives, who have remained loyal during this trouble. In order to secure the services of these men the company was obliged to assure them regular employment, and it cannot honorably or legally violate those contracts and discharge these men. The company has, however, employed no more than from time to time have been absolutely necessary to operate such parts of its lines as it could safely operate, but has refrained from employing new men more rapidly with the hope and in the expectation that its late employees would re-enter its service. The only thing the company can do is to re-employ at once, without regard as to whether they are union men or not, as many of its former employees as its business requires, which will to-day be at least 60 per cent of the entire number, and as many more as possible, distributing the runs among the present employees and of those thus re-employed as equitably and fairly as possible, taking into account the rights of each. Beyond this, as additional men are needed in the company's service, its former employees will have the preference at all times.

In this re-employment two things must, of course, be understood: First, the service of the former employees with the company's present employees must be loyal, and the latter must not be subject to annoyance or abuse by the former; second, the company reserves to itself the right not to re-employ any of its former employees who have committed unlawful acts during the strike. It is not necessary to discuss any other matters of difference until some agreement is reached upon this most important proposition.

This proposition was refused by the strikers, who demanded that all employees except those who had been actually detected in destroying property be taken back, that all disputes between the company and its employees on questions of schedules or wages of men should be determined between the company and a committee of employees, and that all their questions should be determined by outside arbitrators, if the joint committee cannot agree. The strikers formally receded from their main original contention that union employees only should be employed.

On June 25, the strike committee of the Common Council reported as follows:

The council committee appointed by the City Council to aid in adjusting, if possible, the strike between the Cleveland Electric Railway Company and its late employees, can to-day obtain such an adjustment upon the following terms, to which the said company on its part assents:

1. The restoration of former schedules to stand, as publicly announced to the city authorities.

2. Upon questions of wages of the men working short hours, the distribution of extra runs and the pay therefor, as well as upon other grievances, the company will receive a committee of its own employees for the purpose of considering the same, and if unable to reach a conclusion with such employees or their committee as to the reasonableness thereof, the company will submit these differences to disinterested arbitrators, to be chosen in the usual way.

3. In order that the men in the company's employ may have a proper sense of security in their employment, the company shall not discharge any man except for cause, which cause shall, at his request, be given him, and he shall be given a full and fair opportunity to explain or disprove the same, by himself or a committee of said company's employees, to be selected by said discharged employee.

4. Questions of schedules and of wages shall not be submitted to arbitration. The company shall have the ultimate right to hire and discharge men, contracting with them individually, and not collectively. It shall take back into its employment such of its former employees as its business demands, aggregating at the present time 80 per cent of such employees, and as other vacancies occur shall give preference to such former employees, excepting always those who have committed unlawful acts against the company, its property, or its employees, during the present strike; but the rehiring of all men shall be upon the express condition that their services with the company's present employees must be loyal, and the latter must not be subjected to annoyance or abuse by them, and any violation of this condition shall be deemed cause for discharge.

5. The services of the employees shall be distributed as equitably as possible under existing conditions. The company shall at once, upon the return of its former employees to its service, give 80 per cent of the runs to the former employees and 20 per cent of the runs to its present employees; the remainder of its former and present employees to be placed on the extra list in the same proportion. The method of apportioning these runs between former and present employees shall be as follows:

The first four runs on the time-table of each line shall go to the former employees, the fifth run to the present employees; the next four runs to the former employees, and the tenth run to the present employees, and so on through the time-table, with the day runs, late runs and extra list.

Temporarily this adjustment may work some inequalities to some men, but the same will be adjusted as equitably and promptly as possible on these lines.

These propositions the committee deem equitable to both present and former employees and to the company, and recommend the same for your acceptance. Unless acted upon and accepted at once, the committee believes its service will be of no further avail. The committee is fully aware that the public services cannot longer await the adjustment of this difficulty. Some means will have to be adopted at once to provide for the public needs on this company's lines.

The above proposition was agreed to and signed, as follows:

The Cleveland Electric Railway Company, by H. A. Everett.

L. B. Whitney, R. S. Thompson, Everett Todd, Thomas McHugh, George S. Gilmore, A. N. Miller, strikers' committee.

It will thus be seen that the company has virtually won the strike, its refusal to make its system a union road being consistent and absolute. The later reports from Cleveland are that the strikers are not observing that clause in the contract which provides that new men taken on during the strike must not be subjected to annoyance or abuse by the old men. There have been a number of riots, due to the presence of new men on the cars, and they are at the present time being treated with great harshness by the old men.

Tapping an Oil Pipe Under Pressure

BY J. F. HOBART

An oil cup which was piped into the engine supply pipe several feet above the engine, recently became detached by the thread stripping out where the small pipe was screwed into the larger one. This allowed the steam to escape into the engine room rather too freely for comfort, until a pine plug was driven into the hole where the pipe came out. Soon the engine began to groan (in the cylinder) from lack of oil, and it became absolutely necessary to get the $\frac{3}{8}$-in. pipe connection in again.

The thread had come so completely out that the pipe could not be screwed back in again, and it seemed impossible to tap the thread in that hole, with 120 lbs. steam pressure in the pipe. The engine could not be shut down, for it was driving cars and working up to the limit with no relay, pending the putting in of a duplicate engine beside it.

The job was finally done in this manner: A tap was procured of the right size to fit one size larger pipe, and a reamer was put into a common brace (bit stock), the same as used by carpenters. A piece of heavy sheet packing—it was about ¼-in. thick—was found in the cupboard. The packing was about 3 ft. square. A hole just large enough to squeeze the shank of the reamer through was made in the middle of the sheet of packing, the reamer put through and the brace put on.

Then the plug was taken out of the pipe and the engineer stood right up to that hissing steam pipe—stood on the engine cylinder—and reamed out the hole in the steam pipe until the tap would enter. Then the reamer was removed and the tap put in the brace, and the sheet of packing used as before. It took but a very few minutes after that to tap the hole and start in the bit of pipe with a globe valve on it. After the pipe was in place the job was practically finished as far as the "kink" was concerned, but I have seen the same kind of a shield rigged up for use when a gage glass blew out and there was no way of shutting the valves without getting scalded. The packing did it all right then, too.

Employment Contract in Milwaukee

The employment contract used by the Milwaukee Electric Railway & Light Company in engaging its employees contains the following clauses:

I agree to submit to a medical examination by the company's doctor, and to pay for the same a fee of $1.

I agree to work on trial, under instruction, and without pay five days in said company's shops, and at least ten days on such of its cars as I may be assigned to.

I understand that no compensation is paid to trainmen for time spent by them while engaged "on watch" (which means waiting at any designated point for an opportunity to work), but that wages are allowed only for service rendered while actually employed on said company's cars, and are computed at following rates:

—— cents per hour for first six months after being placed on extra list.

—— cents per hour for second six months after being placed on extra list.

—— cents per hour for second year after being placed on extra list.

—— cents per hour for third year after being placed on extra list.

—— cents per hour after three years' service with said company.

These wages are entirely satisfactory to me, and for which, if given employment, I agree to work contentedly and faithfully.

I further agree that if I am discharged, or leave said company's service voluntarily at any time during or after the trial period above referred to, I shall have no claim against said company for services rendered or expenses incurred by me during said trial period or while performing duty "on watch," as above explained.

When placed upon the extra list I agree to deposit with the company, without interest, the sum of $25 as a surety fund for the faithful performance of my duty.

I agree within thirty days after being placed on the extra list to provide myself, at my own expense, with a standard uniform, in accordance with the rules and regulations of the company.

So long as I remain in its service I agree to study carefully and comply faithfully with all rules, regulations and orders of the company.

In witness whereof I have hereunto set my hand and seal at Milwaukee, Wis., this —————— day of ——————, 18—.

Electrical Exposition in Chicago

The National Exposition of Electrical Arts Company has been organized in Chicago and incorporated, with a capital of $50,000, in the State of Illinois, for promoting an exposition to be held at Tattersalls, Sept. 25 to Oct. 9. Coming as it does at the time of the fall festivals in Chicago, the exposition gives promise of meeting with very great success. The autumn carnival, to be held in connection with the laying of the corner stone of the new post-office, will be in progress on the date set for the opening of the exposition, and, as there will be thousands of visitors in Chicago, the exposition will undoubtedly be one of the chief attractions. The officers of the exposition company are N. J. Heimbach, president; W. E. Burnham, treasurer, and T. Carrabine, secretary, names well known among Chicago business men.

It is the intention to make this a general electrical exhibition. Manufacturers of electrical apparatus from all over the country are already signifying their willingness to co-operate, and the exposition will be one of the most complete ever held in Chicago.

The American Street Railway Association will have its exhibition in the same building, beginning a few days after the first one closes. This increases the interest of the latter to street railway men and manufacturers of street railway apparatus. Those who intend making exhibits at the street railway convention can, with very little additional expense, arrange to present their exhibits at the National Exhibition of Electrical Arts. All applications for space should be sent to the Exposition Company in the new Life Building, Chicago. Tattersalls Building will be handsomely decorated and lighted.

Space will be leased to exhibitors at rates varying according to size and location. The Tattersalls building is 148 ft. x 265 ft. There are 149 exhibition spaces, ranging from 100 sq. ft. to 400 sq. ft. In case of very extensive exhibits two or more sections may be combined. The aisles are from 9 ft. to 12 ft. wide, and plenty of open space is left at the entrance of the building.

Among the concerns that have already signified a determination to take part in the show are the Chicago Edison Company, Chicago Telephone Company, Postal Telegraph Cable Company, the Allen-Hussey Company, Advance Specialty Company, and Eureka Telephone Company. It is probable that gold medals will be awarded for excellence of exhibits.

Recent Sales of Electrical Supplies

Elmer P. Morris, of New York City, reports that during the past month the demand for electric railway supplies has been unusually heavy, and orders have came in from all parts of the world. He has sent poles to Brazil, Cuba, Syracuse, N. Y.; Asbury Park, N. J.; Phœnixville, Pa.; Brooklyn, and Westchester County, New York, and other supplies to Africa, South America, Cuba, Trinidad, etc. The sales of wire have been particularly large.

Mr. Morris has recently appointed two new agents; one the Miller Electrical Maintenance Company, at Pittsburgh, and the other, Henry L. Prather, New England Building, Cleveland, Ohio.

Additions for Brooklyn

The Westinghouse Electric & Manufacturing Company is executing an important contract for increasing the electric plant of the Coney Island & Brooklyn Railroad Company. Last year one power station was equipped with two 500-h.p. Westinghouse compound engines, direct connected to two Westinghouse generators of 500 h.p. each, to deliver current at 550 volts for the railroad. A duplicate outfit of 1000 h.p. is now being provided for the Smith and Knight Streets power station. In addition there will be installed a 500-kw. Westinghouse generator, with a series wound booster, direct connected to a steam engine, to do railroad work. A two-paneled switchboard is included in the outfit.

Major-General Leonard Wood, Military Governor of the Province of Santiago, has received an offer of the presidency of the Washington (D. C.) Traction & Electric Company, but he has not yet signified his decision in the matter, and will sail for Cuba on July 3 or 4, to continue his work in Santiago, at least for the present. General Wood's great organizing and executive ability, his long residence in Washington, and his high reputation in every way would seem to make him an almost ideal man for this position, but it is doubtful if he can be induced to give up his army career.

Convention of the Ohio Street Railway Association

The annual convention of the Ohio Street Railway Association was held at Springfield, Ohio, June 14. There were twenty-four members and visitors in attendance. The morning was spent in visiting the power house of the local company and in taking an inspection trip over several of its lines. After dinner at the Arcade Hotel, the convention convened at the Lagonda Club.

There were no papers read, but a general and informal discussion was indulged in, the chief subjects being how best to further the interests of the association and the procuring of new members.

New members were added to the association as follows: Wheeling Railway Company, Wheeling, W. Va.; Mansfield Electric Railway Company, Mansfield, Ohio; Canton & Massillon Electric Railway Company, Canton, Ohio; Zanesville Electric Railway Company, Zanesville, Ohio.

Cincinnati was chosen as the next meeting place of the association, the meeting to be held on the second Wednesday of June, 1900. Officers for the ensuing year were chosen, as follows: S. L. Nelson, president, Springfield, Ohio; J. F. Flood, vice-president, Steubenville, Ohio; Charles Currie, secretary and treasurer, Lima Ohio; executive committee—A. A. Anderson, Youngstown, Ohio; W. A. Lynch, Canton, Ohio; T. H. McLean, Toledo, Ohio.

After supper the members and visitors repaired in a body to the Elks Street Fair, which was in progress in the city, and where a most enjoyable evening was spent. The members and visitors in attendance were as follows: B. Walker Peterson, vice-president, Wheeling Railway Company, Wheeling, W. Va.; Charles Currie, secretary and treasurer, Ohio Streeet Railway Association, Lima, Ohio; E. J. Wehrly, general manager, Arbuckle-Ryan Company, Toledo, Ohio; H. C. Fogle, general manager, Canton & Massillon Electric Railway Company, Canton, Ohio; A. L. Wilkinson, Ohio Brass Company, Mansfield, Ohio; Charles Hodge, Westinghouse Electric & Manufacturing Company, Columbus, Ohio; John Harris, superintendent, Cincinnati Street Railway Company, Cincinnati, Ohio; G. A. Schroeder, Multiplex Reflector Company, Cleveland, Ohio; F. H. Strieby, General Electric Company, Cincinnati, Ohio; C. S. Nolloth, Standard Electric Company, Cincinnati, Ohio; F. E. Ginn, superintendent, Lancaster Traction Company, Lancaster, Ohio; C. E. Harrison, Hildreth Varnish Company, Steubenville, Ohio; O. C. Evans, Lorain Steel Company, Cincinnati, Ohio; William H. Sinks, Varney & McOuat, Indianapolis, Ind.; C. S. McMahon, Street Railway Journal, Chicago, Ill.; H. J. Kenfield, Street Railway Review, Chicago, Ill.; Arthur E. Jones, National Lead Company, Cincinnati, Ohio; G. R. Scrugham, Creaghead Engineering Company, Cincinnati, Ohio; Lou. Williams, superintendent, Springfield Railway Company, Springfield, Ohio; H. A. Dorner, Dorner Truck & Manufacturing Company, Cleveland, Ohio; W. R. Morrison, assistant general manager, Bay City Electric Railway Company, Bay City, Mich.; Reid Carpenter, Mansfield, Ohio; C. H. King, Ohio Brass Company, Mansfield, Ohio; P. Leidenger, Dayton Manufacturing Company, Dayton, Ohio.

The entertainment provided by S. L. Nelson, of the local company, was most hospitable, and the Ohio Street Railway convention at Springfield will be long remembered by all present.

The Ohio Brass Company exhibited its emergency hose bridge, and a test of it was made on the local line, the exhibit being attended by all present in a body. A number of cars were run over the bridge, both rapidly and slowly, and with absolutely no inconvenience; in fact, it scarcely seemed an obstruction. This bridge is now in use in Chicago, Dayton, Cleveland, Toledo, Nashville and other cities. The company states that it is meeting with universal success.

Varney & McOuat, of Indianapolis, through William H. Sinks, exhibited armature coils, of which this company is now making a specialty. The company is doing a large repair business for railways throughout the Central States. The company's excellent work, together with its central location and excellent shipping facilities, is building up a large business.

The Multiplex Reflector Company, of Cleveland, Ohio; was represented by George A. Schroeder, who exhibited one of the company's new multiplex reflector lamps. These lamps are no more expensive than others in use, and throw a most powerful light, owing to the peculiar construction of the reflector.

Virginia Street Railway Association

The latest State street railway association to be organized is that of Virginia. The association of that State includes both electric railway and lighting interests, and held its first annual meeting at the Hotel Jefferson, Richmond, May 16. Representatives were present from electric railways in Stanton, Norfolk, Richmond and Lynchburgh. The papers read were on "Track Bonding," by R. D. Apperson; "How to Increase Revenue of Electric Light Stations;" "Park Amusements," and "The Use of the Wattmeter on Electric Cars to Check the Unnecessary Use of Current." Mr. Apperson, in his paper, stated that he used the plastic bond on his railway, and referred to it in the highest terms.

The Washington Consolidation

The bankers who are financing the Washington consolidation have just issued a prospectus of the Washington Traction & Electric Company, and offer $12,000,000 out of an authorized issue of $20,000,000 of first mortgage, collateral trust 4½ per cent, fifty-year gold bonds. This company controls eight street railway companies, with 116 miles of track, and the only two electric light companies in the city, with 72 miles of subway, about 400 miles of duct, and many miles of overhead wires. The Capital Traction Company is the only railway in the city not in the consolidation. Of the $20,000,000 bond issue, $6,558,000 is reserved to retire outstanding bonds of constituent companies, $1,442,000 is held for future uses of the company, and the remaining $12,000,000 is now issued as stated. An estimated statement of earnings for the year ending July 1, 1900, issued by Messrs. Stevens, Crosby and Lieb, is as follows:

Gross earnings of railway properties	$1,750,000
Gross earnings of lighting properties	550,000
Total	$2,300,000
Operating expenses	1,150,000
Net income	$1,150,000
Total fixed charges	887,480
Surplus over charges	$262,520

H. H. Vreeland and F. S. Pearson, in their report to the United States Mortgage & Trust Company, estimate that the gross revenue of these properties will be $1,850,000 per annum, and that the operating expenses should not exceed 50 per cent at first, and 40 per cent eventually, of the gross receipts. They estimate also that within three years the electric lighting properties should earn at least $1,000,000, and the percentage cost of operation should not exceed that of the railways. Within three years' time the combined revenue from the entire consolidated properties should not, they say, be less than $3,000,000.

The different lines comprising the Washington Traction & Electric Company's system are being put in first-class shape, and a number of extensions are under way. The contractors for the work are J. G. White & Co., of New York, who are now building about 35 miles of new track and 45 miles of overhead work; the track work, including the laying of both girders and T rails, and comprising the reconstruction of the present track and overhead work of the Georgetown & Tennalytown Railroad and the extension of this line to Rockville; the reconstruction of the Brightwood Railway, including branches to the Soldiers' Home and Tacoma Park; the reconstruction of the Washington, Woodside & Forest Glen Railroad, including relining, surfacing and ballasting the present tracks and rebuilding overhead work; rebuilding the overhead line of the Glen Echo Railway, and rebuilding the overhead line of the Great Falls Road. The construction is all first-class in every way, a greater part of the T rail being rock ballasted. The overhead construction will all be double trolley, positive and negative. The size of the trolley wire will be 00.

The New York & Long Island Tunnel

The Long Island & New York Terminal Railroad Company was incorporated June 17, with a capital stock of $7,500,000, for the purpose of constructing a tunnel from the present terminus of the Long Island Railroad on Atlantic Avenue, Brooklyn, to the Manhattan Island terminus at the corner of Cortlandt and Church streets. The directors of the company represent many important financial interests, and are trustees of enormous capital, so that there is no doubt that the work will be entered upon immediately and pushed through as rapidly as possible. President Baldwin, of the Long Island Railroad, states that a force of men has been at work for more than a year making test borings in the streets of Manhattan Island and under the East River, and they are now perfectly familiar with the route to be followed, the materials to be encountered and the nature of the work to be done. The Legislature having at its last session granted necessary permission for the work to proceed, the next step will be to obtain franchises from the municipal assembly. There will be two tunnels, or parallel tubes, placed at a depth of 80 to 132 ft., and the lowest point below the surface will be reached at the Brooklyn City Hall.

LEGAL NOTES AND COMMENTS

EDITED BY J. ASPINWALL HODGE JR., OF THE NEW YORK BAR

The Right of a Street Railway to Carry Freight

In a brief, recently filed by eminent counsel, in an action where the right of a street railway to carry freight or express, it is stated that "from 1834, when John Stephenson invented the first street railway car, to within a period of one year no street railway company ever claimed or asserted the right to operate cars exclusively for the transportation of property." This, we believe, is a much broader statement than the facts justify. It would be interesting to learn of the earliest date when such a car was operated by a street railway in this country; but the vital question is not whether, or when, the right was claimed, but whether it *exists* under present statutes of the various States.

The question is being litigated in the action referred to *(DeGrauw vs. Long Island Electric Railway Co. et al.)*, and is pending before the appellate division of the Second Department of the Supreme Court of New York.

The plaintiff asked for an injunction restraining the defendant from operating a car devoted, exclusively, under a contract with the National Express Company, to the carriage of express packages between two depots of the express company in the Borough of Brooklyn. A demurrer of complaint was sustained in the court below, on the ground that the New York act granting to street railways the right to carry "passengers and property" included the right to run such a car, and the plaintiff has appealed from that decision.

The plaintiff's appellant contention is briefly: that no such right can be implied. If it exists it must be founded upon some express provision of law; that construing the words "passengers and property" in connection with the subject matter of a street railway act, applying the maxim "*noscuntur a sociis*," the words mean "passengers and passengers with property," and do not mean "passengers and freight;" that the legitimate uses of a street do not include the transfer of freight and express, and certainly do not include the transfer of the same from fixed places under contract with a particular individual or corporation, the public generally not benefiting, directly, thereby. In support of these propositions many *dicta* from decisions were cited, wherein it was stated that "street railways transport passengers only," while "commercial railroads carry both passengers and freight;" the first, stop at short intervals, on the highway to take passengers, off and on, and the latter receive and discharge both passengers and freight at regular depots, further apart. *East End St. R. R. Co. vs. Doyle, 9 L. R. A. (Tenn.), 100; Louisville, etc., R. R. vs. City R. R., 2 Duval (Ky.), 178; Funk vs. St. Paul R. R., 29 L. R. A. (Minn.), 208; Nichols vs. Ann Arbor R. R., 16 L. R. A. (Mich.), 374.)*

Among the text-book writers Messrs. Booth, Elliott and Rorer were cited.

On the behalf of the defendant-respondent it was urged with much force that the words "passengers and property" were precisely the same words which are used in the general railroad act of New York, and in fact to-day are used in a section of the railroad law which, by express provision, applies both to steam and street railways. And further, that prior to the Constitution of 1875, special acts were passed by the Legislature, granting to particular street railways various powers, and in some cases expressly prohibiting the carrying of freight; in other cases the special acts gave them the right to carry passengers without any reference to property at all. It was contended in the light of these statutes that the words "passengers and property" used in the general act must mean passengers and freight.

The weight of authority would seem to support the defendant's contention where these words are in the statute.

In considering the decisions in any particular State it is, of course, quite necessary to examine, carefully, the charter or the general act under which the street railway is formed, to determine what authority is given to it. In that connection it should be remembered, that the franchise to construct and operate a street railway is one that must be conferred by the State, and that its power is sovereign over the streets.

A serious problem is presented in New York, if the contention of the Long Island Electric Railway Company is sustained, since, under the decision of the case of the Broadway surface road *(People vs. O'Brien, 111 N. Y., 1)*, it would appear that this right, if now held by the street railroads of New York, can be exercised even against the will of the Legislature, on the ground that to deprive them of the right they now hold, would be taking away a property right, protected by the Constitution of the United States.

In such city streets as are now crowded with passenger cars the running of numerous freight or express cars might work to the public inconvenience, rather than to the public convenience. While, in the great majority of cases, it is obvious that the carrying of freight and express upon rails would work a great public benefit, whether within city limits or between towns and cities.

The problem is one of the present and future, and the courts may be trusted to develop the law in accordance with the needs of the public and the improvements of the age, according to the now well-established doctrine which is ably expressed in the Diamond Match Company case *(Diamond Match Company vs. Roeber, 106 N. Y., 473, 481)*.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

IOWA.—Duty to Refloor Bridge—Ordinance.

Under an ordinance authorizing a corporation to operate a street railway over certain streets, avenues and bridges, and requiring it to keep in repair that portion of such paved streets and highways which is included between its tracks and one foot on either side, and to pave such portion of any street or avenue when ordered by the council, the company is not bound to refloor with oak plank any portion of a bridge over which its tracks pass.—(City of Cedar Rapids vs. Cedar Rapids & M. C. Ry. Co., 79 N. W. Rep., 125.)

MASSACHUSETTS.—Parol Evidence—Illegal Sale.

1. Parol evidence to contradict the terms of a note is inadmissible.

2. Plaintiff was constructing a street railroad for the I. Company, but, before completion, was notified that it would not be accepted. Some three miles of the road had been finished, except the overhead work. Thereupon plaintiff acquiesced in such refusal, and sold "all the material and other property now being on the line of the street railway" to the A. Company, and agreed to take their notes in payment therefor. The purchasing company, by resolution of its directors, voted to buy "all the material and other property owned" by the plaintiff. At the same time plaintiff agreed to credit all sums received from the A. Company in payment of its claim against the I. Company. A short time thereafter the A. Company was operating the line. Held, that as soon as the rails were annexed to the soil by the plaintiff they became the property of the I. Company, within the meaning of Pub. St., chap. 113, sec. 56, forbidding a street railway company to sell or lease its road; that the refusal to accept them did not change this fact; and that, if the whole transaction was a scheme whereby the I. Company attempted to sell the road being constructed by plaintiff to the A. Company, it was illegal, and the notes given in consideration thereof were void.

3. For the purpose of showing the real nature of the transaction, oral evidence of what was said and done at the meetings of the directors of the companies at the time the matter was under

* Communications relating to this department may be addressed to the Editor, Johnston Building, 30 Broad Street, New York.

consideration by them is admissible.—(Clemons Elec. Mfg. Co. vs. Walton, 53 N. E. Rep., 820.)

MISSOURI.—Operating Over Other Lines—Injunction—Damages—Jurisdiction—Appeal—Reversible Error.

1. Where, pursuant to St. Louis city charter, art. 10, sec. 6, providing that any street railway company may run its cars over any other company's lines, on payment of compensation, under such regulations as may be prescribed by ordinance, ordinances were passed authorizing one company to operate its cars over the lines of another, and providing the manner of adjusting compensation, and such compensation had been fixed and accepted by the latter company, it is not entitled to an injunction to restrain the former from operating cars which interfered with the running of its cars, and from using certain modes of connection, where the connections were made according to the latter's plans, and the inconveniences suffered were the natural result of the legitimate use of the connections.

2. The court had jurisdiction of the subject-matter of the action, since, under the petition, complainant might introduce evidence showing that defendant had connected its tracks in a manner not authorized, and was running cars not contemplated by the award, to plaintiff's continuous damage.

3. Error in rendering judgment in plaintiff's favor, of which he cannot complain, is not reversible, where he alone appeals.—(People's Ry. Co. vs. Grand Ave. Ry. Co., 50 S. W. Rep., 829.)

NEW YORK.—Receivers—Claims.

A debt incurred for supplies furnished an elevated railway company prior to the appointment of a temporary receiver, in an action to foreclose a mortgage on its property, under Code Civ. Proc., sec. 1788, is not a preferred claim, and the receiver will not be ordered to pay it.—(Mercantile Trust Co. vs. Kings County El. Ry Co. et al.—in re Lovell et al.—57 N. Y. Suppl., 892.)

NEW YORK.—Change of Motive Power—Inference.

1. A horse railroad consists of two tracks laid on opposite sides of the two tracks of an underground trolley system occupying the middle of a street 50 ft. wide between the curbs, and there is 32 ft. between the outside rails of each track of the horse railroad. A change of its motive power to the underground trolley system contemplates that the cars will project over the rails so that there will be less than 12 ft. of clear space between them and the curb, but the rails are to be laid flush with the surface and the cars are to be run intermittently. Held, that it could not necessarily be inferred that the change would permanently obstruct it, and result in an exclusive appropriation of a portion of it to other than customary street uses, and that it would depend on the speed and frequency with which cars were run.

Same—Right to Change at Will.

2. Laws 1873, chap. 825, granting the right to construct, operate and maintain a street railroad by steam, animal or mechanical power over certain streets and avenues in New York city, including what is now Amsterdam Avenue, does not empower owners of the franchise to change at will the motive power of a constructed road, irrespective of the consent of the railroad commissioners or property owners.

Same—Consent of Propertyowners.

3. Laws 1890, chap. 565, sec. 100, providing that a street surface railroad may change its motive power on the consent of "the owners of one-half of the property bounded on that portion of the railroad with respect to which a change of motive power is proposed," contemplates that a majority of those owning property, measured by its extent in lineal feet along the route as to which a change of power is proposed, shall consent.—(St. Michael's Protestant Episcopal Church in City of New York vs. Forty-Second St., M. & St. N. Ave. Ry. Co; Society for Relief of Destitute Blind of City of New York and Its Vicinity vs. Same, 57 N. Y. Suppl., 881.)

NEW YORK.—Payment of Judgment—Right to Recover Back—Mistake.

After the denial by the Appellate Division of an application for leave to appeal to the Court of Appeals from an affirmance of a judgment, and during the pendency of an application to the Court of Appeals for leave to so appeal, made without the procurement of a stay of execution, the judgment debtor, erroneously believing that his application to the Court of Appeals had been rejected, paid the judgment on the creditor's threat to issue execution. Held, that, on being granted leave to appeal, the judgment debtor could not recover back the amount paid under a mistake, since the payment, made while the right to issue execution on the judgment existed, was voluntary.—(Third Ave. R. Co. vs. Klinker et al., 58 N. Y. Suppl., 136.)

OHIO.—Ejectment—When It Lies—Recovery of Possession of Streets by City.

1. Ejectment will lie by a city to recover possession of streets in which the public has an easement.

Courts—Following Prior Decisions.

2. Defendants, claiming as licensees of a city in a suit by adverse claimants, set up and successfully maintained the right of the city to certain land under a dedication for street purposes. Held, that in a subsequent action by the city against the defendants, the evidence being practically the same, the former decision as to the validity of the dedication as claimed by the city would be followed, on the principle of stare decisis, though the city was not a party to the adjudication.

Municipal Corporations—Abandonment of Street—Intention.

3. Where a city had granted, or attempted and assumed to grant, the right to defendants to use ground it claimed as a street, its acquiescence in such use for any length of time will not operate as an abandonment of its claim to the property.

Estoppel—Acts in Pais—Construction of Party's Conduct.

4. The conduct of a party, sought to be made the basis of an estoppel against him, must be viewed in the light of the understanding he then had of his rights, and not in the light of such rights as they may be thereafter determined.

Same—Acts of City.

5. In 1849 the city of Cleveland entered into a contract with certain railroads, by which it granted them the right to use a portion of a tract of land claimed as a street. Not long afterwards, in a suit against the railroads by an adverse claimant, the defendants alleged their interest in the land to be that of licensees of the city, and successfully defended on the city's title under a prior dedication. Held, that the city, by permitting the railroads to remain in undisturbed, or even exclusive, possession of the ground for forty-five years, and to expend large sums in the construction of improvements thereon without objection, was not estopped, as against them, to claim any rights in the property consistent with the contract, according to the construction and meaning given it by the defendants in their pleading in the former suit, where they had never given notice of any other or different claim.

Limitation of Actions—Ejectment—Nature of Defendants' Possession.

6. Nor can the defendants in such case successfully plead limitation against an action by the city, whatever may be the true construction of the contract under which they took possession, or the nature of their rights otherwise acquired, as by their own admission, in a sworn pleading, their holding was not adverse to the city, and it had the right to rely on such admission until notified that they claimed under a different tenure.

Same—Admissions in Pleadings.

7. A formal allegation in a petition in ejectment that, on the date it is filed, defendants unlawfully keep the plaintiff out of possession of the property, is not an admission that defendants' possession is adverse which will support a plea of limitation, on proof that they have held in the same right for more than the statutory length of time.

Rights to Public Grounds—Construction of Contract with City.

8. Under the constitution of Ohio of 1802, the only restriction upon the exercise of the power of eminent domain by the Legislature was the provision that money compensation should be made for private property when taken for public use, and by the railroad act of 1848 (46 Ohio Laws, p. 40) railroad companies were given power to construct and maintain railroads between the points named in their respective charters, and to appropriate streets or other public grounds to their use when necessary, either by agreement with the public authorities, or, such agreement failing, by a decree of a court. Held, that a contract made in 1849, while such act was in force, between a city and a railroad company, by which the city granted, "as fully and absolutely" as it had the power or legal authority to do, the right to the "full and perpetual use and occupation" of a portion of a street required by the railroad company for terminal purposes, did not reserve to the city any rights in, or control over, the property described, but that the railroad company took from the State under the statute, and not from the city, an easement of a perpetual and exclusive use.—(City of Cleveland vs. Cleveland, C., C. & St. L. Ry. Co. et al., 93 Fed Rep., 113.)

PENNSYLVANIA.—Contracts for Use of Tracks—Construction—Estoppel—Parties.

1. The S. Co. has no such substantial interest in the subject of the right of the T. Co. to use the tracks of the S. Co. under an agreement between the P. Co. and the A. Co. as will authorize the entertaining of its bill to enjoin the use thereof, where all the stock of the S. Co., except five shares, which are unrepresented, and the owners of which have made no objection, is owned by the P. Co., which has for years had possession of and run the road of the S. Co.

2. The P. Co. is estopped from contesting the validity of an agreement for use of its tracks by the A. Co. on the ground that it was not authorized by the directors, or reported to and approved by a meeting of the stockholders, where the officers of the P. Co. were the movers for the agreement, and it was sanctioned by its

attorneys, and approved, before it was made, by a majority of its stockholders, and was reported by its president to the next annual stockholders' meeting, when no objection was made to it, and it has been carried into effect fully and completely; the tracks being repaired, payments made, and the road operated thereunder for several years.

3. The T. Co., which owns all the stock of the A. Co., and has a lease for 999 years of all its franchises, property and rights of every kind, is an "assign" of it, within a contract giving certain rights to it and its assigns.

4. A contract which gives the A. Co. and its assigns the right to run its cars over the tracks of the P. Co. for a certain consideration, though not requiring a greater consideration in case of an increase in the number of cars, does not allow an assign of it, which owns other lines, to run its cars, and in addition those of the other lines owned by the assign, over such tracks for such consideration.—(South Side Pass. Ry. Co. vs. Second Ave. Pass. Ry. Co. et al.; Pittsburg & B. Traction Co. vs. South Side Pass. Ry. Co. et al., 43 Atl. Rep., 346.)

WASHINGTON.—Taxation—Validity of Assessment—Ownership of Property.

1. The power house and other buildings of an electric street railroad company were situated on a tract of land, a part of which was owned by the company and a part held under a lease for twenty-five years, which bound the company to pay the taxes thereon. Held, that the company might properly be regarded as the owner of the entire property for the purposes of taxation, and its assessment as an entirety was valid.

Same—Improvements on Real Estate.

2. Where a street railroad company may properly be regarded as the owner, for the purposes of taxation, of leased land upon which its power house and plant are in part situated, such buildings are taxable, under the statutes of the State of Washington, as a part of the real estate.

Same—Railroad Right of Way—Actual Use for Other Purposes.

3. Under the statute of Washington (1 Hill's Ann. Code, sec. 1046), providing that all lands occupied and claimed exclusively as right of way for railroads must be assessed as a whole, and as real estate, at a certain sum per mile, a part of the designated right of way of a railroad, but which is in the actual use and occupation of a street railroad company for purposes of its power plant, under a lease for twenty-five years, cannot properly be taxed as a part of the right of way of the railroad company.—(N. Y. Guaranty & Indemnity Co. et al. vs. Tacoma Ry. & Motor Co. et al., 93 Fed. Rep., 51.)

LIABILITY FOR NEGLIGENCE.

ALABAMA.—Collision with Buggy—Willful Injury.

Where a horse and top buggy, inclosed by curtains, moving in the same direction as, and about 100 ft. ahead of, a street car, running five or six miles an hour, turned to cross the tracks, and the motorman, though he saw the buggy turn, failed to slacken speed or give warning, and the car struck the buggy, his conduct amounted to a willful injury.—(Birmingham Ry. & Elec. Co. vs. Smith, 25 So. Rep., 768.)

CALIFORNIA.—Negligence—Sprinkling Carts—Trial—Questions for Jury—Compromise and Settlement—Evidence—Ratification.

1. Plaintiff was rightfully driving a street sprinkler on a street car track. According to his custom, on turning into the street on which the tracks were, he followed rapidly behind a passing car, sprinkling the street as he went, and turned around several times to see that no accident might happen. A car coming behind plaintiff sounded the only warning bell 700 ft. away, and then came on with accelerated speed; not attempting to slack the car until within two or three car lengths of the cart, and even then not using the most effective appliance for stopping the car. The cart and its load weighed five tons, and made considerable noise when sprinkling. Held, that the street car company was negligent, so as to be liable for the injuries to plaintiff.

2. A person severely injured by an accident compromised the claim next day, and made his mark as a signature to the receipt. He testified that his mind was a blank as to the occurrences from the time of the injury until several days after the alleged settlement, when he was taken to a sanitarium. Two witnesses testified that he spoke of the settlement after coming to the sanitarium, and there was nothing to show that at that time any one had informed him of the settlement. Held, that the question whether he had knowingly settled the claim was for the jury.

3. Evidence of a person who had been injured, that he knew nothing of what occurred the next day, when he made an alleged settlement of his claim, is equivalent to a statement that he was "entirely without understanding" at such time.

4. The retention of money paid in settlement of a claim for personal injuries is not a ratification of the settlement, where retained without knowledge of how it was obtained.

5. Where the jury was instructed that they might deduct from the amount of damages for personal injuries any money given to plaintiff by defendant by way of an alleged settlement, defendant cannot complain that it was injured by such payment.—(Los Angeles City Water Co. et al. vs. Superior Court of Los Angeles County; City of Los Angeles vs. Los Angeles City Water Co. et al., 57 Pac. Rep., 216.)

CALIFORNIA.—Injuries to Passengers—Evidence—Pleading—Damages.

1. Where a passenger was thrown from a street car while rounding a curve and injured, his testimony that the car was going at an unusually rapid rate of speed is sufficient to sustain a verdict, where other passengers were thrown at the same time.

2. Under an allegation that the accident was caused by the high rate of speed he may prove that the fall was occasioned by a sudden jerk, accompanied by the high rate of speed.

3. Evidence that uterine trouble was caused by an accident due to defendant's negligence is admissible under a general averment of bodily injury and resulting damage.—(Samuels et ux. vs. California St. Cable Ry. Co., 56 Pac. Rep., 1115.)

GEORGIA.—New Trial—Instructions—Arguments of Counsel—Injury to Passenger—Evidence—Appeal—Review—Pleading—Amendment.

1. That the contentions of one party were not as specifically set forth in the charge of the court as were those of the other was not cause for a new trial, when the charge as a whole fully, fairly and correctly covered the law applicable to every issue in the case.

2. There was no error in refusing to give a request in charge which implied that counsel for the adverse party had made an improper appeal to the jury, when, as shown by the certificate of the trial judge, no such appeal was made.

3. Refusal to give requests in charge is not error, when, so far as legal, they are fully covered by the general charge.

4. Where counsel for the defendant objected to certain language used by plaintiff's counsel in his argument to the jury, upon the ground that it was an appeal "to make a verdict based on matters not in the plaintiff's declaration and suit," and thereupon the presiding judge stated to the jury that "the position of the defendant's counsel was the law, and the jury should take it as such," and gave further appropriate instructions upon the subject, after verdict a new trial should not be granted the defendant upon the ground that "the court should have given direct and unqualified disapproval of such appeal to the jury, and that the response of the court to the point made by defendant's counsel on that line of argument was not adequate in view of the nature of the appeal made." The defendant's counsel should have requested such instructions as, in his opinion, would have been sufficient to remove any improper impressions made upon the minds of the jurors by the unauthorized appeal of plaintiff's counsel, or moved that the case be withdrawn from the jury and a mistrial declared.

5. The cries or exclamations of bystanders upon seeing an accident about to occur may be proven to explain the state of mind and conduct of a person hearing them, and who is injured in the accident.

6. This court cannot undertake to determine whether or not error was committed by the trial judge in refusing to permit counsel to ask a witness and have him answer a given question, when it does not appear what the answer thereto would have been had it been allowed. (a) A witness who is not an expert as to the subject upon which he is questioned is incompetent to give an opinion thereon, without stating the facts on which his opinion is based.

7. Though in defense to the plaintiff's contention that the person for whose benefit the suit was proceeding was injured by reason of the negligent running of the defendant's cars, the latter introduced evidence tending to show that the injury could have been caused or aggravated by excessive sexual intercourse, there was, under all the facts and circumstances, no error in rejecting other evidence offered to show that a given person had caressed, hugged and kissed such injured party.

8. Where the defendant offered to prove by a witness that he had taken liberties with the woman for whose benefit the suit was proceeding, and had become intimate or familiar with her, and by another witness the circumstances under which he had seen her and a certain man in the woods, and the intimacy existing between them, this court cannot determine whether or not error was committed in the rejection of such evidence by the trial judge, when it does not appear what the acts or circumstances constituting such familiarities or intimacies were.

9. There was no error in rejecting evidence offered to show the state of feeling existing between certain witnesses.

10. There is no merit in a ground of a motion for a new trial which complains that the court erred in allowing a given amendment to the declaration "after the trial had commenced, and when there was no opportunity for medical examination of the plaintiff" as to the additional injury alleged in the amendment; especially where it does not appear that the defendant objected to the amendment for any reason.

11. The evidence for the plaintiff was amply sufficient to authorize the verdict, and in the light of such evidence the verdict was not excessive.—(Atlanta Consol. St. Ry. Co. vs. Bagwell; Bagwell vs. Atlanta Consol. St. Ry. Co., 33 S. E. Rep., 191.)

INDIANA.—Injuries to Person on Track—Proximate Cause—Contributory Negligence—Vehicles—Right of Way.

1. Where the driver of a sprinkling cart saw a street car approaching, but erroneously thought he could cross the track before it reached him, there being no sudden or unexpected peril, his act was the proximate cause of his injury.

2. There can be no recovery for injuries where plaintiff's negligence proximately contributed thereto, unless defendant's negligence was willful.

3. The right of a vehicle to cross a street car track is subject to the superior right of way of the street car company.—(De Lon vs. Kokomo City St. Ry. Co., 53 N. E. Rep., 847.)

KENTUCKY.—Starting of Streeet Car Before Passenger Has Alighted—Evidence.

1. Though a street car has been stopped without a signal, yet where the driver sees a passenger about to leave the car, when he ought to know that such is her purpose, it is negligence on his part to start the car before she has had time to alight.

2. Evidence that it is customary for passengers to leave the car while in motion is not admissible to excuse the act of the driver in starting a car before a passenger has alighted.—(Louisville Ry. Co. vs. Rammacker, 51 S. W. Rep., 175.)

MASSACHUSETTS.—Master and Servant—Injury to Servant—Assumption of Risk.

Plaintiff was ordered by defendant to get on a pile of lumber and throw off a piece of timber, and was injured by the collapse of the pile, which had been defectively built. He had been working near the pile for two days, but there was no evidence that he knew it was defective, or that its defect was apparent. Held, that he did not assume the risk.—(Millard vs. West End St. Ry. Co., 53 N. E. Rep., 900.)

MICHIGAN.—Disorder on Street Car—Failure to Let Passenger Off—Conflicting Evidence.

In an action for injuries through failure to let a woman off a street car after disorderly persons began fighting thereon, evidence of plaintiff that the conductor stood in the front door, and that "he did not say anything to me when I screamed and wanted to be let off—never moved"—and paid no attention to her, and of a witness who saw the car pass, that she saw the conductor standing where plaintiff said he stood while the struggle was in progress (in the middle of the car), contradicts defendant's evidence that the conductor was engaged in attempting to disarm one of the disorderly persons when he responded to her request by calling to the motorman to stop the car, and that he failed on account of an obstruction forcibly placed in his way, so as to take plaintiff's case to the jury.—(Cross vs. Detroit Citzens' St. Ry. Co., 79 N. W. Rep., 11.)

NEW YORK.—Crossing Tracks—Degree of Care—Contributory Negligence.

1. One crossing a street car track at a place other than a crossing is bound to use reasonable care not to obstruct the passage of the car unnecessarily, but he has a right to rely on a delay of the car in its progress to enable him to cross, if it becomes necessary, and contributory negligence cannot be predicated on a mere mistake of judgment on his part.

Same—Jury.

2. Where one driving a heavy wagon at a slow walk attempted to cross a street car track at a place other than a crossing, and got on the track as a car was approaching some 50 ft. away, the question as to whether he used reasonable care not to obstruct the car, and whether the car driver could have avoided a collision by exercise of the same care, was properly submitted to the jury.

Instructions—Error.

3. Refusal of a requested charge covered by the court's charge is not error.

Same.

4. A charge assuming a statement of facts not supported by the evidence is properly refused.—(Lawson vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 997.)

NEW YORK.—Evidence—Negligence—Jury.

Plaintiff and one witness testified that plaintiff was thrown to the ground by a street car starting with a jerk after it had stopped to let her off. The conductor and gripman testified that she stepped down facing the opposite way before the car stopped, and that they called to her to wait till the car stopped. Two other witnesses testified that she fell or stepped off before it came to a full stop, and a third that she stepped off just as the car was coming to a standstill. Held, that the question of the company's negligence was for the jury.—(Bennett vs. Third Ave. R. Co., 57 N. Y. Suppl., 994.)

NEW YORK.—Injuries to Pedestrian Under Elevated Road—Evidence.

1. Evidence that an injury was caused by the falling of coals and cinders from a locomotive of an elevated railway company makes a prima facie case of negligence against the company.

Same.

2. Evidence that as a train was passing on an elevated railway, burning coals and cinders were seen to fall, and at the same time plaintiff, who was walking underneath, was struck on the forehead and rendered unconscious, and that the wound showed evidence of burns and contained foreign substances resembling coal, is sufficient to go to the jury on the question whether the injury was caused by coals falling from the engine.—(Kister vs. Manhattan Ry. Co., 58 N. Y. Suppl., 132.)

NEW YORK.—Injuries in Alighting from a Car—Witness—Impeachment—Verdict.

Plaintiff, suing for injuries caused by alighting from a street car, alone testified to the accident. In response to a motion for a bill of particulars, he denied knowing the number of the car, yet on the trial gave it to his lawyer. He testified that two men who picked him up gave him their addresses, yet one had known him before, and testified he did not see the accident, and the other was not produced. Plaintiff testified he was fourteen months in bed as a result of the injury, and had done no work. His physicians testified he was in bed two or three months, and during that time would go out, and visited them at their offices. It was proved plaintiff worked as a night watchman at $7 a week for eleven months between the accident and the trial. He testified he spent $125 for medicines, but could not give the name of a single shop where he spent any part of the money. Held, that the witness was thoroughly impeached, and a verdict based on his testimony alone should be set aside.—(Streicher vs. Third Ave. R. Co., 57 N. Y. Suppl., 716.)

NEW YORK.—Collisions with Vehicles—Contributory Negligence.

1. It is not negligence, as a matter of law, for one driving a wagon at night in the track of a surface railroad to fail to look back to see an approaching car.

Same—Evidence—Province of Jury.

2. In an action for injuries caused by an electric car running into a wagon at night, plaintiff, whose mental ability was somewhat impaired by the injuries, testified that he was driving at a slow walk, that when he heard the bell of the approaching car it was within 25 ft. of him, and that he looked back and turned out of the track, but was struck before he cleared it. A witness testified that the bell was rung when the car was three blocks away, that plaintiff then commenced to turn out of the track, and that the car was coming at a terrible rate of speed. Plaintiff had once before turned out for an approaching car. Held, that the question of plaintiff's negligence was for the jury.—(Bossert vs. Nassau Elec. R. Co., 57 N. Y. Suppl., 896.)

NEW YORK.—Injury to Child in Street.

Refusal to instruct that, if defendant's car was running at a moderate and proper rate of speed, and at the time deceased child left the curb to cross the tracks the car was so close to where deceased was struck that it was impossible for the car, under any circumstances, to be stopped before running over deceased, verdict must be for defendant, is error; the court not having elsewhere instructed as to what would be the duty of the jury, or the rights of the parties, on such a state of facts.—(Weitzman vs. Nassau Elec. R. Co., 57 N. Y. Suppl., 1120.)

NEW YORK.—Collision—Negligence.

Plaintiff stopped his delivery wagon in a street, supposing that he was clear of a street railway track. When within 100 ft. of his destination, he looked behind for an approaching car, but did not discover any. It was dark, but he could see the headlight of a car about 300 ft. Where he stopped the curb was about 6 ft. from the rail. The wagon was about 4 ft. wide, and there was some overhang to the car. Plaintiff, on stopping, stooped to get his packages, when he was struck. Held, that whether he was negligent in failing to look back for a car just at the time he stopped, and to make the necessary observation to see that he was clear of the track, were questions for the jury.—(Black vs. Staten Island Elec. R. Co., 57 N. Y. Suppl., 1112.)

NEW YORK.—Injuries at Crossing—Contributory Negligence.

1. Plaintiff was driving a wagon at an ordinary walk across car, and he was injured. He testified that he looked in both di-

rections before attempting to cross. Held, that a finding that he was free from contributory negligence was justified.

Damages for Personal Injuries—Question for Jury.

2. In an action for personal injuries, where the doctors who examined plaintiff immediately after the accident, and again after his leg had been in a cast for two weeks, refuse to testify that the leg was fractured, merely stating that it might have been, and that there were symptoms so indicating, it should not be left to the jury to determine whether there was a fracture.

Appeal—Reversible Error—Damages.

3. Where the question whether plaintiff in an action for personal injuries suffered a fracture of the leg was submitted to the jury, with no evidence that he did, it is reversible error.—(Weidinger vs. Third Ave. R. Co., 57 N. Y. Suppl., 851.)

PENNSYLVANIA.—Contributory Negligence.

In an action against a street railway company for injuries to plaintiff, one of a gang of workmen repairing a street, the question of plaintiff's contributory negligence is for the jury.—(O'Malley vs. Scranton Traction Co., 43 Atl. Rep., 313.)

NEW YORK.—Injuries on Tracks—Verdict—Weight of Evidence.

Where a number of disinterested witnesses testify for a street railway company that injuries to one driving on the track did not result from the collision of a car with the driver's wagon, but from a subsequent fight between the motorman and driver, precipitated by the latter, a verdict for the latter is against the weight of the evidence.—(Lynch vs. Nassau Elec. R. Co., 58 N. Y. Suppl., 23.)

NEW YORK.—Evidence—Public Records.

In an action against a street railway company for injuries to a horse and wagon through a collision with a car, entries on a blotter of the police department, purporting to be the report of a police officer, respecting the conduct of the motorman at the time of the accident, are not admissible, as such a blotter is not a public record.—(Kerr vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 794.)

NEW YORK.—Crossing Accidents—Negligence.

A pedestrian cannot recover for an injury from a street car at a crossing, where there was no evidence that she looked for an approaching car, or as to how far distant the car was when she attempted to cross, or that the accident was due to negligence of the company.—(Balla vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 746.)

NEW YORK.—Appeal—Review—Excessive Damages.

A verdict for personal injuries will not be set aside as excessive where the amount is not so large as to show that the jury were actuated by prejudice or corruption.—(Timpone vs. Dry Dock, E. B. & B. R. Co., 57 N. Y. Suppl., 827.)

PENNSYLVANIA.—Trolley Cars—Passengers—Standing on Platform—Negligence.

It is negligence per se for a passenger to remain on the platform of a moving trolley car where there are vacant seats inside the car, though the injury to the passenger was caused by a collision, and he might have been injured had he been inside the car.—(Thane vs. Scranton Traction Co., 43 Atl. Rep., 136.)

OHIO.—Repair of Street Railway—Injury to Traveler—Although one driving a team of horses upon a public street has knowledge that a street railway company has negligently removed the pavement from its tracks and conducting wires, he is not to be charged with negligence if he drives upon the exposed track and wire, not voluntarily, but because his horses are partially beyond his control.—(Farmer vs. Findlay St. Ry. Co., 53 N. E. Rep., 447.)

PENNSYLVANIA.—Actions for Personal Injuries—Limitations—Statutes—Repeal by Implication—Subject—Sufficiency of Title—Vested Rights.

1. The failure of a statute to expressly repeal a former statute on the same subject does not necessarily leave the former statute in full force; it being a question of legislative intent.

2. Act June 24, 1895 (P. L. 236), sec. 1, provides that any right of action which may hereafter come into being by reason of an injury wrongfully done to the person of another shall survive the death of the wrongdoer. Section 2 provides that "every suit hereafter brought to recover damages" for injuries not resulting in death must be brought within two years from the injury. Held, that section 2 is not limited to actions where the wrongdoer dies before suit is brought.

3. Section 1 of the act creates no new right of action, but merely provides for the regulation of a class of rights which existed before.

4. The act embraces but one subject, i. e., actions for injuries wrongfully done to the person.

5. Act June 24, 1895 (P. L.236), entitled "An act providing that the right of action for injury wrongfully done to the person shall survive against the personal representative of the wrongdoer and street car tracks, when the rear end of the wagon was struck by a limiting the time within which suit for such injury must be brought," clearly expresses in its title the second section of the act, which provides that "every suit hereafter brought to recover damages for personal injuries" not resulting in death must be brought within two years from the injury.

6. Act June 24, 1895 (P. L. 236), limiting the time in which to sue for personal injuries, does not interfere with vested rights, in so far as it applies to pending rights of action.—(Rodenbaugh vs. Philadelphia Traction Co., 42 Atl. Rep., 953.)

PENNSYLVANIA.—Relation of Passenger—One who, having received a transfer from one line of a street railway company to its other line, is proceeding from the sidewalk to the car on the latter line, which is standing at the end of the route, when she is struck by a piece of the trolley, which breaks while being changed, as usual at such point, from one end of the car to the other, is entitled to recover as a passenger for her injury, in the absence of a showing that the company has used the highest degree of care.—(Keator vs. Scranton Traction Co., 43 Atl. Rep., 86.)

PENNSYLVANIA.—Injury to Employee—Negligence of Fellow Servant.

1. Where a motorman leaves his car standing on a switch, without setting the brake, and the car, because of such neglect, being on a down grade, moves onto the main track, and collides with a car thereon, injuring the conductor thereof, the injury was caused by the negligence of a fellow servant.

2. Where a street car was off the track, and the superintendent of the road called on employees standing by to assist in replacing it, and a motorman leaves his car, without setting the brakes, and, it being on a down grade, runs away and collides with another car, the negligence causing the accident was that of the motorman, and not of the superintendent.—(Hoover vs. Carbon County Elec. Ry. Co., 43 Atl. Rep., 74.)

Improvements at Celoron

The Jamestown Street Railway Company, of Jamestown, N. Y., serves one of the best equipped pleasure resorts in the country. This is at Celoron, on Chautauqua Lake, and is owned by the Celoron Amusement Company, a company composed largely of the same gentlemen owning the street railway lines. George E. Maltby, general manager of the amusement company, and also general manager of the Jamestown Street Railway Company, writes as follows concerning Celoron:

"Regarding the improvements at Celoron, we, like all other amusement companies, are obliged to keep fresh and attractive things before the public. This year we have changed the color of all our buildings, making them snow white, as well as the large boulders, which beautify the grounds. We have also added the Paul Boynton's "Trip Down the River," ours being, I understand, the only one in this country outside of Coney Island. We also have with us the miniature train that was at the Omaha Exposition. This is certainly an attractive feature, having a miniature engine propelling six coaches, each containing two persons, the engineer sitting on the tender, and firing his engine with hard coal. We also have a school of trained seals.

"We opened on May 29 with a good company for two weeks. The third week we had refined vaudeville show; fourth week, minstrels, opening up the week of July 3 with a comic opera company for four weeks. From this on, completing the sixteen weeks which we are open, our opera house will be pleasingly filled with the best talent which we are able to procure. We have found, as, no doubt, all others have in this line of business, that refined entertainments are the only kind which attract and draw. People will not follow entertainments that are vulgar, and it is impossible to succeed by permitting them on your stage.

"We have also given a series of animated pictures and stereopticon views; for instance, on one evening we gave a set of views of Germany; on another evening, France; then England, then Switzerland, and then views of interest in the United States. We did this for the purpose of attracting and entertaining the people on the grounds, and it is barely possible that we shall give a series of the "Passion Play," animated pictures as well. These, you understand, are entirely free, and are simply to attract those who may remain in the evening. Of course, we intermingle balloon ascensions, high dives and rowing contests, and everything of interest to the public.

"From a financial standpoint, we must say that our enterprise has been successful. Of course, we have quite a large investment, but believe that a park giving its patrons clean and wholesome amusements will financially succeed.

"For the week of May 29 we had a 'Wild West' entertainment. We are also figuring with the Banda Rossa for their famous concert some week in August, and will have several displays of fireworks at different intervals during the season."

NEWS OF THE MONTH

The Birmingham Railway & Electric Company has discovered a well organized movement to defraud the company on a large scale. It has been found that a number of the employees have obtained a large quantity of used tickets, which had been torn in half and thrown away. The two halves of the tickets were cleverly pasted together with a special glue, and the tickets were then sold three for ten cents.

The Market Street Railway Company, of San Francisco, recently replaced an old turntable at the end of one of its lines by one of more modern construction. The moving of the old turntable through the streets of the city was quite an undertaking, requiring about forty horses. The immense circular frame nearly occupied the width of the street in transit.

The Denver City Tramway Company has announced its intention of advancing the wages of all its employees in view of the fact that the court has recently decided the franchises are valid. Under the new schedule the men for the first year will receive 17½ cents an hour; the second, 20 cents; the third, fourth and fifth years, 21 cents; and thereafter 22 cents. This will place the Denver employees among the best paid street railway men in the country.

In the suit of the Mercantile Trust Company, trustee of two mortgages executed by the Denver Tramway Company conveying to the trust company certain lines of street railway, to restrain the corporate authorities of the city of Denver from repealing an ordinance under which the roads conveyed by the mortgages were constructed between 1885 and 1890, Judge Hallettt has granted the request of the plaintiffs and issued the desired restraining order. Notice of appeal has been entered by the city.

The Capital Traction Company, of Washington, has increased the wages of the men on the Cherry Chase branch from $1.60 to $2 per day.

The Court of Appeals, in session at Wytheville, has reversed the decision of the Circuit Court of Alexandria in the case of the City Council of Alexandria against the Washington, Alexandria & Mt. Vernon Electric Railway Company. The City Council adopted an ordinance requiring the railway company to lay grooved rails in King Street, between Fairfax and Royal Streets, which portion of the street was ordered to be repaved with vitrified brick. The railway company declined to comply with the terms of the ordinance relative to the grooved rails, and the corporation attorney was directed to institute mandamus proceedings to compel such compliance. Judge Nicol rendered a decision in favor of the city, and the railway company took an appeal to the Court of Appeals, which reversed the decision of the lower court.

Owing to an agreement recently signed it will soon be possible to ride all over the District of Columbia for a single fare. Switches and cross-overs will be built connecting different lines, so that the cars from one system can be transferred to the tracks of the other systems. One of the features of this arrangement will be the possibility of an extensive private car service.

A bill introduced in the Florida Legislature requiring street railway companies in Florida to provide separate compartments or cars for white and colored passengers recently passed the Senate, but did not pass the House of Representatives, and therefore did not become a law.

The Siemens & Halske Electric Manufacturing plant, which came into the hands of the Illinois Electric Vehicle & Transportation Company some time ago, is to be immediately fitted up for the manufacture of the company's vehicles.

The Savannah, Thunderbolt & Isle of Hope Street Railway Company has furnished all its employees with new summer uniforms. A new rule has also been put in force requiring conductors to be courteous at all times in their treatment of passengers, and ordering them to assist ladies and old persons on and off the cars.

It has been the custom for some time to turn the cars of the Rockford Railway, Light & Power Company over to the ladies of the city one day each year, and give the day's receipts to a charity fund. This was done on June 10, and over $1,000 was cleared by the Ladies' Union Aid Society.

It is probable that an appropriation will be made by the Common Council of Chicago to enable a committee consisting of three Aldermen and two engineers to make a very careful investigation of street railway problems in other cities during the summer vacation. It is intended to have the committee examine and report upon the systems in Boston, New York, Washington and other American cities, and also in England, France, Germany and other European countries.

An order has been issued by the South Park Board of Commissioners, of Chicago, forbidding automobiles the use of the parks and boulevards within its jurisdiction. The reasons given are the illegal speed at which horseless carriages are often run, and also the frightening of horses and the consequent danger from runaways.

The Madison Electric Light & Street Railway Company, which has been employing woman conductors for over a year, reports that it is well satisfied with the service given by them, and does not intend to return to men conductors.

The Indianapolis Street Railway Company has advanced the pay of conductors and motormen one cent an hour. Employees for the first three months will receive 15 cents an hour, for the second three months 16 cents, and after that 17 cents.

Judgment against the New Orleans Traction Company in the sum of $429,246.62 has been given to R. M. Walmsley, John C. Russell and E. W. Clark, Jr., this amount being the balance left unpaid, with interest, legal expenses, etc., on $1,500,000 of trust notes on which the company defaulted as to interest, and the collateral securing, which brought but $1,200,000 at its sale.

The street railway companies of New Orleans, in view of the attempted enforcement of an ordinance requiring them to provide seats on all cars for conductors and motormen, have sent a communication to the City Council stating that it is impracticable under present conditions to manage electric cars safely if the motormen and conductors are permitted to sit down while performing their duties.

As the result of a serious rear-end collision which occurred some time ago on the Riverview Park branch of the United Railways & Electric Company of Baltimore, the cars of the system will be equipped with a rear oil signal lamp. The accident in question was caused by the stopping of a car, due to the untying of the trolley rope by a passenger on the back platform. The trolley pole jumped the wire, and in the darkness the conductor was unable to find the trolley rope in time to avoid the accident.

Through the courtesy of R. S. Goff, president and general manager of the Globe Street Railway, the inmates of the Old People's Home at Fall River were recently given a trolley outing to the company's pleasure park.

Fifty new cars are being constructed in the shops of the Detroit Electric Railway Company. Of these twenty-five are open and twenty-five closed.

The directors of the Fitchburg & Leominster Street Railway Company held their annual dinner on June 8, and their guests were, as formerly, members of the newspaper fraternity. Dinner was served in the hotel at the company's pleasure resort at Whal-

com. After the dinner the hotel and the grounds were carefully inspected, and everything was found in excellent condition.

The Consolidated Street Railway Company, of Grand Rapids, has made a reduction in the fare from Grand Rapids to Reed's Lake and North Park. This has formerly been seven cents, but it is now reduced to five cents.

A bill has been introduced in the State Legislature of Michigan making it legal for the street railway, gas and electric light companies in the State to consolidate their interests.

There seem to be indications that a severe rate war will be carried on near Detroit. In order to meet the competition of the electric railway company, and if possible force it out of business, the Flint & Pere Marquette Railroad will run a regular semi-weekly excursion train from Northville and Plymouth at 25 cents for the round trip. The regular rate has been $1.55. The electric railway fare is 70 cents for the round trip from Northville, and 60 cents from Plymouth.

The street railway employees of Detroit have asked the companies to increase the wages of conductors and motormen to 25 cents an hour. The officials do not wish to make any change in the wage scale until the municipal ownership agitation is settled definitely.

A temporary injunction has been secured restraining the Detroit, Ypsilanti & Ann Arbor Electric Railway Company from running its cars faster than 12 miles an hour in the city of Ann Arbor.

Among the bills introduced into the Legislature of Michigan is one providing for the equipment of cars over 20 ft. in length with air brakes.

At a meeting of the City Council of Duluth on June 12 a resolution was passed appointing a committee to confer with the Lakeside Railway Company, with a view to the purchase of its line by the city.

At the recent annual meeting of the Metropolitan Street Railway Company, of Kansas City, it is understood that Armour interests of Chicago came into the control of the property. The earnings for last year were at the rate of 7½ per cent on the capitalization.

The general offices of the St. Louis & Suburban Railway Company are to be removed from the Wainwright Building to the De Hodimont station.

The South Orange & Maplewood Traction Company is considering the advisability of putting automobiles in service in Orange between the Orange Music Hall and the terminals of the company's lines in Main Street.

A suit brought some time ago by the city of Bridgetown against the Bridgeton & Millville Traction Company has just been decided in favor of the city. The city had entered suit to compel the traction company to operate its cars on certain streets, the service having been discontinued on said streets when the Board of Freeholders removed the rails from one of the bridges on the route.

The Brooklyn Rapid Transit Company has furnished to the New York Stock Exchange a statement, showing that it holds in its treasury $40,449,828 par values of stocks, bonds and accounts receivable of the underlying companies. The mileage now controlled is 482.2. The assets amount to $46,433,951, as against a capital stock then issued of $38,770,000 and bonds of $7,000,000. The surplus is $248,325. A detailed financial analysis of the property was contained in the STREET RAILWAY JOURNAL for June, 1899, page 370.

A gang of robbers was interrupted while breaking into the safe of the Jamestown Street Railway Company at three o'clock on June 19, and succeeded in making their escape. The bandits had sandbagged the watchman, and were preparing to blow open the safe, when they were frightened away by a number of employees returning to work.

The third rail on the Brooklyn Bridge used for carrying the current for the elevated and bridge trains became loosened from the insulators one day recently and fell to the ties for a long distance. The accident, which was caused by a defective contact shoe, interrupted traffic for several hours.

It is stated that all the employees of the principal street railway companies in Greater New York have secretly formed an organization under a charter from the Knights of Labor.

The Middletown-Goshen Traction Company has made an advance in the wages of its employees, from 14 to 15 cents an hour, and from 12 to 15 cents. The company recently had a spotter on the road for about a week, and as a result about eighteen motormen and conductors were ordered to report to the office for various reasons.

The Ithaca Street Railway Company recently posted in the car barn a notice cordially thanking the employees for their conduct and excellent work on Decoration Day, when the company carried the largest number of passengers in its history.

Two of the double-deck trolley cars for use on the Syracuse, Lakeside & Baldwinsville Railroad were put into service recently.

C. L. Rossiter, president of the Brooklyn Rapid Transit Company, has announced that the management has under consideration an advance in the wages of all the employees of the system.

The Canton-Massillon Electric Railway Company has voluntarily advanced wages of conductors and motormen to $1.75 per day. The old rate was $1.60 per day. For extra time the men will receive 16½ cents per hour.

The city electrician of Cincinnati has recommended in his annual report that all electric wires in the city be placed under ground, including the electric light and street railway wires. If this is done it will necessitate the removal of 15,000 poles, about 275 miles of feeders and 75 miles of trolley wire.

It is stated that the system of the United Power & Transportation Company, recently formed in Philadelphia, will be operated by water power from the Schuylkill River.

A funeral trolley car service will soon be inaugurated in Wilkesbarre.

A dozen masked men entered the car barn of the Fairmount Park Transportation Company, of Philadelphia, on June 19, and, after capturing and binding six of the employees, blew open the safe with dynamite and robbed it of nearly $4,000. The robbers got away.

A defective journal caused a serious accident at Pawtucket on June 1. The car was running at high speed, and when the journal broke, tipped completely over, injuring the motorman and conductor, the only occupants.

The employees of the London (Ont.) Street Railway Company have been on strike for some time, and there is no immediate prospect of a settlement. The company's cars are running, but the public has quite generally boycotted them.

The Montreal Street Railway Company, on account of the increased receipts of the road, has decided to greatly better the condition of its employees, and a new schedule of wages has gone into effect. The schedule is $25,000 a year higher than previous

years. Conductors and motormen between their second and fifth years will receive $34 a year more than they are now getting, and after the fifth year will receive $49 more. The company has also started an insurance fund, which it will maintain at its own expense. Disabled employees will receive a weekly amount from this, and at death $1,000 will be paid to the estate of the deceased. Motormen and conductors have formerly paid two-thirds of the price of their uniforms, but the company has now made arrangements by which they will pay but one-half.

The American Railways Company, which was organized some months ago, and of which A. A. McLeod, formerly president of the Reading Railroad, is the leading spirit, is negotiating for the purchase of the Consolidated Traction Company of Pittsburgh. It is reported that 40 is being offered for the common stock and 70 for the preferred stock, payments to be made in 5 per cent collateral trust bonds of the American Railways Company. The latter is also negotiating for the purchase of the Philadelphia Company, which owns nearly all of the Pittsburgh United Traction Company's stock, and of the Pittsburgh Gas Companies' stock, and the price offered for the Philadelphia Company's stock is said to be 97½ per cent, or $48.75 per share. The details of these two purchases are not yet completed, however, and the above prices represent current rumors. The American Railways Company formally announces its acquisition of the Bridgeton Electric Company and the Millville & Bridgeton Traction Company, which latter company owns the entire capital stock of the Bridgeton Rapid Transit Company, the Bridgeton & Deerfield Turnpike Company and the Bridgeton & Millville Turnpike Company. Other companies said to have been acquired by the American Railways Company are the railway and lighting systems of Springfield, Ohio, and similar properties in a Southern city.

The International Car Wheel Company has been incorporated under the laws of New Jersey, with a capital stock of $15,000,000. It includes a number of important firms in the Northeast and Canada, among them being the New York Car Wheel Works, with plants at Buffalo, New York city and Philadelphia; Swett Car Wheel and Foundry Company, Boston; Boston Car Wheel Company, Boston; Ramapo Car Wheel Works, Ramapo, N. J.; St. Thomas Car Wheel Company, Ontario, Canada; Hamilton Wheel and Foundry Company, Montreal; John McDougall & Co., Montreal; Weston Furnace Company, Manistique, Mich., and Pittsburgh Car Wheel Company, Pittsburgh, Pa. The temporary officers are: P. H. Griffin, president and chairman of the board of directors; T. G. Smith, vice-president, and Warren P. King, secretary and treasurer.

In a recently issued statement of the condition of the Electric Storage Battery Company, of Philadelphia, it is said that sales of the finished product for the calendar year 1898 amounted to $1,340,988, as against $1,026,926 in 1897, and that during the five months ending June 1, 1899, sales were $1,360,561, as against $314,498 in the same period of 1898. The company now owns five-twelfths of the automobile business controlled by the Electric Vehicle Company and the Columbia Automobile Company, through its ownership of $4,000,000 in the stock of the former and half of the stock of the latter. These two companies have united their patents and organized a manufacturing company called the Columbia & Electric Vehicle Company, for the purpose of manufacturing all parts of automobile vehicles, with the exception of the storage batteries, which will be furnished solely by the Columbia Automobile Company. The entire product of this new manufacturing company will be purchased by the Electric Vehicle Company, and sold by it to the various electric vehicle transportation companies now organized throughout the country.

The experiment of providing a 10-cent route to Brighton has been instituted by the Brooklyn Rapid Transit Company. There are already several 5-cent routes to this and neighboring resorts, but the officials of the company believe that many people will greatly prefer to pay a double fare and thus escape the annoyance of traveling on overcrowded cars. It would seem as if this plan could be worked to advantage in other large cities, and the idea might even be extended to smaller places by running a few cars as "specials" and limiting the number of persons carried to the seating capacity. This service, however, should be an adjunct to, and should not in any way interfere with the regular service.

Rumors of labor troubles in New York have been diligently circulated in Wall Street last month, to the effect that trouble was brewing among the employees of the Metropolitan Street Railway Company, but this turned out to be wholly untrue. The management of the Metropolitan Company is probably stronger in the respect and affections of its employees than is that of almost any other railway of the country, and it would be exceedingly difficult to foment trouble among them, particularly in view of the fact that they are now receiving high rates of wages, and have many collateral advantages through their connection with the company.

Albert L. Johnson, who has been until recently interested in a large number of American street railway properties, has been investigating the opportunities for investment in England during the past year, and in a recent interview says: "The project I have in mind is not primarily for London street traffic, but to bring the seashore within reach of the great mass of the population, just as Coney Island is brought nearer to New York by trolley lines. In other words, I want to make Brighton, 53 miles from Charing Cross, a suburb of London. I intend to make a proposition to Parliament and the County Council to establish an electric road from Brighton over a private right of way to the London city limits, and then, by some arrangement through the streets to the heart of the city. It is to be an underground trolley system, similar to the Fourth Avenue line in New York. It costs $1.50 to go by steam railway from London to Brighton, and the price prohibits the masses from reaching the seashore. I propose to carry passengers the entire distance for 12 cents, running a mile a minute."

Governor Stephens has finally signed the bill permitting street railway consolidations in the State, which has been for some time in his hands, and as a consequence it is practically certain that the remaining street railway properties of St. Louis not as yet purchased by Brown Brothers, of New York, will be brought into a general consolidation. These companies include the "Chicago Syndicate lines," seven in number, one of the most important and valuable systems in the city, the St. Louis & Suburban and one or two minor lines. The system will comprise over 400 miles of track, and a large sum, stated as $5,000,000, will be spent in improvements.

J. Edgar Leaycraft, one of the State Tax Commissioners, has briefly outlined the policy to be pursued by the commission in carrying out the provisions of the Ford law for the assessment of franchises. The commission will make its headquarters in Albany, and until August will devote itself to completing ordinary routine work. It is the intention to prepare a very comprehensive blank, to be ready in about six weeks. One or more of these blanks will be sent to every corporation, and its officers will be required to fill it out to the satisfaction of the commission. Where there are any suspicious circumstances connected with the information furnished, the commissioners will make a personal and thorough investigation, but otherwise they will not make any inquisitorial pilgrimage throughout the State. The commission will first take up the franchise assessment in those counties of the State where the tax books are closed earliest, and the work will be expedited in every possible way.

The United Railways & Electric Company, of Baltimore, has purchased a lot 2100 ft. x 900 ft., upon which it will build shops, car house and general office buildings for the entire system. The various shops and houses belonging to the different companies before the consolidation, and which are scattered throughout the city, will be abandoned, and all the repair and storage departments concentrated on the new property. The United system earned, gross, during the month of May, 1899, $32,500 more than for the same month last year.

The Problem of Elevated and Suburban Electric Railway Transportation.*

BY FRANK J. SPRAGUE

Rapid transit is the science of competitive railroading, and if by wheeled vehicles, ultimately reduces to a question of the proportion of weight upon the driving wheels. All other matters entering into the question for any given case and set of conditions, such as schedule speed, traffic capacity, extent of equipment, total investment, frequency of service, operating cost, and even safety and reliability of service, are incidental to and directly or indirectly dependent upon the adhesion of the driving wheels of the vehicles to the track.

The fastest possible car movement between stations can always, under equal conditions of equipment, load, grade and power supply be made by the vehicle which has the greatest percentage of weight on the drivers. Therefore, definite theoretical and practical limits exist for railroad schedule speeds under any given conditions, and the highest schedules in any case can only be made by a train system which preserves under all circumstances the specific characteristics of a motor vehicle with 100 per cent weight on the drivers.

In the present stage of development of rapid transit systems for urban, suburban and interurban service, where stations are close together, traffic much congested morning and evening, and yard and terminal facilities limited and costly, high schedule speeds are absolutely essential. How shall they be had?

There are three distinct and generic methods of railroad passenger transportation, as follows: The single car operating independently, the locomotive pulling trail cars, the multiple unit system, or aggregation of transportation units, each fully equipped, into trains and provided with secondary control.

The first received its great impulse at Richmond in 1887-8. Its history and characteristics as illustrated by the tens of thousands of cars in daily operation need no detailed description. Each car is a motor unit, with large effective driving weight, from 80 per cent to 100 per cent, equipped with hand control, but incapable of aggregation into trains with localized control. This system broadly includes all modern street railways.

The second is the locomotive system, following steam precedents, and dictated by the limitations of steam engineering, in which there is concentrated in a single unit the weight and power necessary to handle a train under given conditions. This locomotive idea has taken two forms, one of which copies one or other of the many types of steam locomotives, with such modifications as are permissible with electric motors, but which, despite the remarkable general progress of electric transmission, still finds comparatively few applications in actual practice. Notable among these are the B. & O. tunnel locomotive in Baltimore and the proposed equipment for the Central London Railway. Among the earliest, if not the first, of the large locomotives, is one of 1000-h.p. capacity, built by the writer and his associates for the North American Company about seven years ago. Another form of the locomotive may be described as the locomotive car, which consists of a car body of the usual form, arranged to carry passengers, with one or both trucks equipped with motors, and hence with the weight distributed over a considerable distance, and with, as in the other case, hand control provided at either end of the car. Such a one was experimented with by the writer on the Thirty-fourth Street branch of the Manhattan Elevated in 1886-7, where was used the first modern railway motor, and a special car was built about the same time which was to have had an equipment of two 75-h.p. motors on each truck. This was before the days when the Richmond road was built, and therefore before the modern advance in electric railroading. This type of locomotive car was used in the Intramural Railroad in Chicago during the World's Fair, and is now in operation on the Metropolitan and Lake Street elevated railways in Chicago.

A modification of this locomotive car plan has been more recently proposed, which consists in putting a locomotive car at each end of the train, passing the main circuits through all the other cars, and providing duplicate hand controls at each end of each locomotive car for the eight motors constituting their equipment. The system is absolutely untried, presents innumerable difficulties, and has about all of the defects of the locomotive system, but constitutes an acknowledgment of the utter necessity of greater weight on drivers and greater power for meeting the requirements of modern transportation.

In matters of transportation, the passenger's demand and the wishes of an operating manager are not always alike. The passenger requires for his convenience the most frequent time intervals, the shortest station waits, and the highest possible schedule speed. The railway manager is apt to concentrate loads, increase the time intervals, and let the passenger wait, but in so doing he may lose the passenger. With a locomotive car system this is the inevitable result, because otherwise the entire motive equipment would be kept in continuous operation at low economy and at great expense.

All these methods—the single car, the locomotive, the locomotive car and the doubling up of locomotive cars—fall short of meeting the requirements of a flexible railway system to be operated on a high schedule. The single high-power car, using all of its weight on the drivers, needs no commentary so far as ordinary application is concerned, but the methods proposed for the aggregation of cars and the handling of trains through the medium of a locomotive or locomotive car, or aggregation of hand-controlled locomotives occupying fixed positions, utterly ignore the possibilities of electric application and the advantages manifest in every car operated on the street. In some form or other this has been recognized for a number of years, and it occurred to a number of engineers that for increased adhesion and to provide more power with distributed weight motors could be distributed throughout the train, the mains carried through it, and the system governed by a controller at the leading end.

One of the earliest of these proposals was made before the Society of Arts in Boston in 1885, just prior to conducting experiments on the elevated railroad, at which time I contemplated the use of motors on each car or every other car and a pilot locomotive of car containing an adjustable controlling apparatus which could be made effective for handling one or more cars. This project, however, never reached fruition, and, of course, fell short of the possibilities. Much more seemed certainly feasible. The excuse for the last mentioned proposal is found in the evident engineering truth that if greater power is applied to a train, and a high percentage of the weight on the drivers utilized during acceleration, higher schedules with reduced strain were possible.

Considering for a moment a single car as a unit, and putting all the available power in the motors connected to each of the axles which space permits, it is readily possible to put on motor equipment which will develop over 20 h.p. per ton moved, and to use 100 per cent of the weight on the drivers. The possibilities of this unit, that is, using the entire weight of the car for traction, and all the power which can be put within the space permitted, is the limit, and absolutely the only limit of the possibility of the speed to be attained by an electric car. If now this unit is lengthened, that is, cars aggregated into a train, and the same ratio of weight on the drivers and the same horse power per ton is maintained, then it matters not what the length of the unit, identically the same schedules can be made with the train as with the single car.

The most effective train operation, however, requires something more than schedule speed, and it seemed that, considered from a competitive standpoint, and with the idea of gathering every passenger possible, the proper method of operating a railroad should be something as follows: Starting at the time of least traffic, to operate the smallest allowable unit at intervals determined by the ratio of the increased cost of operation to the increase of passenger receipts to be obtained by shortening the interval. Then, as traffic increases, to shorten up this time interval as far as is consistent with safety, then to increase the size of train unit while maintaining the same interval and high schedule to take care of the greater traffic.

It is said that smaller train units cost more to operate than larger ones. This is to a certain extent true, but against this is the simple fact that on the scale of wages paid on many railroads the difference in total cost between operating two two-car trains and one four-car train is one passenger per car for every fifty stations as spaced on the elevated railroads in New York. In view of this fact it can hardly be questioned that if shorter intervals are made possible then more passengers would be gathered than represented by these differences, and trains would, if a practical system were devised, be operated in any length from one car up.

These, I think I may fairly say, were the views which finally came to be held by such transportation authorities as Chief Engineer Wallace, of the Illinois Central Railroad, and Chief Engineer Cornell, of the Brooklyn Elevated, in the spring of 1897, and in this connection it is interesting to note a chronological review of various proposals which had from time to time been made for elevated railroad equipment and operation, which is appended to this paper, which will serve to illustrate a diversity of ideas and recommendations which have done much to bring ridicule upon the professions of electrical engineers.

This review is not intended to give a complete or detailed history of electric railway development, but is a running commentary on a variety of proposals made for train operation on elevated or suburban railroads from the year 1880 to the present time. A sur-

* Abstract of a lecture delivered before the American Institute of Electrical Engineering, on May 16, 1899.

vey of this record for the first seventeen years, up to and including the first proposals made as late as the spring of 1897 to the South Side road, shows that with the exception of proposals made by me at various times, beginning at the Society of Arts, in Boston, in 1885, and ending in definite proposals to the Manhattan Elevated Railway in 1896 and 1897, there were no propositions, or even a suggestion, from any manufacturing corporation or individual to equip a railroad on any other than a locomotive or locomotive car plan, with the single exception that on the Liverpool Overhead Railway two-car trains are operated as a unit, each unit having a motor disposed at the leading and back ends, and with a hand controller at each end. Typical important installations were on the locomotive plan pure and simple in 1895 at Baltimore, and on the locomotive-car plan, under the supervision of W. E. Baker, on the Intramural Road at the World's Fair in Chicago, 1893, and on the Metropolitan West Side Elevated Railroad, under the same supervision, in 1895, at the former of which Mr. Baker had to override recommendations in favor of a locomotive.

The variety of ideas indicated by these notes and the inexcusably wide divergence of expression concerning the commonest engineering facts, as well as the crudeness of many electric railway proposals, was never more sharply shown than in a paper by Mr. Wallace, of the Illinois Central Railroad, on the subject of "The Substitution of Electricity for Steam as a Motive Power for Suburban Traffic," before the American Institute of Civil Engineers, Feb. 3, 1897, and in the discussion which followed it. Mr. Wallace, having, in December, 1891, been directed by the management of the Illinois Central Railroad, of which he was then the chief engineer, to investigate the subject of adopting electricity on the Illinois Central Suburban Railroad, after a careful consideration of the requirements of the road, issued a list of forty-five categorical questions covering the operation of a fairly fixed equipment at 20 miles an hour. These questions were sent to all the various electrical companies except the Sprague, which had at that time been absorbed by the Edison General Electric Company. Consequently, for the Sprague Company and for myself I must disclaim any responsibility for the "mix up."

I will not attempt to review the answers to all the inquiries as presented by Mr. Wallace, but only touch upon a few of them, to illustrate the disparity of recommendations made, but for an interesting detailed comparison refer to the comments at the meeting by Charles Henry Davis, who began his remarks with a statement partly quoted from Mr. Wallace, that: "The engineers giving this matter their attention have been enthusiastic electricians; they have seldom been practical or expert mechanics, and the writer would add, usually inexperienced as railroad engineers."

But let us briefly take note of the recommendations. The motor capacity varied from 100 h.p., divided into four units, to 200 h.p., divided into two units, and distributed from one to two motors on each of two trucks under a locomotive car carrying passengers, or on, the other hand, aggregated into a locomotive pure and simple, without passenger capacity.

Both ring and drum armature construction was recommended, and driving wheels of from 30 ins. to 42 ins. diameter. About every possible form of axle driving, except chain or belt transmission, was proposed. One company was indifferent as to whether the motors were directly on the axles or gear transmission was adopted; another recommended spur gearing; another, cranks and parallel rods; and still another, no form of gearing under any circumstances, but an armature mounted on the hollow shaft surrounding the axle.

The central station equipment varied from 4800 h.p. to 18,000 h.p., and the steam units, from 400 h.p., driving single machines, to 1500 h.p., driving double machines. Horizontal compound and vertical triples had their advocates, and rope or belt as well as direct connection between engines and dynamos. The space required for the central station varied from 12,000 to 75,000 sq. ft., and the cost of power plant, not including real estate or buildings, from $320,000 to $1,169,000. Amount of fuel required per horsepower, from 2 to 3½ lbs. The annual cost of power plant operation ran from $60,000 to $225,000. The potential varied from 500 to 1000 volts. The cost of trolley lines and feed wires varied from $40,000 to $172,000, and repairs to the same and other line expenses, from nothing to $23.50 a day. The practical curvatures ranged from "50-ft. circle" to "150-ft. radius."

On one subject there was unanimity of agreement, the transmission was to be by continuous current, and by overhead trolley. Despite Mr. Wallace's request for information about a third-rail supply, it was incontinently waved aside. The multiple unit system was not in any form proposed, but there was discussion on the subject of the relative advantages of small independent units versus trains.

The recommendations made hardly need extended comment, and one can well imagine the reasons which stopped any then further action on the part of the Illinois Central Railroad. The whole paper is one of great interest, but from the discussion I will extract only a few comments which, in view of the immediate subsequent developments, are important.

Thomas C. Clarke, the past-president of the Society, stated as follows:

"The author, under the head of 'minor problems,' speaks of 'the size of transportation units and whether independent motors of large power shall be used to haul long trains of trailers, or whether small transportation units, run at more frequent intervals, shall be adopted.' with motors on the cars. In designing the rolling stock and structure of elevated electric railways in cities, this is the main point, and not one of minor consideration. Neglect to study this and to come to the correct conclusion has led to the financial failure of one of the largest electric elevated railways that has been constructed, and will lead to the financial failure of all others that follow the same lines.

"Carrying passengers in a city does not differ from any other business. The first requisite is to get abundant traffic; the second, to handle it with economy. Elevated lines run in competition with surface lines, and charge the same fare. The surface lines can beat them in all points but one. They afford more frequent stops; there is no climbing of stairs; cost of construction and, consequently, interest is less, and the system of transfers to branch lines is a great accommodation to the public. The elevated trains, not being impeded by surface traffic, can make better time; but for that, no person would ride in them, except to escape crowding.

"Common sense would indicate that the managers of elevated lines should try to approach, so far as possible, the conditions which have made surface lines a success. Frequent stops can only be attained, without losing too much time, by having a great power of acceleration. Any amount of power can be sent from the central reservoir, but if the wheels of the car slip, a limit is reached. Therefore, instead of having only one-third of the weight of the train available for adhesion, as is the case where an electric locomotive draws a train of trailers, utilize the whole weight of the train and passengers by putting motors on every car, connected electrically and mechanically, and worked by a motorman at one end of the train. Another advantage resulting from this is that gradients can be steepened, and the height of the station and their stairways reduced. If, in addition to this, short trains of light cars are used, the weight and cost of the structure can be greatly reduced, and the interest charges also. Small trains mean frequent trains to enable the traffic to be carried, and everybody knows there is no means of attracting traffic so powerful as that of frequent trains, as there is then no waiting at stations, which everybody hates.

"The summing up of the whole matter is, that to make city elevated railway a success, the surface electric system must be copied, and placed above obstructions from other traffic, and not the steam locomotive system of long trains at greater intervals. The process of evolution which develops everything along the fittest lines will make the city elevated railway of the future one of light structure, carrying light and very frequent trains, with motors on the cars themselves—a development of street trolley lines, and not of steam locomotive railroads."

Walter H. Knight said:

"The whole object of the elevated railroad is speed, and speed cannot be made with short headways. It would make little difference, as far as speed is concerned, whether the cars were all equipped with motors, or all the electric apparatus concentrated on one car."

Mr. Wallace stated that:

"One of the practical difficulties in the way of placing motors on each axle of the car and on several cars of the train, and coupling them up so that they can all be used and under the control of one motorman, is that, so far as the author's investigations have gone, there is as yet no perfect and adequate controller in use in the United States which will provide for the proper manipulation of more than two motors."

And his conclusions seemed to be that while a train system did not give that which was necessary, nothing had been presented to him in answer to all his inquiries and his painstaking research which gave him any promise of successful departure from his then existing method of operation.

There is small cause to wonder that the early project for electrically equipping the Illinois Suburban was for the time abandoned.

At the time when Mr. Wallace's paper was presented a committee, including himself and some other officers of the road, had been formed, with John Lundie as engineering secretary, and with a number of assistants, was making some further investigations as to the possibilities of electric application. A report was made about the end of the year, and accompanying it was a proposal from me to guarantee a 24½-mile schedule on the suburban service of the road, instead of the 18½, which was then being accomplished by steam, and if I am not mistaken, all further consideration of a locomotive pulling trailers was abandoned.

I think, as events have turned out, that with regard to the diametrically opposed views presented by Mr. Clarke and Mr. Knight, the former may well rest content with the position he assumed.

THE MULTIPLE UNIT SYSTEM

Such was the generally unsatisfactory state of electric railway development for all else than ordinary street roads in the spring of 1897, and the conclusions which I have already given, together with apparent advantages which would accrue, pointed unerringly to the necessity of the third generic system of railway equipment and operation, that which I have termed the *multiple unit system*, which is the most logical, and seems to me a finality in railroad development. It may be briefly described as a semi-automatic system of control, which permits of the aggregation of two or more transportation units, each equipped with sufficient power only to best fulfil the requirements of that unit, with means at two or more points on the unit for operating it through a secondary control, and a "train line" for allowing two or more of such units, grouped together without regard to end relation or sequence, to be simultaneously operated from any point in the aggregation.

For any given weight to be moved, whether it be in one or two cars, there is a certain capacity of motive equipment with which it is best to operate it under fixed conditions, and that is the motor equip-

ment which should be put on that unit, not something either larger or smaller, and then when more capacity is required, to simply add another unit of like character.

A unit may be a single car or a pair of cars, and the number of motors used whatever desired. The logical equipment is two motors for each car, and when so equipped the importance of some of the practical results is emphasized.

Among the advantages which such a general system when fully developed must possess, may be mentioned, first:

Similarity of Equipment.—This gives absolute flexibility of train operation. It insures like characteristics for trains, whatever the length, and whatever the combination of cars. The motor equipment is directly proportional to the number of car units. There is a practical fixed relation between the weight on the drivers and the total load, whatever the length of the train, and it is a matter of indifference to the motorman whether he is operating one car or any aggregation of car units in a train, for its characteristics are always the same.

Independence and Facility of Operation.—Each car being lighted, heated and braked independently, has independent movement in yards or car houses or on the tracks, wherever stored, and thus inspection, repairs and train combinations are facilitated. The head and tail switching characteristics of locomotive practice is entirely abolished. Trains in whole or in part can be reversed at any crossover, thus reducing the dead mileage and intensifying the car movement to meet the conditions of passenger movement. Cars can be added to or taken from a train in a third of the time that is possible with a locomotive system.

Where a system has main tracks with branches, car units for the different branches can be aggregated on the main line and then split at the junction, thus preserving the time intervals on the branches, but doubling the distance intervals on the crowded sections. The fullest use can be made of all sidings and tracks, wherever located, for storage, and in a large measure for inspection, which insures less dead mileage and useless returns, and effects concentration of car movement impossible where the cars must be stored in one place.

Increased Schedules.—Any required rate of acceleration or schedule speed up to the maximum becomes possible, thus giving the highest schedule with any given maximum, and the lowest maximum with any given schedule. A partial equipment may be made by equipping alternate cars, and this schedule later increased by additions to the existing equipment without changing its character. Local and express service can be operated with greater or less aggregation of motor equipments.

It has been suggested that with a locomotive system, when trains are reduced in length, and the service on the road is diminished the locomotive car can then increase the schedule, and that during the times of heavier traffic it still has capacity enough to pull a train.

Such an argument is a reflection on the common sense of a railway manager, and such practice a parody on railway operation. The time above all when schedule speed, capacity and effective operation are required is when traffic is greatest and the road most liable to congestion. It is difficult to see how any engineer can seriously offer such an argument in support of locomotive practice, for it is directly contrary to the most vital requirements on a railroad.

If, as is vital in competition service, a high schedule is necessary, and ignoring for the moment all questions about relative strains, weights, facility of making up and controlling trains, and the advantages of variable train lengths and intervals, when we come to six or seven-car train units a high schedule with short interval stations is impossible, except with two heavy four-motor locomotive cars or with every car equipped with a pair of motors. And, from every point of view, the latter is preferable.

Reduced Strains.—This is of importance where elevated structures or bridges are used, especially when already possibly strained. It is apparent that the weight of cars, truck and motive equipment between columns is necessarily less than with any locomotive or locomotive car system. All the longitudinal or shearing strains are greatly reduced.

The hammering on the rail joints, with the resulting shock to the structure and to the moving train, will be diminished because of the less weight per driver. The thrust strains for any given rate of acceleration are equalized and distributed over a considerable length of structure, and become practically the reverse of the braking strains. The strain on car bodies, platforms and couplers are reduced to a minimum.

Increased Density.—The safe time interval between trains for a given schedule and for any given length of train and station stop is dependent upon the maximum speed and the rates of acceleration and braking, and the greater these latter with any given schedule, that is, the lower the maximum speed and, consequently, the less the travel of the train after the brakes are applied, which distance varies roughly as the square of the speed at the time of applying the brakes, the shorter can be both the time and the distance interval between trains.

If there were an infinite rate of acceleration and braking, then there would practically be necessary, barring accidents, only that time limit between trains occupied by a train at and blanketing a station. In practice, a motorman will approach a station with more confidence and under closer headway when his maximum speeds are low, and the braking distance which he travels short, and when he has confidence that the train ahead, once started, will promptly accelerate and increase speed while that of his train is rapidly diminishing.

It is apparent, of course, that the length of a train is only limited by the platform accommodation.

Better Equipment.—From this standpoint better motor manufacture is insured. There are fixed limitations of wheel base, track gage, wheel seat, diameter of axles and distances between axle and bolster, and hence there are practical limitations to the outside dimensions of motors. The smaller the capacity of the machine put into that space, the greater the margin for increase of dimensions of the essential working parts, such as bearings, gears and commutators, and the greater the freedom for inspection. Likewise, also, is there greater space for the application of any kind of brakes, electric or mechanical.

Reduced Number of Cars.—With any given maximum hourly mileage the number of cars in service or on relay will vary inversely as the schedule. The advantage is further augmented by those already instanced, the concentration of car movements where most desired, and the storage of cars at the most convenient points, with consequent less dead mileage.

Simplicity of Operation.—The operation of the multiple unit system becomes the simplest. Every motor car or pair being a transportation unit, and every aggregation of such being, so far as the motorman is concerned, simply an extension in the length of the unit, without in any manner changing its character, the operation becomes almost automatic, a sort of second habit. Like hand and like train movement exists whatever the combination, and wherever the motorman is situated. The making up of trains, so far as electrical features are concerned, is as simple as coupling up an air hose. No main currents are carried from car to car, only small currents through reversible jumpers, and the electrical combinations are effected automatically, however the trains are made up and whatever the end relation of the cars.

Protected by the automatic features, a child of ten years can handle full-sized trains on regular service with less trouble so far as the electrical apparatus is concerned, and with less instruction than is required for the simplest form of air brake.

Ease of Inspection.—The train line and the main motor circuits being absolutely independent, and provision being made on any car for cutting out a set of motors, facility exists for an easy inspection whe ever the cars are located. Almost all the working parts of the motors can be inspected through the trap door in the bottom of the car, and since the cars have independent movement and can be rapidly run through an inspection shed over a pit, a little practice enables an inspector to make the most rapid survey of trucks, brake rigging, motors and everything else which is under a car.

Economy.—Transportation wages per car mile, the largest element of cost, are reduced because of the simplicity of operation, and because of the increased schedules. With the same efficiency, there is less power per car mile expended, and hence less coal burned, for any given high schedule with like conditions of traffic than with a lower rate of acceleration, because of the less amount thrown away in braking. The increase of power required because of low acceleration over high is anywhere from 25 per cent to 50 per cent.

When it is realized that a system like the elevated railroad would use only one-sixth of the power actually used now if it made no stops the importance of this fact may be seen.

The question of coal economy is of less importance, however, than many other features of railroading, and, from a financial standpoint, far less important than getting absolute freedom in determining train intervals and train lengths. In this connection it should be noted that altogether too little consideration is given to the question of car construction and car weights, and it seems to be forgotten by many engineers that useless tons of dead weight moved represent unnecessary investment in plant, and a continuous charge against operating expenses, and it is about as sensible to ignore this question as it would be to add pig lead to a car having all of its weight on its drivers to increase its traction. If half the gray matter was spent in reducing useless tonnage moved as there is in bargaining on the cost per kilowatt of apparatus, the cost per car mile and the ratio of operating expenses to receipts would be gratifyingly reduced.

Safety.—The highest safety is essential. In the case of fail-

ure of brakes or on slippery rails, the machines throughout the entire train can be safely reversed. The current input to the machines is automatically limited on each one to its safe capacity. In case an accident should happen to an operator, and he lets go of his controlling handle, the entire power is instantly removed from the train, and in case the controlling apparatus on the leading car should become disabled the train can be operated from either end of any other car. In fogs and on slippery rails a fixed schedule can be maintained more effectively because of the lower maximum speed, the less distance traveled in braking, the greater confidence in approaching a station, and the promptness of the leading train in getting away. On account of the reserve capacity of the machines it is possible to make up time in clearing a road, which is a matter of the gravest importance on a congested system. The automatic cutting off of current will have an important bearing in a not distant future when a Legislature is apt to, and should, prohibit the operation of a train with only one man in front unless there is some certain method of removing the driving power in case of accident to the operator. This is an instance of where a small thing, possibly determining the employment of several hundred extra men, has a vital importance.

Least Cost.—The multiple unit system means lowest first cost, as well as lowest cost of operatoin. This is contrary to first impression, but the explanation is simple in that the cost of the delivery of electrical energy to the car shoes per unit of constant use is eight to ten times the cost per unit of maximum capacity of car equipments, and by using the higher rate of acceleration rather than the lower for any given high schedule, the aggregate cost of the total equipment from power house to car equipments for any given hourly mileage is less, because, notwithstanding the increased cost of car equipment, the difference of economy creates a saving in that portion of the electrical equipment, that is generation and distribution, which costs so many times more per unit equipment than the units of car equipment, that the latter increase is more than made up by the saving in the former.

All this is readily proven, for I know of no problem presenting greater and more interesting possibilities of exact determination so far as results are concerned than that of electrical railway engineering; yet, on the other hand, I know of none in which there is a more reckless disregard of possibilities than in this very profession. In this, as well as in every other problem of kinetics or construction, and just as certainly as in the construction of a bridge, great increase of first cost and cost of operation may accrue from a disregard of the essential relations of all parts of the system, and on the other hand great savings may be achieved by a thorough knowledge of them. Despite these facts, it is curious to note oftentimes the inversion of the sound engineering with which the consideration of the electrical equipments of a road is often attended.

On any existing road whose traffic is known, the problem, put in the briefest form, should be: Given the existing maximum car mileage and schedule, how best and most cheaply, both as to first cost and cost of operation, most quickly and with the least interference with service, and without increase of strains on elevated structures or bridges, can the existing mileage be maintained, how much can it be safely increased, what possible schedules can be made, and what will be the effect on the traffic and operating expenses of the road?

The fact that there is a most intimate connection between the generating, transmission and the motor parts of the equipment seems often to be lost sight of entirely. The natural procedure would be to determine what results are desired, and then find the best method of getting them. Instead of that, oftentimes a purely empirical decision is made as to portions of the equipment, such as the capacity of the central station and size of its units, and the results so far as the movements of cars are concerned left to take care of themselves. This procedure reminds me of the architect who desires to erect a sky-scraper, deciding upon the foundation without regard to the weight of his building or the character of the soil beneath it.

There is, in fact, the most intimate possible relation, as should be perfectly evident, between the various parts of the equipment, and this relation is such that the cost of each part is seriously varied with exactly the same schedule, grade and load conditions by variations in the manner of making those schedules.

This is in no manner more effectively shown than in John Lundie's most interesting methods of detailing the essentials of first cost and cost of operation for various schedules under various rates of acceleration, all referred to a common factor, the percentage of weight on the drivers.

Such, then, are the practical advantages to be derived from a properly devised multiple unit equipment, but to be effective the details of the system had to be developed at great expense and much experience to a state of absolute reliability and reasonable simplicity. It may be stated, now, that the essentials of the multiple unit system are not complicated, despite the remarkable variety of functions which they have. They may be stated briefly to be as follows:

1. The master controllers on the platforms at each end of a transportation unit. They are of the simplest and most reliable character.

2. The master controller and train line cables, which become parts of the permanent wiring of a car, and are just as reliable and as simple as that for the lighting system. These secondary controlling cables are absolutely independent of the main motor circuits, and carry very small currents.

3. The jumpers, which are removable sections of the train line, connect the parts of the latter, which are permanent to each car, just as air hose couplings connect up a brake line.

4. The main controller, which is composed of the following parts: (*a*) certain relays and a throttle, developed in electric elevator service; (*b*) pilot motor with automatic limits, something like that used in elevator controls, but of more robust make; (*c*) a rheostat cylinder, with or without motor grouping switches, the parts similar to those of hand control; and (*d*) a reverser with like parts, but independently operated.

The braking system, whether using automatic air or electric, is something like the multiple unit electric system. There is a train line with means at each end of each transportation unit for simultaneously applying the brakes. When automatic air is used there is a train and equalizing line, a compressor with an automatic governor, illuminated gages, and a simple form of engineer's valve at the ends of each car for each transportation unit.

RESULTS OF THE MULTIPLE UNIT EQUIPMENT ON THE SOUTH SIDE ELEVATED RAILWAY

[Here follows a complete technical description of the installation of the Sprague multiple unit system on the lines of the South Side Elevated Railway Company, the substance of which has already appeared from time to time in the columns of the Street Railway Journal.—Ed.]

The financial results of operation on the South Side Elevated Railway are as follows, the months of November and December, 1897 and 1898, being the first strictly comparative months:

In addition to all "loop" expenses there is a rental charge equal to 10 per cent of the gross passenger receipts of the road. This should be considered really as an interest charge, not as an operative expense.

For these two months, with an average of 489,979 car miles on the main line, the comparative table following shows:

(*a*) Ratio of expenses to earnings, *including* "loop" rental, taxes and licenses;

(*b*) Ratio of expenses to earnings, *excluding* "loop" rental, but including taxes and licenses;

(*c*) Net earnings.

	(*a*)	(*b*)	(*c*)
November, 1897, steam.....	87.3	77.7	$10,603.80
November, 1898, *electric*.....	57.3	47.7	39,448.56
December, 1897, steam.....	83.6	73.8	14,691.69
December, 1898, *electric*.....	55.0	45.4	45,355.68

The succeeding months show increasing traffic and equally favorable results.

The operating expenses per car mile during November, 1898, on the main line, including and properly apportioning to it everything except licenses, taxes and rental, were less than 7½ cents on an average and maintained schedule of 15 miles an hour, with stations 2080 ft. apart.

So much for the actual results accomplished on the South Side road. The question naturally arises: Have there not been difficulties, and if so, of what character?

Of course there have been, and I should have been surprised, and almost sorry, if it had been otherwise, because it is only through the difficulties incident to the earlier operation of a system of this character that the essentials are fully determined and apparatus developed to a state of perfection. It is curious, however, that there have been more troubles with what is classed as "standard apparatus" than with that individual to the multiple unit control. These latter troubles were, first, with the rheostats, which were of new construction, and later, poor brush terminals, cracked gear cases, and with the earlier type of air governors.

With the specific multiple unit apparatus the principal troubles were with poorly and hastily wound relay coils, too light and unsubstantial construction of auxiliary contacts, and improper jumper construction, causing an occasional opening of the controlling circuits.

Taken all in all, however, the president and superintendent of the road state there were less troubles than when starting with their compound locomotives, and on the whole the success of the road has been unparalleled in electric railway history where so radical a departure has been taken.

ESTIMATES OF SAVING ON MANHATTAN RAILWAY, NEW YORK

Coming to New York conditions, I may say that, based upon the Chicago performance, and allowing for difference of coal cost, the Manhattan road, now operating at 12½ miles actual schedule during time of actual load, and making about 43,000,000 miles annually, can be operated at over a 16-mile schedule at not exceeding 9 cents, instead of 11.9, and on the existing mileage this would mean a saving, excluding interest on investment, of about $1,250,000 per annum, or, allowing interest on investment, of about $750,000, to say nothing of any other gains. A 17-mile schedule can actually be made with two motor equipments.

In closing, perhaps I may venture an opinion as to the general features which should characterize a suburban passenger railway equipment. I think it may be safely stated that the first is the use of the continuous current in the motor equipment, in spite of the claims which have been made and the results accomplished with alternating current motors, at least so far as we can judge by any present developments.

The problem, then, is whence shall be derived this continuous current, and that depends upon distances. For moderate distances, continuous current generators supplying current directly to the line, with or without the addition of storage batteries, are preferable. When the extent of the line becomes at all serious, then it must be considered as made up of a number of shorter sections joined together, each of which derives its principal source of supply from a local station, which station can be driven directly by water or steam power, or by an alternating current from a distant station, using a motor-dynamo combined in a single type of machine, the rotary converter, or joined in the form of a directly coupled set, the dynamo end being for continuous current and the driver a synchronous or induction type of motor.

Generally the sub-station should be supplemented by a storage battery, to take care of fluctuations in the load, to make even the duty on the sub-station and as far as possible at the central station, and to take care of some portion of the peak load caused by abnormal variations in the aggregate service at different times of the day. Of course, with the storage battery comes the necessity of a means of some kind of automatic regulation; there are various methods, but I will not enter into them here. Looking forward, however, to a perfectly assured future of a heavy service over considerable distances, I may state that the general equipment of such a road should generally involve the following essentials:

1. High potential alternating current transmission from one or two well-placed central stations, with or without static transformers.
2. Motor-dynamo sets, or rotary converters, at a number of conveniently placed sub-stations, to convert high pressure currents into continuous currents of about 600 volts' pressure.
3. Storage batteries of quick charge and discharge capacity at the same sub-stations as the motor converters to equalize their duty and to prevent sharp variations in the generating plant, as well as the sub-station.
4. A system of feeders and main conductors.
5. A power rail or trolley wire supplying continuous current, but ordinarily without any switching of currents.
6. Individual transportation units with a multiple unit control, so that combination of cars without regard to sequence or end relation can be made up at any portion of the line independently, and controlled from any selected point.

Chronology of Modern Electric Railroad Operation

Accompanying Mr. Sprague's paper on the "Multiple Unit System," read before the American Institute of Electrical Engineers, on May 16, was the following interesting chronology of modern electric railroad operation from 1880 to 1899.

1880.—Edison built and ran at Menlo Park an electric locomotive, and subsequently designed some others.

1883.—Daft, at Mt. McGregor, ran the Ampere, pulling one car, and Field, at Chicago, the Judge, also pulling one car.

1884-5.—Vandepoele, at Toronto, and later in 1885 or 1886, at Minneapolis, pulled trains of cars with an electric locomotive.

1885.—Daft, at Baltimore, operated a locomotive and trail car, subsequently increasing the equipment, and on the elevated road pulled a train with an electric locomotive for experimental work.

DECEMBER, 1885.—At Society of Arts Sprague stated some of the possibilities on the elevated railroad, and pointed out the advisability of putting motors under each.

1886.—Sprague built the first locomotive car. This was intended for experimental work on the elevated road, but was abandoned before the motors were completed.

1886.—About this period the Rhode Island Locomotive Works, under direction of Knight & Bentley, designed a locomotive for rapid transit train operation, but it was not built. About this same time Stephen J. Field designed an electric locomotive for the same purpose.

1886-87.—Sprague operated a standard elevated railroad car with two single reduction motors axle centered, and with one end spring supported from the truck body, on the Thirty-fourth Street branch of the elevated railroad, and also pulled a trail car, and prior to this, a platform car, with the same motors, in the Durant sugar refinery on Twenty-fourth Street, New York. This was followed by the Richmond equipment, the beginning of the modern development.

NOVEMBER 4, 1890.—City & South London Road opened. Originally designed for cable. Light trains operated by electric locomotives having two gearless motors with the armatures rigidly mounted on the axles of drivers.

1892.—Sprague, Duncan & Hutchinson designed, afterwards building it, a 60-ton electric locomotive for experimental work in connection with the North American Company. It was not put to use.

FEBRUARY 4, 1893.—Liverpool Overhead Railway. Operates two-car trains, each car having one motor disposed at the leading and back ends of the couple, the two cars being kept together as a unit. Hand control at each end.

SPRING OF 1893.—Under the general supervision of W. E. Baker, assisted by B. J. Arnold, in charge of the steam plant, and Charles H. Macloskie, in charge of the car equipment, the Intramural Railway was constructed at the World's Fair. The General Electric Company was largely interested in this enterprise. Four-motor cars, with hand control, were used to pull three trail cars, this plan of distributed motors under the passenger car having been advocated by Mr. Baker in opposition to the general opinion then in favor of electric locomotives. The third-rail supply, with the flexible sliding contact shoe, was here used for the first time, and the road may be said to be the first real practical train operation on any serious scale in this country.

NOVEMBER 3, 1893.—The General Electric Company's engineers, in a communication to Col. Hain, general manager of the Manhattan Elevated, recommended eight-car trains to be pulled by a single 40-ton, four-motor car, guaranteed an increase of 14 per cent in schedule, and stated that the motor car could pull thirteen-car trains as easily as present steam locomotive could pull five cars.

Proposed potential of about 600 volts, direct supply, unspecified number of stations, and did not suggest alternating currents, boosters or storage batteries.

MAY, 1895.—Metropolitan West Side Elevated Railroad equipped under the supervision of W. E. Baker, and using General Electric Company's apparatus, opened on locomotive car plan, using two motors on locomotive cars. This was the first commercial elevated road put into operation in the United States.

JUNE 27, 1895.—First of three 95-ton locomotives put in operation in Baltimore, by General Electric Company, for pulling freight and passenger trains through B. & O. tunnel.

SEPTEMBER 20, 1896.—Lake Street Elevated Railroad, which had been operated since October, 1893, with steam, began electrical operation, plans similar to those on the Metropolitan.

FEBRUARY 1, 1896.—(Daily paper.) Electric Storage Battery Company, of Philadelphia, described and proposed a storage battery locomotive to pull trains, storage batteries to be used in combination with current from third rail.

FEBRUARY 8, 1896.—(Daily Paper.) Sprague, in reply to strictures on the capacity of electric motors, in a daily paper, offered, under $50,000 forfeiture, to equip a train which could be pulled by a locomotive car, and also by motors under each car simultaneously controlled, and to make a speed of 40 miles an hour on express service.

APRIL 17, 1896.—In interview in daily paper, Westinghouse, on behalf of the Westinghouse Electro-Magnetic Company, with what was called the Westinghouse Wheeless system, proposed for all elevated and suburban roads the use of a contact pin system and the continuous current. At the same time it was stated that in ten days public demonstration was to be made to demonstrate success of the Tesla alternating current motor for this purpose.

JULY 16, 1896.—Exhibition of contact pin system for the benefit of Manhattan Elevated officials.

JUNE 6, 1896.—Sprague proposed to Messrs. Gould, Sage and Galloway, special committee of Manhattan Elevated, to make demonstration equipment of multiple unit system.

MAY, 1896.—Nantasket Beach Railroad put in by the N. Y. & N. H. R. R., under the supervision of Col. Heft, was opened—used General Electric apparatus and a locomotive car carrying passengers and pulling a trail car.

November 29, 1896.—Under the supervision of C. C. Martin, electric service was instituted on the Brooklyn Bridge Railroad. Twenty motor cars, each equipped with four General Electric Company 62½-h.p. motors and hand control, replaced the steam shifting engines, and were used in connection with the cable.

December 10, 1896.—The General Electric Company, through its Western office, proposed to the South Side Elevated Railroad an equipment of three and four-car trains, one of which should be a locomotive car having two motors, and six-car trains, one of which should be a locomotive car having four motors, guaranteeing that on the first combination 35 miles an hour could be made, and on the second 45 miles an hour between stations 2000 ft. apart. No central station system was described, either alternating or continuous, nor any potential determined.

December 10, 1896.—The Walker Manufacturing Company proposed to the South Side Elevated Railroad a system as follows: Continuous current, station in middle, pressure 600 volts, three and four-car trains, one being a locomotive car having two 125-h.p. motors, and guaranteed to save seven minutes in the trip from Congress Street to Sixty-third Street, a distance of about 8½ miles, that is, to make a schedule of nearly 19 miles.

February 14, 1897.—Sprague again stated the possibilities of the multiple unit system to the Manhattan Road, and again offered to make a demonstration equipment and to work up to eight-car lengths under every possible condition.

February 25, 1897.—Sargent & Lundy reported on general equipment for South Side Road, giving summary of locomotive car proposals and their recommendation, one of which was to double up trains.

February 26, 1897.—Potter, engineer of the railway department of the General Electric Company, reported to the third vice-president at Schenectady his recommendations of a system for the Manhattan, with details as follows:

Direct current,three-wire system, the cars on one track being in series with those on the other, 650 volts on each line, and 1300 volts between power rails on the two tracks, the track rails to be used as the neutral wire; two power stations equipped with 2300 kilowatt generators, direct current supply; five-car trains to be pulled by a single motor car with four motors; possible boosters or storage batteries at South Ferry alone; no alternating current, no sub-stations proper, and no storage battery regulations at sub-stations.

About the same date, a system diametrically opposed in almost every essential was proposed and recommended to the general contractors for the Central London Railway, by Mr. Parshall, of the British Thomson-Houston Company, with the General Electric Company in consultation as sub-contractors.

This proposition opposed the three-wire system, and on about 6 miles of road, recommended alternating current machines, four sub-stations with rotary converters, no storage batteries, five-car trains pulled by electric locomotives pure and simple, instead of locomotive cars. The locomotives are now being built and weigh 45 tons each. The schedule is moderate, and acceleration and braking are aided by having the station at peak grades of from 2 to 3 per cent.

The Westinghouse Company made proposals of something the same nature and the Siemens-Halske also, but the latter proposed the three-wire system, one track being in series with the other.

March, 1897.—Sargent & Lundy issued general specifications calling for alternative proposals for:

Thirty-six locomotive cars each having four 125-h.p. motors.

Forty-five locomotive cars each having two 150-h.p. motors.

One hundred and twenty motor cars each having two 35-h.p. motors.

April, 1897.—General Electric Company, through W. B. Potter, engineer of the railway department, proposed to the South Side Elevated Railroad four and five-car operation, one car being a locomotive with four motors.

April, 1897.—Westinghouse Electric & Manufacturing Company proposed to South Side Elevated operation of five-car trains, one being a locomotive car equipped with four 125-h.p. motors, and guaranteed to make an 18-mile schedule.

April 7, 1897.—Sprague, as consulting engineer, condemned the locomotive car system for South Side road, and recommended the adoption of the multiple unit system.

April, 1897.—Messrs. Sargent & Lundy, after report by Sprague, abandoned the locomotive plans for the South Side Elevated, and fully endorsed the multiple unit system.

April, 1897.—Chief Engineer Wallace, of Illinois Central Railroad, stated that trains could be run in any length, from one to a dozen cars, and he hoped to be able to run them with a push-button.

April 17, 1897.—Sprague tendered to the South Side Elevated Railroad a proposal to equip 120 cars on multiple unit system.

May, 1897.—Chief Engineer George B. Cornell, of the Brooklyn Elevated Road, stated that two essentials of his endorsement of any change from steam to electricity on that road were increase of schedule speed and a control which could enable him to run single cars or any desired aggregation of cars into trains.

July, 1897.—Short, for Walker Manufacturing Company, proposed locomotive car operation on Brooklyn Elevated Road.

July 16, 1897.—Sprague made demonstration at Schenectady of two-car multiple unit train, and ten days later of six-car train.

November-December, 1897.—Sprague made working test of multiple unit train on Metropolitan Elevated of Chicago of five-car multiple unit train.

Fall of 1897.—On the Brooklyn Elevated Railroad the General Electric Company's engineers recommended for a 15-mile schedule four and five-car trains, two of the cars being locomotive cars, each weighing about 35 tons, and equipped with four motors, with through connections of the main circuits, so that either the four or five-car unit could be operated from either one of the locomotive cars from a hand control. No independent operation of other cars was proposed. An alternating current central station, with sub-stations, rotary converters and storage batteries were also recommended.

1897.—Short, for Walker Manufacturing Company, proposed locomotive car plan for Manhattan Elevated.

December 23, 1897.—Sprague Electric Company sent the Illinois Central Railroad Company on specifications of John Lundie, the consulting engineer, a bid for an equipment for the suburban service of the Illinois Central Railroad, to use direct current system, with storage battery equalizers, individually equipped cars, multiple unit system, and to make a schedule speed of 24½ miles with stations averaging 2900 ft. apart.

December 23, 1897.—On same specifications, General Electric Company made similar bids to the Illinois Central, under agreement to get controllers for same from Sprague Company, in case their bid should be accepted.

January 12, 1898.—Mr. Sprague proposed to Mr. Gould to operate any combination of from one to ten cars under any conditions of rail on multiple unit system.

February 18, 1898.—Sprague tendered to the Brooklyn Elevated Railroad the multiple unit system. For temporary use, twenty-four equipments were consolidated on twelve cars to be used first as locomotive cars, and afterwards to be distributed.

The motor equipments were to be designed for 17-mile schedule, with existing station intervals.

Those on the South Side were designed for a 15-mile schedule, but make 16½ miles at times, with longer intervals.

February, 1898.—The General Electric engineers offered to supply on the first twelve cars actually equipped by the Brooklyn Elevated Railroad, motors with either hand or semi-automatic control, and proposed to supply four or five months later, when developed, a full multiple unit control.

April 20, 1898.—Sprague began operations on South Side road with multiple unit system.

June 18, 1898.—Sprague began operation on the Bridge end of the Brooklyn Elevated road.

July 12, 1898.—Waterloo & City, London. Straight run 1½ miles, no mid-station. Operates light four-car train units, the two end ones being motor cars with two motors, and the intermediates being dead cars.

July 27, 1898—Multiple unit system in full operation on South Side road, and steam abandoned.

Equipment on South Side road afterwards increased to 180 cars, 150 of which are fully equipped, and thirty for emergency service, partially equipped.

November 1, 1898.—Westinghouse Company began to put twenty cars on the Kings County Elevated Railroad, each equipped with two sets of two motors with controllers actuated by air pistons and controlled by a secondary electric circuit. Four only out of the twenty cars are in use at present and for locomotive purposes.

1898.—General Electric Company proposed six-car trains and double locomotive cars for the Manhattan Elevated, and three-car trains, with one single locomotive car, for the Boston Elevated.

And finally the engineers of the General Electric Company are credited with an intention to operate an experimental multiple unit train.

Of course, there are a number of other proposals which have been made both for multiple unit and other systems, and for various roads, of which, however, mention is unnecessary for the present.

Electric Traction on Tramways

Upon this subject, J. Clifton Robinson, M. Inst. E.E., A. Inst. C. E., managing director and engineer of the London United Tramways, Ltd., and the Imperial Tramways Company, Ltd., and engineer to the Bristol Tramways and Carriage Company, Ltd., read an interesting paper before the Cleveland Institution of Civil Engineers, of Stockton-on-Tees, England, May 29. The extent of the paper precludes its publication in this journal, but parts of it relating to the roads in which Mr. Robinson is interested, are given below.

BRISTOL TRAMWAYS

The Bristol tramways demand our attention as practically the first line in England where overhead electric traction was shown in its modern aspects. In the construction attention was seriously given to the provision of a solid roadbed, with heavy girder rails properly bonded, so as to secure a perfect return. The Board of Trade automatic recorder, now placed in the power house for the registration of any drop in voltage beyond the margin of 7 volts between any two points in the system, has commanded the most patient attention; and here, as in every line constructed subsequently under my supervision, this automatic record has remained from day to day and from hour to hour well within the margin.

The power station is located about the center of the present system. Its equipment has been extended and altered since the station was originally designed, and the two boilers have been increased to four; but they are all of the Lancashire type, and are fitted with Vicars' mechanical stokers, and one Green economizer in flue for the complete battery of boilers. The engine room contains four direct-coupled sets. Each unit consists of a 250-h.p. McIntosh & Seymour engine, driving one of the British Thomson-Houston type M.P. 6—150—200 generators. The total capacity of the station is 920 h.p. The engines are of the horizontal tandem compound type, with high-pressure cylinder 13 ins. in diameter; the low pressure 23 ins., and stroke 17 ins. The speed is 200 r.p.m., and the steam pressure 160 lbs. The economical load is 230 h.p. at one-third cut off.

In addition to the four traction generators there is a motor-generator which supplies current for the lighting of the station, and a negative booster for reducing the difference of potential on the rail return circuit. There are also four electric motors, of which two drive the feed pumps, one the mechanical stokers and fuel economizer, and one the machinery in the repair shops. Each of these motors will give up to 20 h.p. if necessary. The motor-generator is capable of developing on its secondary terminals an output of 230 amps. at 135 volts; its general construction is similar to that of the large generators. The motor portion of the machine is compound wound in such a manner that the e.m.f. at the secondary terminals is constant, but the compounding of the field is done entirely from the motor armature and not from the secondary armature, so that this latter may be used in connection with the accumulator battery. The primary terminals of the machine are connected to the main station bus bars, and have, therefore, to work at a potential of 500 volts. In connection with the shunt winding of the fields of the motor-generator there is a regulating switch with twenty steps and a suitable resistance, enabling the potential between the secondary terminals to be varied between 135 and 105 volts.

The total distance from the power station along the track to Staple Hill is 5.6 miles, and as there are usually about twenty-four cars distributed over this part of the system, there would be a drop on the return of about 9 volts, under these conditions. In order to diminish this drop and bring the operation into agreement with the Board of Trade regulations, a portion of the current is drawn from the rails by means of the negative boosters previously mentioned. This machine consists of a 500-volt motor, direct coupled to a separately excited, series-wound generator, having a maximum capacity of 300 amps. at 500 volts, on the terminals. The generator armature is connected in series with the negative bus bar through an insulated cable leading to the rails, while the field is in circuit with an insulated feeder connected from the positive bus bar to the trolley wire. It is instructive to watch the recording voltmeter in series with the test wire connected to the Staple Hill terminus, as the field of the negative booster is varied. The drop on this section with the booster cut out is 9 volts, and with the booster in, and with approximately zero potential on the rails, the drop is only 3 volts, or well within half the maximum limit allowed.

An armored feeder cable is laid underground the whole length of the line, and is connected about every half-mile to the cast iron section boxes containing switches and lightning arresters. In addition to the feeder there is a small three-strand insulated conductor laid the whole length of the system. One of these strands is for the Board of Trade leakage tests. It is only connected to the rail at the extreme ends of the line and at the power station to the Board of Trade panel. The other two wires are for telephones, an instrument being fixed in each of the section boxes for use by the company.

The trolley wires running from end to end of the line are of hard-drawn copper, 0.32 in. in diameter, and are divided by section insulators about every half-mile, where the two ends are brought to the switch boxes and joined to the feeders through the switches. Any section can thus be cut out, if necessary, without disturbing the traffic on the rest of the line.

The practical success of the early installation at Bristol has led the company to undertake the electrical conversion of all their lines, which amounts to some 50 miles. Work is also being vigorously pushed forward at the new central power station at St. Philip's Bridge, on the River Avon. The site is located advantageously in respect to coal and water. This station will be equipped with the highest type of plant and machinery, one unique feature being that the engine room is on the ground floor, and the boiler room vertically above.

The engines are of the vertical cross-compound Corliss type, with cylinders 22 ins. and 44 ins. x 43 ins. stroke, running at 90 r.p.m., and each has direct coupled a 500-kw. electric generator. The flywheels are 16 ft. in diameter and weigh 85,000 lbs. The steam consumption of these engines is guaranteed to be 12.7 lbs. of steam per i.h.p., with a mechanical efficiency of not less than 92 per cent. On account of the central location of the power house the distribution will be on the continuous current principle. The generators will be of the 10-pole type to generate 1000 amps. at 500 or 550 volts, as may be required.

The steel frame building will be 140 ft. long, 52 ft. wide and 93 ft. in height from the basement to the roof trusses; the basement being 9 ft. in height, the engine room 37 ft., the boiler room 20 ft. 8 ins., with an additional floor above the boiler room 15 ft. in height to contain the water tanks, coal storage bunkers, economizer flue, etc. A 25-ton electrically driven overhead crane will traverse the whole length of the engine room.

The boiler room will contain eight horizontal water tube boilers, each with the capacity of evaporating 8250 lbs. of water per hour, at a steam pressure of 160 lbs. Each furnace will be fed by an electrically driven mechanical stoker of the "Coking" type, and the ashes will be removed by the return line of the conveyor, and received into a tank outside the building, from which they can be drawn off into barges.

The coal supply will be received from barges by automatic shovels and delivered into a coal storage tank at the back of the building, from which conveyors of the noiseless gravity bucket type will deliver the coal into the bunkers above the boilers, and from these the supply will be drawn off for the furnaces through weighing hoppers.

The smokestack will be erected at the end of the boiler room, having 10 ft. clear inside diameter and being 200 ft. in height above the foundations. It will be built up of steel plates in rings lap-jointed and riveted, tapering upwards, and finished with an ornamental cap at the top. It will be entirely self-supporting, and will be lined throughout with firebrick.

On the floor above the boiler room there will be located the economizer, consisting of 360 tubes in thirty-six sections, and here also there will be two water tanks of 6000 gals. each.

The engine room will also contain two lighting sets, consisting of two two-crank tandem compound high-speed engines, running at 400 r.p.m., and each having direct coupled a 50-kw. 500-volt lighting generator, and three motor generators, each of about 40-kw. capacity, for use in connection with the rail return.

The condensing apparatus will consist of two surface condensers of the Admiralty type, each containing 3200 sq. ft. of cooling surface and located on the engine room floor. The air pumps will be of the vertical twin type, one set for each condenser. The circulating pumps will be motor-driven 8-in centrifugal pumps, one for each condenser. The condensing plant and auxiliary steam piping will be located in the basement. The boiler feed pumps will be of the vertical compound duplex type, and will be located in the boiler room.

The hot well will consist of a cylinder 96 ins. long and 48 ins. in diameter located in the basement; the water from this hot well being lifted to the water tank on the economizer floor by two electrically driven three-cylinder pumps.

The switchboard will be of white marble panels 8 ft. in height, bolted to angle-iron frames on a raised gallery at the bridge end of the engine room. It will consist of four generating panels,

two lighting generator panels, three booster panels, sixteen feeder panels, one lighting circuit panel and one meter panel; all complete with instruments and switches of the most approved type and design.

The system, including the St. George & Hanham Light Railway extension, when completed, early in the coming year, will have an equipment of 250 cars, and will prove in its organization to be one of the most modern and complete systems of electric tramways in the world.

DUBLIN TRAMWAYS

Only second in interest to this first Bristol line, and of more importance as regards length of line and the special and important mechanical and electric equipment which the greater length of line demanded, is the Dublin, Kingston & Dalkey Electric Tramway, 8 miles in length. This line was inaugurated as an electric tramway by the Lord Mayor of Dublin on May 16, 1896.

In point of construction of the permanent way all the experience of Bristol was adopted, and, where possible, improved upon, and as the line at some places in Kingstown and Dalkey lay along curved and sometimes rather narrow streets, and considerable differences in levels and contours of roadways had to be adjusted, the roadbed formed a problem which it took much care and contrivance to solve. But in the general detail, so far as the line below and above was concerned, the Dublin line merely repeated and accentuated the experience in Bristol.

It was different as regards the power house and the distribution of the current. The stringency of the Board of Trade regulations at once demanded that on a line of such extent special provision must be made, because, despite the greatest care in insulation and in the proper bonding of the rails as a return for the current, it was almost impossible to preserve so small a drop in voltage as the Board of Trade regulations allowed. In place of distributing the current for the whole 8 miles from one center, two substations were established—at Blackrock and Dalkey—so that the work of distribution was made from three points. Had the service been from the main power house only, the current would have been always in one direction, and the accumulation of minor (and unpreventable) leakages would no doubt have rendered the preservation of a maximum drop of 7 volts difficult, if not impossible. The means taken to counteract this difficulty I shall now proceed to describe.

In the initial plant the power house contained four Willans & Robinson engines, the flywheels carrying 18-in. belts, by which the electric generators were driven. Two of these generators are direct current, each capable of giving 100 kw. continuously, or 120 kw. on emergency. These dynamos supply directly the section of line nearest Dublin. The other two engines drive two three-phase alternators, which constitute the special feature of the installation. These alternators are six-pole, of capacity of 150 kw., and are driven with a frequency of 30 periods per second. The general design and construction of these machines were effected by the eminent electric traction expert, H. F. Parshall, who has been my coadjutor in most of the various works in this country, and whose idea of the three-phase distribution had its first extensive illustration here. From the power house at Ball's Bridge, two cables carry the currents generated by those machines to the substations at Blackrock and Dalkey. The current is carried at high tension, averaging 2500 volts, and at the substations it is transformed to the required line current of 500 volts continuous. At Blackrock there are two three-phase synchronous alternate current motors connected direct with two direct current railway generators, capable of working up to 75 kw., and from the latter the portion of line nearest Blackrock is supplied with current of the standard 500 volts. Similar apparatus at Dalkey, somewhat less powerful, takes off the high tension current from the cable and transforms it for the supply of the third section of the line.

Some of the practical advantages of this system are that by its use a much greater number of cars can be operated without breaking the Board of Trade rule; that the three-phase method of distribution requires about three-fourths the weight of copper which would be required by a single-phase alternating current system of the same voltage; that the motor generators may be run from either the 500-volt continuous or the 2500-volt three-phase mains; and that by the use of the synchronous motor the phases of the alternating currents can be so governed that the amount of power delivered to any substation can be regulated as desired.

The convenience and flexibility of the motor generator method of transmitting power is quite apparent when it is borne in mind that the reaction on the field of the synchronous motors can be compensated for by a few turns of wire in series with the armature of the generator to which it is coupled, thus keeping up the counter e.m.f of the motor, and insuring that under no circumstances whatever can the motor be thrown out of synchronism. The combined efficiency of the motor generator set is 85 per cent at full load. Another feature of the station which gave great satisfaction was the operation of the switches on the three-phase circuit. They consist of three switches mechanically operated from a single line through wooden connecting rods about 3½ ft. long. Their efficiency was tested by repeatedly breaking the circuit, and no instance of an arc being maintained is yet recorded.

During the tests which were made on this system the railway generators which are directly coupled to the three-phase motors in the substation were directly short circuited, and also run for some time at 60 per cent overload, but under no circumstances was it found possible to pull the synchronous motor out of step. The switchboard in the Blackrock substation has two panels for the distribution of power from the 500-volt generators. On the three-phase part of the board there are five three-phase switches, one for cutting out each of the cables coming in from Ball's Bridge, one for cutting out the cable that extends on to Dalkey, and one for cutting out each of the synchronous motors.

The three-phase synchronous motors are excited by means of the 500-volt continuous current machine. These three-phase motors are self-starting, but in normal practice the machines are brought to speed by means of the continuous current generator used temporarily as a motor, and driven from the 500-volt trolley line, which receives this starting current from the main power station at Ball's Bridge. This is the modus operandi of starting up one substation when neither of the machines is running. When one of the machines is running the current for starting the other is, of course, obtained from it.

The success of the Dublin Southern was so marked that the Dublin United Tramways Company has been led to convert to electricity the whole of its lines, which amount to some 75 miles of single track. The central power station at Ring's End, now under construction, will have a capacity for operating 600 cars. The coal handling is to be done entirely by automatic machinery. The boilers are of the water tube type, equipped with Vicars' stokers. The engines are of the vertical cross-compound type, with Corliss valve gear, and run at 90 r.p.m. Owing to the favorable location of the new power house it will be found possible to work the whole system by continuous currents. Earth boosters and pairs of test wires are run from the station to various points in the earth return system, so that the voltage drop can be regulated to any desired extent.

MIDDLESBROUGH, STOCKTON AND THORNABY ELECTRIC TRAMWAYS

The power station of this road contains three alternators of the three-phase type, each of 300 kw. capacity, 32-pole 2500 volt, giving a frequency of 25 cycles at 94 r.p.m. The fields are excited from the 500-volt bus bars. To supply light when the machinery is shut down and to start the dynamos in the morning a battery of accumulators has been provided. These are by the Tudor Company, and consist of 260 cells, with a discharge rate of 48 to 70 amps.; the capacity at the lower discharge rate being 240 amp.-hours. For charging these accumulators a boster is connected in series with the 500-volt bus bars. This booster consists of a rotary converter fed from step-down transformers of special design. Each transformer has the primary and secondary separated so as to give the effect of a considerable reactance, this arrangement giving a large range of voltage on the rotary converter to provide for the alteration in the charging volts required by the cells. The rotary converters employed at the generating station and at the substation are of comparatively recent introduction into this country, and have been employed in preference to motor generators on account of the high efficiency which they give and the general ease of their manipulation. They consist essentially of direct current generators, to the armature winding of which connections are made at suitable points to a set of three collector rings on the end of the shaft opposite that occupied by the commutator. The three-phase current is led into these collector rings and the machine is run at the correct speed for 25 cycles. The same winding thus serves both for the alternating current led into the machine and for the direct current taken out.

The system of distribution of electrical power is further specially designed to give the maximum power at any point of the system on the most economical basis. A 500-volt continuous current direct from the rotary conyerters in the central power house feeds the trolley lines on either side, while the Middlesbrough and Linthorpe sections of the lines are fed by a current transmitted at 2500 volts from the central station to the substation at Newport, and there transformed down so that power is delivered from this subcenter direct into the line at 500 volts.

The considerations leading to the adoption of this method of distribution had reference not only to the position of the main generating station and the properties otherwise available as car sheds, machine shops, etc., but to the length of the line, and the

regulations of the Board of Trade as to the earth return. The experience in Dublin was repeated here. With the number of motor cars to be operated on the lines in the borough of Middlesbrough, had the current been supplied at 500 volts direct from Stockton, the drop in the earth return between the termini at Linthorpe and Ormesby Road and the Stockton main station might have exceeded the prescribed limit, and in order to secure compliance with the Board of Trade regulations a substation was established at the Newport depot for the distribution of the current.

The feeder cable which transmits the three-phase current at 2500 volts from the central power house to the substation consists of two three-core cables, in each of which are three conductors of copper suitably insulated, each conductor having an area of 50 sq. mm. or .0775 sq. in. With this small section it is possible to transmit 300 kw with a loss of less than 5 per cent. At the substation this current is reduced by step-down transformers of 80 kw. capacity to 320 volts, and this current is then passed into the alternating current side of a rotary converter, from which a direct current of 500 volts is drawn to feed the portion of the line supplied from the substation. The two four-pole rotary converters of 200 kw. capacity running at 750 r.p.m. in the main power station feed direct into the portion of the lines supplied.

A novel feature of the main station equipment is the combination of static and rotary transformers for charging the batteries, specially designed for this installation. The charging current is passed through the rotary, and raised from the line voltage 500 volts to a maximum of 650 volts for charging. There being no direct current primary generators in the station, it became a problem how to charge the batteries for supplying the excitation to the three-phase generators. This was solved in the following manner: A rotary converter was designed to supply the difference between the line voltage and the variable voltage required for charging; combined with this is a static transformer having a ratio of transformation of 330 to 80 volts on a non-inductive load. The transformer was designed with a large amount of leakage between the primary and secondary, the leakage being adjusted so that by changing the phase of the armature current by variation of the field current of the booster, the transformer ratio is varied, and consequently the voltage on the collector rings. In this way it is possible to vary the voltage on the continuous side of the rotary from 40 volts to 150 volts. The charging current is 60 amps. The armature of the rotary is designed to carry 60 amps. continuously.

In common with the Bristol and Dublin lines, two wires are extended above the tracks from end to end of the system, and convey current to the car motors by means of trolley poles fitted upon each car. The wires are of hard-drawn copper, .364 in. in diameter, and are divided electrically in half-mile sections by sectional insulators. There are overhead points and crossings at the ends of the lines and at the branches leading into the main and substations, and on the lines as well as in the substations the cars are moved and handled entirely by the trolley.

The section pillars are placed at each half-mile section on the road. They are about 4 ft. in height, and are placed on the curb lines, so that they are accessible from either side. The "Columbia 0000 rail bond" is used.

The Middlesbrough & Stockton track has a gage of 3 ft. 6 ins., and it will be obvious at once that the problem of constructing roomy and commodious vehicles is much more difficult on a gage of 42 ins. than (as in Ireland) on a gage of 63 ins. The cars carry sixty passengers, thirty inside and thirty outside, and this is seven more than were carried by the first electric car put on the Dublin-Dalkey line, and sixteen or seventeen more than were carried on the first electric cars at Bristol. We have thus shown that by judicious planning even the narrow gage line can give on each car as much public accommodation as where the lines are wider. The use of the larger type of bogie-truck motor cars, which I especially designed for this line, obviates the use of trailer cars, which are opposed to the most advanced principle of street railway practice—namely, to employ as units of service self-contained cars run at short intervals.

THE LONDON UNITED TRAMWAYS

The main work at hand in this kingdom at present in the extension of electric traction is that in the western suburbs of London, on lines owned and projected by the London United Tramways, occupying the district extending from Hammersmith to Hounslow and Hampton Wick on the southern boundary, and from the Central London Electric Railway terminus at Shepherd's Bush to Hanwell and Uxbridge on the north, with junction lines uniting these tramways into one vast system, amounting, if all that has been proposed should be carried out, to over 39 miles of road line, and practically to 75 miles of track. As regards actual accomplishment, the system already extends (working or under construction) to about 27 miles of route, and the balance is, to the extent of 13½ miles, actually under promotion, while a section of main road of about 2½ miles through the suburb of Ealing will come before Parliament next session.

On 1 mile of this the London County Council insists that we shall experiment with some method of underground electric conduit.

The London United original system, which is under process of reconstruction as described, is unique in its electrical arrangements. On account of the requirements of the committee of the Royal Society appointed to protect Kew Observatory, the company has been debarred from using the rails as an earth return, consequently the overhead wires are on the double insulated trolley system. Such a system, when connected up on the two-wire principle, requires, practically, twice as much copper in the conductors as a trolley system installed on the usual lines. To overcome this difficulty, and likewise to increase efficiency, the overhead trolley wires are connected up on the three-wire system, the two center wires forming the neutral, and the outside wires the positive and negative side. The neutral wire is grounded at the station, and at the central station only.

In the present session we are promoting extensions from points on the Hounslow line, to bring into direct tramway relation with London the favorite residential suburbs of Twickenham, Teddington and Hampton Court. Should our application to the Light Railway Commissioners prove successful, we shall, when completed, have a comprehensive system of 40 route miles of electric lines, with 250 motor cars in operation.

The power station will be in High Road, Chiswick. It will be a one-story building of brick and freestone, 154 ft long and 106 ft. wide, divided into an engine and boiler room. The boiler room will be 45 ft. wide, and consist of a steel frame structure in order to carry the heavy weights due to the coal storage bunkers (holding 500 tons), economizers, flue and water tanks, which will be located on a floor above the boilers. This steel structure will extend to the roof, and thus make the boiler room practically independent from the engine room.

The coal supply will be delivered from the ground level outside the building to the coal bunkers above the boilers by a noiseless gravity-bucket type of conveyor, capable of handling 40 tons per hour. This conveyor will also remove the ashes, dumping them into a special ash bin, from which they can be readily removed. An additional coal store of 2000 tons' capacity will be provided north of the boiler room. It is intended to deliver coal to the stores direct from the North & South-Western Junction Railway's depot, about 700 ft. distant from the boiler room, by means of a gravity-bucket conveyor. Alongside the coal siding, and entirely below the surface, will be placed a receiving hopper with the necessary apparatus for the delivery of coal to the conveyor, thus enabling the coal to be handled automatically direct from the railway trucks and to and from the company's coal stores and to the stoker hoppers.

The boiler room equipment will consist of eight horizontal water-tube boilers, each having a capacity of evaporating 8250 lbs. of water per hour at a steam pressure of 160 lbs. Each boiler will be fed by a mechanical stoker of the "Coking" type, the coal being delivered to the stokers by weighing hoppers from the coal bunkers above the boilers, thus securing a record of the exact amount of fuel consumed by each boiler.

The economizer, located on the floor above the boiler room, will consist of 360 tubes in thirty-six sections, provided with motor-driven scraping and cleaning arrangements. Here also will be two water tanks of 6000 gals each.

The smokestack is to be 10 ft. clear inside diameter, and 200 ft. in height above the foundations. This stack will be built of steel plates in rings, lap-jointed and riveted, tapering upwards, and finished with an ornamental cap. It will be entirely self-supporting and lined inside with firebrick.

The engine room will contain one 25-ton overhead traveling crane traversing the length of the room. There will be three vertical cross-compound condensing 750-h.p. engines, with cylinders 22 ins. and 44 ins. x 42 ins. stroke, three of them running at 90 r.p.m., and each of these having two 500-kw. electric generators; the fourth engine, running at 94 r.p.m., will be direct coupled to a 500-kw. three-phase 5000-volt generator, with a frequency of 25 cycles per second.

The lighting sets will consist of two two-crank tandem compound engines, each directly coupled to a 75-kw. 500-volt generator, and running at 400 r.p.m.

The condensing apparatus will consist of surface condensers of the Admiralty type, each containing 3200 sq. ft. of cooling surface, and located on the engine room floor. Each condenser will be supplied with a vertical cross-compound combined air and circulating pump, with steam cylinders 8 ins. and 15 ins., and air and water cylinders 20 ins., double acting, all 15-in. stroke.

Two cooling towers will be erected for cooling the water for condensation, these being of the twin type, arranged in two sections, having capacity to care for 4000 h.p., covering a ground space of 40 ft. x 15 ft. and 38 ft. high. The mats composing the cooling surface will be of galvanized iron wire netting, and a proper distributing system for the water over these mats will be provided. There will be two air propellors for each section of tower, operated at 160 r.p.m. by a direct-connected electric motor when giving maximum capacity; two vertical compound duplex boiler feed pumps, each of sufficient capacity, will feed all the boilers. The hot well will consist of a cylinder 48 ins. in diameter and 96 ins. long, the feed water for the hot well being passed through two feed water filters to thoroughly extract all oil before passing to the boilers. An auxiliary feed water heater will be supplied, having 520 sq. ft. of heating surface for heating the feed water before passing it into the economizer, exhaust steam from the boiler feed pumps and other auxiliaries being available for this purpose.

One motor generator set, consisting of one three-phase synchronous motor, having 500 kw. capacity at 5000 volts, and direct connected to two 250-kw. 500-volt generators, will be located in the engine room for converting from direct to alternating current and vice versa, for convenience on light loads and as a spare generating unit.

The switchboard of white marble 2 ins. thick, bolted to angle-iron framing, will contain ten generator panels, two lighting generator panels, one instrument panel, nine feeder panels, and also two three-phase generator panels, and two three-phase feeder panels, and will be supplied with the necessary instruments and switches.

The electrical current will be distributed over the whole of the company's system by lead-covered paper-insulated cables, drawn into cement-lined wrought-iron pipes laid under the footpaths of streets. As many as thirty of these cables radiate from the central power station at Chiswick, over one million feet of these pipes being required.

The London United system is almost entirely double track, and over the rails of each track will be located two trolley wires about 21 ft. in height from the ground, the two inside wires being interconnected and forming the neutral. The overhead lines will be divided into half-mile sections, and in order to meet the Board of Trade's requirements, each 1½ miles of the line being supplied by an independent feeder running direct from the power station, the neutral return also being reinforced for each section of 1½ miles by a separate feeder.

A section of the line furthest from the center of the system, about 8 miles in length, will be operated from a substation. This substation will be fed from the central power station through duplicate three-core lead-covered paper-insulated cables, power being transmitted at 5000 volts on the three-phase system. The substation will have a switchboard consisting of two three-phase high tension feeder panels, six transformer panels, four rotary converter panels, four feeder panels, and two instrument panels, the switchboard being similar in design and finish to that in the main generating station. In the substation will be provided seven static transformers (one being an extra), each of 150 kw. capacity at 25 cycles per second, transforming 5000 volts to approximately 350 volts. The cooling air for these transformers will be supplied by an electric motor directly connected to a suitable fan. Four rotary converters will also be supplied, each of 200 kw. capacity, and 6-pole machines running at 500 r.p.m, and delivering current at 550 volts, for supplying sections of the line radiating beyond 6 miles from the central power station at Chiswick.

The substation is designed generally on the lines of that already existing at Stockton, but there is a difference in the electric connections, owing to the rotatory converters feeding into a three-wire system. These machines will be electrically connected, so as to act both as rotary converters and as balancers; that is, in case one side of the three-wire system be overloaded, the rotary converter acting on the opposite side of the system will act as a motor, and thus assist the overloaded machine.

New Cars for Camden

The Camden & Suburban Railway Company, of Camden, N. J., has recently put into service on its interurban line a large number of 40-ft. double-truck cars of the design shown in the accompanying illustration. These cars were built by the St. Louis Car Company, from plans and drawings upon which considerable time had been expended, as the desire was to get a convertible car to answer the purpose of both a summer and winter car in every particular. The length of the body from outside to outside of corner posts is 28 ft., and from outside to outside of vestibules 38 ft. These cars are built on the style of steam coaches, with straight sides, and have ten windows on each side.

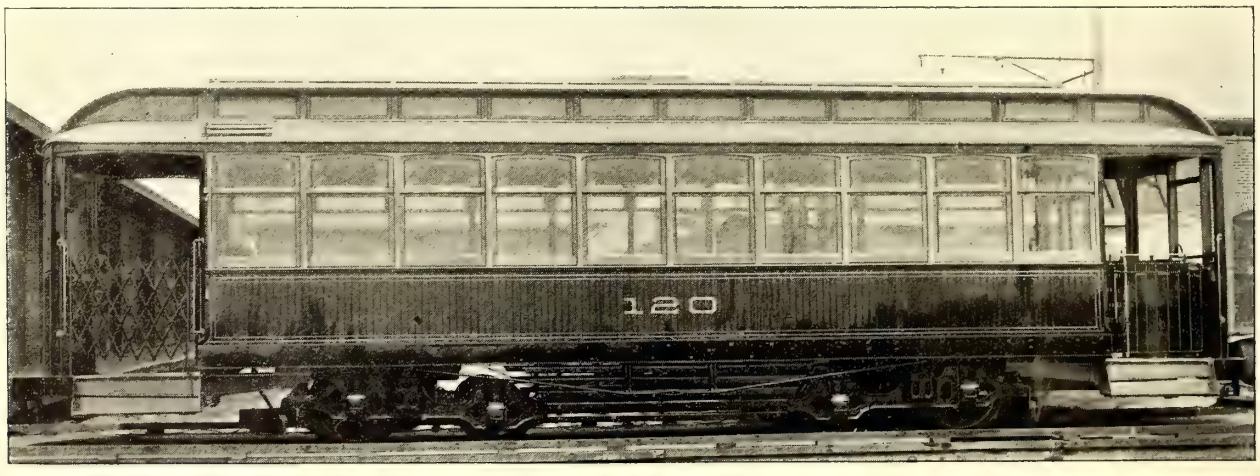
The side sills are plated with ⅝-in. x 8-in. steel plates, and the platform knees with ½-in. x 7-in. steel, while the bumpers are faced with ½-in. x 8-in. steel plates. The bottoms of the cars have truss rods extending from the corner of the sills through the inside sill to hold up the platform end of the car, and there is also a center truss rod between trucks underneath the sill. The cars are equipped with the St. Louis Car Company's patent sand boxes, and ratchet wheel brake, and are very handsomely finished throughout with solid bronze trimmings, highly polished.

The cars are furnished at each end with a vestibule 5 ft. long, with three drop sash in the end. The sides of the vestibule are open, and one side is provided with a Wood gate, while the other side is fitted with a large channel iron folding gate. Arrangements are made for one illuminated sign and hangers above the center sash in vestibule.

The interior finish of the cars is of the best quality white cane ash, finished in natural color. The ceiling is of quartered oak, finished in natural color and neatly striped. The seats are of the St. Louis Car Company's spring rattan "walkover" type. There are sixteen seats, accommodating two passengers each, and one stationary seat at each end accommodating three passengers each, making the seating capacity thirty-eight passengers to the car. The sides of the car are so constructed that when the sash are dropped down they are completely out of sight, and are held firmly by guides so they do not rattle. The opening is covered by a cap, which extends the entire length of the window pane. The windows are fitted with the best quality of Pantasote curtains, with the St. Louis Car Company's patent wire cable fixtures. One end of each car is fitted up as a smoking compartment, with sliding doors in the partition, but these doors and partition are so arranged that they can easily be moved by the railway company if so desired.

The roof is of the full ventilator, steam coach style, and is fitted with ornamental glass. The cars are wired for four two-light clusters, and one light at each end for illuminating the sign in the vestibule.

The bodies are mounted on the St. Louis Car Company's steel



DOUBLE TRUCK CAR FOR CAMDEN, N. J.

maximum traction trucks, No. 13. The diameter of the large wheels is 33 ins., the tread 2 ins., and flange ¾ in. The car will be equipped with No. 38 Westinghouse motors.

Report of the Detroit Street Railway Commission

On May 23, 1899, the commission appointed by the Detroit City Council to consider the purchase of the Detroit street railway system rendered a report to the Council, which is given in its entirety below, together with the report of the commission's actuary, Prof. Edward W. Bemis, of the Kansas State Agricultural College. A few words of preliminary explanation are perhaps necessary in order that the full meaning of this report be understood.

On March 24, 1899, the act known as the "McLeod Law," which authorizes the city of Detroit, Mich., to construct, acquire, maintain and operate street railways, was passed by the Legislature of Michigan and approved by Governor Pingree. It provided for the appointment of a street railway commission of three members, to be given authority to construct and acquire the railways for the city and to operate and maintain them. The Common Council of Detroit, in accordance with the act referred to, on April 1, 1899, selected H. S. Pingree, Elliott G. Stevenson and Carl E. Schmidt as members of the Detroit street railway commission.

The negotiations with the representatives of the street railway companies were concluded on May 23, 1899, and the result is given in the following report of the commission to the Common Council of Detroit:

To the Honorable, the Common Council of Detroit:

Gentlemen—We hereby report to you the result to date of the steps taken by the undersigned members of the street railway commission, looking to the acquirement of the street railways of Detroit for the purposes of municipal operation.

Two elements have entered into the question of fixing the value of such properties:

First. The physical property—real estate, power houses, cars, tracks, equipment, etc.

Second. The franchise rights and privileges, controlled and owned by the companies now operating such railways. This element, in short, is made up of the profit the present owners of the railway properties would make above operating expenses, fixed charges, interest upon value of physical property, etc., during the life of existing franchises.

To ascertain the value of the physical property we secured the services of the following experts: Prof. M. E. Cooley, J. D. Hawks, Gilbert Wilkes, George Dingwall, Albert Albrecht and Henry Spitzley, who were given instructions to take all the time necessary to thoroughly examine and ascertain the conditions of all the physical property, to verify the inventories submitted by the present owners, and to appraise such property at its present cash value—that is, what it would cost at this time to reproduce it, making proper deductions for depreciation on account of its use.

The experts named, we believe, have faithfully discharged their duties, and have reported the result of their labors. Their several reports fix the aggregate value of the physical property, after making allowance for depreciation, at $7,808,737.42.

The railway company insisted that this amount was too low by a million dollars. We have carefully investigated the claims made by the company as to the points of difference, and have reached the conclusion that, as to some parts of the property, the appraised value is a minimum value, and as to other parts it is the full value, and that, on the whole, the work of the appraisers is approximately the fair cash value of the property.

But for the purposes of our investigations and the calculations to be made to ascertain the value of the franchise, we have proceeded on the basis of the value being $8,000,000.

We have done this for the reason that in so doing the result in reaching the value of the entire property—physical and franchise—is not materially affected.

To make clear what we desire to express in this regard, it should be borne in mind that the franchise value is the aggregate of profits that would be realized during the lives of the franchises (reduced to present worth), and that to ascertain the profits, operating expenses and interest on the physical property necessary to produce the earnings, are to be deducted from the earnings. If the larger amount, $8,000,000, is taken as the value of the physical property, the amount deducted from the net earnings for interest on value of physical plant is larger, and therefore the franchise value is reduced, so that in reaching the net result, the difference, whether the value of the physical property be taken at $8,000,000 or $7,808,732.42, is comparatively slight.

To ascertain the value of the franchise owned by the railway companies Mr. E. B. Hutchinson, an expert accountant, has made a very complete examination of the books, records, vouchers, etc., of the railway companies, covering a period of four years, the entire period during which the railways have been operated with electricity as motive power. His report shows that the net earnings of the railway properties for the year ending April 1, 1899, were $805,000. While the work of Mr. Hutchinson was entirely satisfactory, we took the precaution to have it, in respect to the question of the gross and net earnings of the companies, verified by Prof. E. W. Bemis, whom we employed as actuary to make the necessary calculations to fix the franchise value of the property.

Prof. Bemis confirmed the result reached by Mr. Hutchinson as to earnings, but as a matter of precaution concluded it was prudent to deduct $55,000 from the net earnings as shown by the books for the past year, to cover possible, if not probable, increase in operating expenses, depreciation, etc.

The report made to us by Prof. Bemis fixes the aggregate value of the franchises owned by the railway companies at $8,478,563.86. His computation is made on the basis of $750,000 net earnings, deducting 4 per cent on $8,000,000, value of physical plant, and allowing for 4 per cent annual increase of traffic and earnings during the lives of the franchises. This franchise value, viz., 8,478,-563.86, added to the value of the physical plant, viz., $8,000,000, makes the total value of the street railway property and franchise rights $16,478,563.86. We submit herewith Prof. Bemis' report, showing the method adopted by him in reaching the conclusion he did, as well as observations made by him on the general subject under consideration.

In the matter of the franchise value, as in nearly every matter considered, we have had more or less controversy with the railway companies' representatives, and it is perhaps but fair that we give to the public their contention in relation to this subject, as contained in a communication submitted by them on being advised as to the result reached by Prof. Bemis, and the basis upon which he reached it. They contended as follows:

"1. That the method followed by the actuary of valuing the franchises is very unfair to us, because it allows only a 4 per cent annual increase in net earnings, while the net earnings of the company for the past four years have increased at a very much higher rate than the gross earnings. The gross earnings have increased at the average rate of 6.3 per cent per year, as shown by the report of your actuary. If a period of five years be taken, the increase in gross earnings is shown to have been nearly 8 per cent, and in view of the very much larger increase shown in the last few months, and the fact that the last four years have not been typical years of growth, the percentage of increase adopted by the actuary is entirely too small.

"2. That Prof. Bemis arbitrarily reduces the net earnings of over $805,000, as shown by your accountant, to $750,000, and as a result of this deduction of $55,000 a year, with its proportionate increase, the franchises are valued by him at over $1,000,000 less than they should be valued by the method of appraisal adopted by you."

In relation to the contention of the railway company above set forth, we were of the opinion that while the estimate as to increase of traffic and earnings upon which our calculations were based was lower than that shown by the experience of the railway company company here, as well as in other cities, during the four years referred to, yet we ought to have some margin in this record to offset possible reduction of receipts upon inaugurating three-cent fares.

In reference to their complaint as to the reduction of amount of net earnings to $750,000 from $805,000, we were of the opinion that it was justified as a matter of prudence and caution, and are therefore of the opinion that the amount fixed by Prof. Bemis represents the full value of the property.

After Prof. Bemis had given us the result of his investigations and calculations the railway companies' representatives submitted their first definite offer as to price, fixing their price for all the railway properties and rights at $17,500,000—the property being that a new security franchise covering all the lines be granted to a new company, which new company would execute bonds secured by mortgage on all the property of the companies and the security franchise for $17,500,000, and then the city would acquire such property, subject to the payment of such mortgage indebtedness.

We have strenuously endeavored to obtain concessions in the matter of price, and have succeeded to this extent only: The company offers to turn over to the commission, to be used for the purpose of making extensions, payment of interest, or carrying out the sinking fund provisions of the mortgage referred to, $400,000 of bonds, and one of the parties interested has offered to turn over for the same purpose an additional $300,000 of bonds, which would provide $700,000 as a safety fund, and practically reduce the purchase price to $16,800,000.

We feel warranted in saying that no better price can be secured on the terms indicated, which are substantially the only terms upon which we can negotiate.

We have had frequent conferences with representatives of the railway company with reference to the terms of the proposed security franchise, and have disagreed upon several important features.

We have contended for a thirty-year limit, while the company's representatives have insisted that under such a limit the sinking fund payments would of necessity be so large and unusual as to materially affect the saleability of the bonds. It is apparent that it would be of decided advantage to the city to distribute the payment of the mortgage indebtedness over a period approximating fifty years, so that the city might inaugurate three-cent fares, and pay such indebtedness out of the surplus earnings, after providing for reasonable extensions of track, increased equipment, cars, etc., to accommodate increased traffic, resulting from low fares. The contemplated arrangement, however, would permit of the payment of the whole or any part of the indebtedness at any time during the fifty years.

However, it was and is our view that without increasing the payments referred to, the security would be ample, even though but one-half of the bonded indebtedness should be provided for at the end of a thirty-year franchise, for the physical property—now worth $8,000,000—with necessary extensions, increased equipment, etc., would be ample security for the payment of what should remain unpaid at that date. But we have been unable to obtain the assent of the sellers to this view, or to any modification as to the length of the franchise, other than this: The security franchise to be for the term of thirty years, with the provision that at the end of that time if provisions shall not then be made for the payment of the balance of the mortgage indebtedness and the mortgage discharged, the franchise shall be extended until such indebtedness shall be paid, not exceeding eighteen years, the limit of time for paying it under the sinking fund provisions referred to.

So that at the end of thirty years, or for that matter at any time before that, by providing for the discharge of the mortgage indebtedness, the security franchise and all rights under it would terminate.

We have contended that the new security franchise should not disturb the provisions of the Detroit Railway franchise, which for twenty-six years secures to the people accommodated by it fares at eight tickets for 25 cents during the day. The representatives of the companies have contended for a franchise uniform in its provisions and embracing all the lines.

The company has finally receded from its position in this regard, and assents to the proposition that the provisions of the Detroit Railway franchise shall continue until the expiration of the same—twenty-six years hence.

We have contended for extension of hours for workingmen's tickets and transfer privileges, reduction of fares to school children, etc. The companies' representatives have stood for an extension of existing franchises, but have finally acceded to the following:

Six tickets for 25 cents, good at any time.

Eight tickets for 25 cents, 5:30 A. M. to 7:30 A. M.

Eight tickets for 25 cents, 5:00 P. M. to 6:30 P. M.

Ten tickets for 25 cents, 7:30 A. M. to 5:00 P. M., for pupils attending school; all with universal transfers.

To intelligently determine as to the advisability of acquiring the street railway properties upon the terms outlined, the controlling consideration, in our judgment, should be whether such a plan as is outlined can be carried out successfully and insure to the people of the city of Detroit three-cent fares immediately and permanently. With that end in view we have conducted our investigations, and have also given consideration to the consequences that might result from failure. We have, to the best of our ability, weighed all arguments for and against the plan, and have reached the conclusion that under the plan outlined, three-cent fares with universal transfers can be immediately and permanently secured to the people of Detroit.

In reaching this conclusion we have not only had the benefit of the judgment of people who are more competent to judge wisely in reference to the question than we are, but have also had the actual experience of the Detroit Citizens' Railway Company for seven months in 1896, during which time it operated its lines on the basis of eight tickets for a quarter. We found, according to the investigations made, that the gross earnings of the company were during that period greater on the basis of eight tickets for a quarter than they were during the same period the following year at six tickets for a quarter. The expense attending the handling of the increased traffic, however, exceeded the expense during the same period the following year, and the net earnings were slightly less than under the operation at six tickets for 25 cents.

The report of Prof. Bemis submitted herewith, as stated, outlines the basis upon which he reaches his estimate of the franchise values of the railway properties. The following shows the basis upon which the mortgage indebtedness referred to will be discharged through the sinking fund provisions of the mortgage:

$50,000 on the 1st of September, 1900, 1901, 1902 and 1903.

$75,000 on the 1st of September, 1904, 1905, 1906 and 1907.

$125,000 on the 1st of September, 1908, 1909, 1910 and 1911.

$180,000 on the 1st of September, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920 and 1921.

$200,000 on the 1st of September, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, and $37,800 September 1, 1947.

Those payments, together with the interest on the bonds, purchased for the sinking fund, by their use, will retire all of the $17,500,000 of bonds September 1, 1947.

It will be noted by the report of Prof. Bemis that he recognizes the possibility that for the first five years of operation on three-cent fares the net earnings of the properties may not exceed the net earnings of the past year at the higher rates of fare. Having this in mind, the sinking fund provisions have been so regulated that there will not be any danger, even if no increase in earnings is realized for five years, of not being able to meet the interest and pay the money required for the sinking fund.

To illustrate, the interest upon $16,800,000 would be $672,000; the sinking fund provision for the first four years is $50,000 per year, making a total of $722,000 annually, a sum $83,000 below the net earnings as shown for the past year, and $28,000 below such net earnings after making the deductions referred to for increased operating expenses, etc.

In fact, it will be seen from the figures submitted, that if no increase in the earnings over the last year was attained for twelve years, the interest upon the entire bonded indebtedness, and in addition the payments for the sinking fund, would be provided for safely, and the largest sum that will be required at any time, commencing approximately twenty-five years hence, would represent but $122,000 more than the net earnings of last year, as reduced by Prof. Bemis—an amount which would be largely made up by one item—of withdrawing deadhead tickets and having every one pay his own fare on the reduced basis.

That there are many items representing large amounts that can be saved under municipal operation, there can be no question—so many that we feel no hesitation in expressing our confidence that the security franchise, if granted, would never become more than a security franchise.

But, as stated, we have given consideration to the possibility of our judgment proving erroneous, and to the result that would attend the failure of municipal ownership and operation, and as we see it, the result would be as follows:

In any event, the city would control the situation, and the alternative would not be presented of having to pay the bonded indebtedness or permitting the security franchise to become an active one.

And the city could, in the event of being dissatisfied with the result of municipal ownership, lease the railway properties on the best terms attainable, using the rental, so far as necessary, to keep up the payments to which reference is made. Or, if any corporation or other organization would undertake the operation of the railways of Detroit on terms more favorable than the terms provided for in the security franchise, the city having control of the situation, could then make any bargain it saw fit, and either at once discharge the mortgage indebtedness by payment, or meet it as it matured under the provisions of the mortgage. This is made possible by a provision of the proposed mortgage that the mortgage indebtedness can be discharged at any time upon sixty days' notice.

If no more favorable terms could be obtained, the worst situation the city could be placed in would be that the security franchise would become an active one on the terms specified above. Such a situation would be much more favorable than the present, for the following reasons:

While the owners of the present railway properties give to the public six tickets for a quarter, they are not obliged to do so, but could at any time exact straight five-cent fares on all lines except the Detroit Railway lines. Under the security ordinance, if it shall become an active one, the railway companies would be required to sell six tickets for 25 cents, good at any time.

Under existing conditions, the eight tickets for 25 cents on the Citizens' line (workingmen's tickets) are good only between 5:30 and 7 A. M., and 5:15 to 6:15 P. M. No transfers are provided for on workingmen's tickets. Under the proposed security franchise workingmen's tickets at eight for 25 cents would be good from 5:30 to 7:30 A. M., and from 5 to 6:30 P. M., and transfers would be issued on all lines having same rates of fare.

The present franchises do not compel the railway companies to

grant transfers, although they do so at present on certain lines. Under the proposed security franchise the right of universal transfer on all lines having same rates of fare is secured.

Under existing conditions no concessions are made to pupils attending public or other schools of the city. Under the proposed security franchise for the use of pupils attending public and other schools in the city tickets good from 7:30 A. M. to 5 P. M. will be sold at the rate of ten for 25 cents.

On the whole, we think it will be recognized that even if the security franchise should become an active one, very substantial advantages are secured to the people of the city under its provisions. But, as stated, we feel confident that the security franchise would never become an active one, and that if the plan suggested can be carried out with the co-operation of your honorable body and the public, the people of the city of Detroit would immediately and permanently have the benefit of rates of fare as low as three cents, with universal transfers.

Before closing this report we desire to state that for several weeks past we have endeavored faithfully and earnestly to secure a reduction of the price. We have been unsuccessful, owing, we believe, in part to the fact that by the arrangement, as the owners view it, we would be securing the benefit of the use of this property without paying anything whatever upon its purchase price, or ever being required to pay anything except out of the earnings of that which is turned over by the present owners.

We would not look with favor upon the city becoming obligated to provide for the purchase price of the property, fearing that an increase for such purposes in the obligations of the city might hazard its present excellent credit. The proposition that is here presented is one that does not call for the payment of a single dollar by the city, or for the city in any way, directly or indirectly, becoming obligated, in any manner or at any time, for the payment of any part of the purchase price of the properties, nor is it rendered possible that in carrying out the plan the taxes of any taxpayer can be increased in providing for the purchase price.

The easy conditions under which the city can undertake the operation of the street railways undoubtedly enhance the cost, but the result, in our opinion, even at the enhanced cost, is simply to defer the time when rates of fare upon the street railways of Detroit can be reduced below three cents.

On the other hand, it should be understood that if the city should not acquire the railways under the proposed plan, the people of Detroit will pay to the owners during the life of the present franchises, in fares, more than the amount of the indebtedness which it is proposed to place on the property.

A study of the statement of payments required for the sinking fund will, we think, satisfy any one who will carefully consider the situation, that there can be no question as to the earnings providing for the payment of the property, even at the price demanded, and at the same time give the people of Detroit the low fares desired. The reduction of fares to three cents alone will represent a saving to the people of Detroit of $500,000 to $800,000 a year, which, within the life of existing franchises of the company, more than represents the franchise value of the properties of the railway companies.

This we report as the best price, terms, etc., we have been able to secure—the best, we believe, that can be secured. The question as to whether they are such as to warrant their acceptance is one which we feel ought to be settled by the electors of this municipality. It is a responsibility that the undersigned are not willing to assume without the sanction of the electors of the municipality, and we therefore report the situation to you, with the recommendation that, at a proper time, the question be submitted to the people for their decision. But we cannot recommend that any steps looking to the granting of a security franchise be taken under existing conditions, in view of the legal questions raised as to the power of the municipality to enter upon municipal ownership and operation of the railways.

If the security franchise referred to should be granted, and bonds secured by mortgage, including such franchise, were issued and sold to innocent purchasers, the franchise might—probably would—be held valid, even though the court might decide that the city could not, by reason of the constitutional objections raised, avail itself of the advantages we have been endeavoring to secure.

We therefore thought it prudent to co-operate in having the legal questions involved definitely determined, and regret that we feel it necessary to recommend that the matter of submitting the question as to whether the people desire the street railways of Detroit purchased upon the best terms we have been able to secure and operated on the lines indicated, be deferred until a decision shall be reached in the case now under consideration by the Supreme Court.

It does not follow, even though the decision of the Supreme Court should be against the constitutionality of the law under which we are now proceeding that the people of Detroit will, of necessity, be deprived of the advantages we have indicated they would secure under municipal ownership and operation of the street railways.

We have contemplated the contingency suggested, and have worked out a plan which, if acceptable to the owners of the railways, and should be approved by your honorable body and the electors of the city, would enable the people of Detroit, even in advance of the decision of the Supreme Court if desired, to avail themselves of such advantages under private ownership, surrounded by such safeguards as will protect the people in their enjoyment until the power shall be secured to enter upon municipal ownership and operation, if such power does not now exist.

H. S. PINGREE,
ELLIOTT G. STEVENSON,
CARL E. SCHMIDT,
Members Detroit Street Railway Commission.

RALPH STONE,
Secretary of Commission.

May 23, 1899.

REPORT OF EDWARD W. BEMIS, ACTUARY.

April 30, 1899.

To the Detroit Street Railway Commission:

Dear Sirs—I herewith submit as full a report of my investigation of the street railway properties as the time at hand allows, reserving for four or five days the presentation of such additional information within my possession as the needs of the commission may require:

I.—THE VALUE OF THE PHYSICAL PLANT

The appraisal of the structural value of all the street railway properties of Detroit, as given by your experts, is as follows:

Track, 175.95 miles, appraised by J. D. Hawks..		$4,350,183.42
Overhead construction, including feeders, ground wires, etc., appraised by Gilbert Wilkes		760,939.00
Citizens' power house	$440,894.04	
Detroit power house	366,249.32	
Citizens' repair shop	8,003.49	
Total power plant	$815,146,85	
Tools and supplies	75,990,59	
Rolling stock	1,102,212.39	
Total power plant, rolling stock, tools and supplies, appraised by Appraiser M. E. Cooley..		1,993,349.83
Car houses, land incident thereto and other land and buildings, appraised by George Dingwall, Henry Spitzley and Albert Albrecht...		523,248.30
Certain other buildings, fixtures and furniture, appraised by Messrs. Spitzley and Albrecht..		179,016.87
		$7,806,737.42

The average cost per mile, if based on the mileage report by the company of 177 miles of single track in the streets, is $44,106. The cost is much greater in Detroit than in most cities, because of the unusually fine roadbed, laid upon expensive concrete foundation, with steel ties.

Mr. Hawks allowed inspection charges of 2 per cent, engineering charges of 5 per cent, incidentals 10 per cent, and interest on the necessary investment during the course of construction at 5 per cent, thereby raising his portion of the appraisal to $24,150 per mile of a single track, or 22 per cent above the mere cost of material and labor. Such allowances, however, are common, and indeed necessary in such construction. It is also customary for street and steam railroad companies to give a contractor's profit of 10 to 15 per cent on the actual cost of construction. Companies even then will save money rather than by doing their own building. Mr. Hawks balances this contractor's profit over against depreciation, and makes no direct allowance for either in the above figures.

Mr. Wilkes does not explain in his appraisal whether he allows for engineering charges, incidentals, etc., but deducts an 8 per cent depreciation from his total of $827,108, in order to reach the figure given above, of $760,939.

Prof. Cooley has allowed 10 per cent as contractor's profit on the cost of reproduction of the Detroit Citizens' power house, and also 5 per cent a year for four years, or 20 per cent depreciation on the machinery there, including generators, 2½ per cent a year for four years, or 10 per cent, on the cost of electrical equipment, excluding generators, 2½ per cent a year for four years, or 10 per cent, on the cost of the building, or a total depreciation of 14 per cent. A similar treatment was applied to the power house of the Detroit Electric Railway, although for a shorter time, three years in the case of the machinery and generators, since they have

been more recently constructed. As Prof. Cooley states, "In obtaining the present value of the rolling stock and equipment parts, the condition of each separate article has been noted and a record made. The equipment parts were valued on the spot, but the valuation of the rolling stock was made after taking into consideration the amount of money spent per annum for repairs. The average percentage of depreciation for all rolling stock amounted to 16.8 per cent, or, in other words, the present value is 83.2 per cent of the cost of reproduction to-day."

The street railway officials would like to add $66,000 to Mr. Wilke's figures and $90,000 to Prof. Cooley's, on the theory that there is no present depreciation in the efficiency at least of the rolling stock; but there is a form of depreciation undoubtedly due to the progress of the art, the growth of invention, developing better types of cars, and ultimately forcing a company to discard cars that are as strong as when constructed. The company would also like to add $80,000 to Mr. Dingwall's appraisal, and $20,000 to that of Messrs. Spitzley and Albrecht, or a total of $256,000. Even admitting this claim, the grand total would only be raised to $8,062,737. In view, however, of the fact that there is that form of depreciation just spoken of above from the progress of the art; in view, further, of the exceptionally high prices of material to-day, although the same may continue for quite a while, and for other reasons developed in my talk with the appraisers, I am not disposed to concede any large portion of the $256,000. It is fair, however, to concede that several of the appraisers did not take into account, as indeed they were not asked to do, any interest during construction on the necessary investment, although it was done in other cases. It may fairly, therefore, be conceded that it would cost $8,000,000 to duplicate the present plant to-day, without making any allowance for any loss of profits during construction. In valuing the property in the further computations of this report, I shall, therefore, assume $8,000,000 as the fair cost of duplication. It would make no material difference, however, in the final conclusion, whether it be taken as a little higher or a little lower, because what is added to or taken away from my allowance of interest charge on the structural value of the plant would affect to nearly as great an extent in an opposite direction the allowances for franchise earnings.

II.—THE FRANCHISE OR MONOPOLY VALUE

Of the $8,000,000 total valuation of the tangible assets of the Detroit railways the following has been apportioned by the various appraisers as the valuation of the Detroit Electric Railway:

Track	$1,374,256.15
Overhead construction	255,327.00
Power houses	366,249.32
Other real estate	69,457.37
Rolling stock	201,705.00
Tools and supplies	7,599.06
Total	$2,274,593.90

This total of $2,274,593.90 is $41,659.22 per mile. The appraisers valued the property of the Citizens' Company at $5,532,143.22, or $45,197.24 for each of the 122.4 miles of track that the Citizens' Company seems to have, although Mr. Hawks allowed them a mile less. Reckoning 4 per cent as a fair interest on the structural value of the plant, or $90,983.76 payable yearly, the problem before us is to determine the remaining earnings of the plant during the next twenty-six years of the life of the franchise. The process taken has been the following: The total net income of all the city plants was $805,883.62 during the year ending April 1, 1899. Although the plant has been kept up out of operating expenses in such a state of physical efficiency as almost to justify the claim of the officials, that the plant is as efficient now and has as long a life before it, so far as wear and tear is concerned, as when it was constructed; nevertheless there is, as has already been stated, a depreciation because of the progress of invention, change in the taste of the people for style of cars, etc., which must be allowed for. The vice-president of the road, Mr. Hutchins, estimates that from $60,000 to $75,000 a year will have to be spent for the next ten years in enabling the plant to take care of increased traffic on the present miles of track, and it seems fair to consider $55,000 at least as nearly balancing the depreciation just mentioned, leaving the actual net earnings $750,000, or 93.03 per cent of the $805,883.62. Applying this same percentage to the net earnings of the Detroit Electric Railway last year of $135,996.79, there remains a true net profit of $126,558.64.

Further, the gross earnings of all the Deetroit railways have increased in the last four years at the rate of 6.3 per cent yearly, and the net earnings still faster. This is a lower rate than during the same time in Boston (rate, 8 per cent), Worcester (11 per cent), Springfield (12 per cent), and Lowell (10 per cent), Massachusetts, where sworn reeturns are made to the State. The present year, January to December, 1899, gives indications of yielding from 10 per cent to 12 per cent more than during 1898, if we may judge from the receipts since January 1. It has, therefore, seemed a conservative estimate to assume a future rate of growth of 4 per cent yearly. The competition of the bicycle is not likely to be any keener in the future than in the past, while the growth of population is on the outskirts, at greater and greater distances from places of work. To be sure, there are possibilities of invention, like that of the automobile, but when it is borne in mind that the total expense for motive power to-day in Detroit is less than 8 cents per car mile, and less than one-fifth cent per passenger, or 10 per cent of the total expenses, it will be seen that the possibilities for further economy in motive power are not great.

Returning again to the Detroit Electric Railway, let us assume its corrected net earnings of $126,558.61 increase during next year 4 per cent, or up to $131,620.95. Deducting from this the $90,983.76, as above found for interest on physical plant, there remains a monopoly, or franchise, revenue of $40,637.20, which would have a present worth, discounted at 4 per cent, of $39,052.34. Assuming for the second year that the above $131,620.95 increases at 4 per cent, and there would be at the end of the second year a net revenue in hand of $136,885.78. Deducting again the $90,983.76, we have $45,902.02 as the monopoly earnings during the second year. This has a present value on the same basis as before of 4 per cent of $42,413.47. Continuing this process, we have the following result:

Present worth of monopoly earnings of the Detroit Electric Railway:

First year	$39,052.34
Second year	42,413.47
Third year	45,729.93
Fourth year	48,739.41
Fifth year	51,844.17
Sixth year	54,631.08
Seventh year	57,349.15
Eighth year	60,020.98
Ninth year	62,582.38
Tenth year	65,038.95
Eleventh year	67,397.03
Twelfth year	69,663.83
Thirteenth year	71,847.44
Fourteenth year	73,956.92
Fifteenth year	76,002.40
Sixteenth year	77,995.11
Seventeenth year	79,791.99
Eighteenth year	81,542.64
Nineteenth year	83,261.08
Twentieth year	84,962.78
Twenty-first year	86,467.38
Twenty-second year	87,967.96
Twenty-third year	89,483.68
Twenty-fourth year	91,035.60
Twenty-fifth year	92,400.36
Twenty-sixth year	93,562.68
Total	$1,834.736.74

The present worth then of the probable monopoly earnings of the Detroit Electric Railway is $1,834,736.74. To this should be added the value of the physical plant as above determined, $2,274,594, or a total of $4,109,330.74.

Next, this method may be applied to the remaining railways of the city, which I classify under the general name of the Detroit Citizens' Railway. Since we assumed $126,558.61 as the present total net earnings of the Detroit Electric Railway, the remainder of the $750,000 above computed as the total revenue of all the lines in the city, or $623,441.39 is the present net earnings of the Detroit Citizens' system. Also assuming, as has been done above, that $8,000,000 is a fair value of the physical property, 4 per cent as interest on this is $320,000. Subtracting from this the interest, $90,983.76, allowed on the Detroit Electric Railway, and there remains as interest on the physical plant of the Citizens' lines $229,016.24. Following the same method as with the Detroit Electric Railway, we may assume the above $623,441.39 as increased 4 per cent yearly by increase of traffic. The total net earnings then during the first year would be $648,379.04. If from this we take the interest, $229,016.24, just found, there remains a monopoly earning of $419,362.80, which has a present value of $403,007.65. We then increase the $648,379.04 by 4 per cent for the second year's net earnings, and again deduct the interest charge of $229,016.24. Continuing this process for the ten years and eight months in which the entire Citizens' system has an uninterrupted franchise, and we have the following result:

Present worth of the monopoly earnings for ten years and eight

of the Citizens' Railway (including all except the Detroit Electric Railway):

First year	$403,007.65
Second year	411,455.21
Third year	420,320.76
Fourth year	427,274.97
Fifth year	435,774.80
Sixth year	442,270.42
Seventh year	448,865.05
Eighth year	455,670.60
Ninth year	462,151.31
Tenth year	468,334.75
Eight months of eleventh year	316,411.75
Total	$4,691,537.27

The total monopoly value of the Citizens' Railway for the next ten years and eight months may be assumed, therefore, as $4,691,537.27, to which may be added $5,274,594, as the value of the physical plant, making a total of $9,966,131.27. After ten years and eight months the eastern end of the Fort Wayne & Belle Isle Railway, which is that portion east of Clark Street, continues for seven months. That portion of the road had net earnings last year of $44,859.60, or 6.7 per cent of $623,441.39, assumed as the real net earnings of the whole Citizens' system. It should, therefore, be charged with 6.7 per cent of the interest charge of $229,016.24, or $15,344.09. The net earnings of the entire system the tenth year, on a 4 per cent increase, would be $922,845.51, and 6.7 per cent of this, or $61,830.65, may be considered as that portion of the total earnings of the Citizens' system that may legitimately be assumed as connected with this branch of the Fort Wayne system ten years hence. This would increase in seven months to $63,273.36. If from this be taken $15,344.09, as above described, there would remain a net earning of $47,929.28, but such a value eleven years hence is equivalent to $39,818.53 to-day. This may, therefore, be assumed as the value of that portion of the Fort Wayne franchise. The other portion of the Fort Wayne franchise, namely, that west of Clark Avenue, runs for twenty-three years instead of for eleven years and three months as does the portion east of Clark Avenue, and that portion of the line had net earnings of $30,307.29 last year, or 4.52 per cent of the total earnings of the Citizens' system; 4.52 per cent of $229,016.24 interest charge is $10,351.53. The same percentage of the net earnings of the tenth year of the whole system, namely, $922,845.51, is $41,712.62. During that year we must not only count, however, four months as not already included in the eleventh year in the previous computation of ten years and eight months. Continuing the same basis of reckoning as in the case of the Detroit Electric Railway, and the main franchises of the Citizens' systems, we reach the following result:

Monopoly value of the western portion of the Fort Wayne & Belle Isle system, after ten years and eight months:

Remainder of eleventh year	$ 7,145.39
Twelfth year	21,893.37
Thirteenth year	21,941.80
Fourteenth year	22,183.63
Fifteenth year	22,420.12
Sixteenth year	22,656.77
Seventeenth year	22,848.80
Eighteenth year	23,040.46
Nineteenth year	23,234.85
Twentieth year	23,435.42
Twenty-first year	23,592.11
Twenty-second year	23,757.77
Twenty-third year	23,936.78
Total	$283,087.27

The total monopoly earnings, then, of the portion of the Fort Wayne system west of Clark Avenue during the balance of the franchise is $283,087.27.

The Grand River Avenue system runs sixteen years and nine months from now. It had net earnings in the year ending April 1, 1899, of $161,615.38, or 24.12 per cent of the total earnings of the Citizens' system; 24.12 per cent of the entire interest charge of $229,016.24 on that system is $55,238.72. The same percentage of the total profits of the Citizens' system ten years hence, $922,845.51, is $222,590.34. There were only four months of the eleventh year, however, not included in the computations of the first ten years and eight months of the entire Citizens' system. The methods adopted above will give the following result for the remainder of the franchise of the Grand River system.

Present monopoly value of the Grand River system after ten years and eight months:

Eleventh year	$ 38,129.22
Twelfth year	115,761.35
Thirteenth year	117,087.08
Fourteenth year	118,377.59
Fifteenth year	119,644.92
Sixteenth year	120,902.42
Three-quarters of the seventeenth year	92,334.21
Total	$722,236.79

The main line of the Woodward Avenue expires in ten years and eight months, but the portion north of Pallister Avenue or thereabouts is a perpetual franchise, and is growing in traffic more rapidly than most of the city. It is also claimed by the company that if it should fail to secure a renewal of its main line on Woodward Avenue, it could build a short spur just north of the city limits to the Detroit Electric Railway line, which runs for twenty-six years, and thereby get to the heart of the city. It has been thought well, therefore, to compute the monopoly earnings of the Woodward Avenue line at 4 per cent for twenty-six years; that is, for fifteen years and four months after the expiration of the main line of the Citizens' system. This portion of Woodward Avenue now has net earnings of $44,077.72, or 6.58 per cent of the total earnings of the system. This percentage of $229,016.24 makes the interest charge to be apportioned to that part of the system $15,069.27. Likewise, 6.58 per cent of the net earnings of the whole system the tenth year, $922,845.51, is $60,723.24. Using the same methods as previously, the following result is reached.

Present value of monopoly earnings of Woodward Avenue north of Pallister Avenue after ten years and eight months:

Remainder of eleventh year	$10,365.44
Twelfth year	31,580.00
Thirteenth year	31,941.67
Fourteenth year	32,293.72
Fifteenth year	32,639.45
Sixteenth year	32,982.50
Seventeenth year	33,262.07
Eighteenth year	33,541.08
Nineteenth year	33,824.07
Twentieth year	34,116.06
Twenty-first year	34,344.16
Twenty-second year	34,585.38
Twenty-third year	34,845.93
Twenty-fourth year	35,132.63
Twenty-fifth year	35,358.67
Twenty-sixth year	35,519.09
Total	$516,331.92

This $516,331.92 is thus the present monopoly value on the above basis of that portion of Woodward Avenue north of Pallister, after ten years and eight months.

The last system to be considered is that of the Grosse Pointe line, east of Concord Street. This line also has a perpetual franchise, is one of the most rapidly growing lines in the city, and has a connection on Concord Street with the Detroit Electric Railway, which it can use for twenty-six years, although its direct connection on Jefferson Avenue expires in ten years and eight months, and on Congress Street in sixteen years and nine months. The net earnings of this Grosse Pointe line in 1898-99 were $33,365.04, or 4.98 per cent of the total of the Citizens' system; 4.98 per cent of the $229,016.24 interest charge is $11,405, and the same percentage of $922,845.51 gives the computed net earnings of the eleventh year of this road as $45,956.71. Taking the same basis of computation as in the previous cases, we have the following result:

Present worth at 4 per cent discount of the monopoly earnings of the Grosse Pointe line from ten years and eight months to twenty-six years hence:

Remainder of eleventh year	$ 7,872.27
Twelfth year	23,900.29
Thirteenth year	24,174.01
Fourteenth year	24,440.46
Fifteenth year	24,702.52
Sixteenth year	24,961.76
Seventeenth year	25,173.35
Eighteenth year	25,384.47
Nineteenth year	25,598.73
Twentieth year	25,819.72
Twenty-first year	26,009.88
Twenty-second year	26,174.92
Twenty-third year	26,372.11
Twenty-fourth year	26,589.10
Twenty-fifth year	26,760.17
Twenty-sixth year	26,881.58
Total	390,815.34

Thus the total monopoly earnings of the Grosse Pointe line on

the above basis, after ten years and eight months, may be computed at $390,815.34. This Grosse Pointe line increased 9.3 per cent in 1898 over 1897, and the Woodward Avenue line 7.91 per cent in net earnings, while the Fort Wayne increased 5.7 per cent, and the total increase for the whole city was 7.15 per cent. The actual net earnings were made the basis of the above computations, except in the case of Woodward Avenue north of Pallister, and in the separation of the Fort Wayne system into the division east and west of Clark Street. In these two cases the railroad kept no data, except the number of miles traversed by the cars during the last year on the separate divisions of Woodward Avenue and of the Fort Wayne system. But as the number of cars is regulated as closely as possible to the amount of traffic, it is a pretty fair test of net earnings, except as between lines like the Detroit Electric and the Citizens' where different rates of fare are charged.

No attention has been paid to the franchise value of the Michigan Avenue line west of Livernois of 4.36 miles, which has a twenty-eight-year franchise, nor of a long franchise on Mack Avenue of 1.53 miles. The latter, however, is not considered especially valuable.

We may sum up the results thus far by saying that the monopoly or franchise earnings of the various systems have the following value at present on the basis of 4 per cent increase.

Present worth of franchise earnings and of conservative prospects of growth:

Detroit Electric Railway	$1,834,736.74
Citizens', for ten years and eight months	4,691,537.27
Fort Wayne east of Clark Street, from ten years and eight months to eleven years and three months	39,818.53
Fort Wayne west of Clark Street, from ten years and eight months to twenty-three years	283,087.27
Grand River system, from ten years and eight months to sixteen years and nine months	722,236.79
Woodward Avenue north of Pallister, from ten years and eight months to twenty-six years	516,331.92
Grosse Pointe, from ten years and eight months to twenty-six years	390,815.34
Total	$8,478,563.86
Value of physical plant	8,000,000.00
Total	$16,478,563.86
Total value of physical plant and franchise, detroit Electric Railway	$4,109,330.74
Total value of Citizens' system	12,369,223.12

The above basis of reckoning has been accepted as correct by the commission and by the street railway, with the possible exception of some doubt as to the value of the Fort Wayne, Grand River, Woodward Avenue and Grosse Pointe lines, after ten years and eight months. The total on the basis taken in this computation, including all these lines, at the normal rate of growth of the whole system, is $16,478,563.86, or about $16,500.00.

This is practically the same result as would be obtained by reckoning the average life of all the franchises as a whole at sixteen years, nine months.

In the discussion of three-cent fares which follows, it is held that it would be probably wise to reckon on its taking about five years under such reduced fares to get back to the present rate of profits. Applying that to this calculation, it would appear that if the system is worth to the present owners $16,500,000, it is worth that to the city, less a postponement of five years, and plus the value to the people of a reduction of 1.1 cents per passenger, since the present fares average 4.2 cents for the 44,981,091 revenue passengers in the year ending April 1, 1899. The latter saving in fares would be about $500,000 a year to the people, therefore, on the present basis of traffic, or much more than the value of the five years' postponement.

Further calculation has been made of this kind. Suppose that during the next five years the net earnings of the system under three-cent fares only average the same as now, $750,000, being perhaps reduced to $500,000 the first year, and rapidly growing until the average of the five years was $750,000. We may even assume that the sixth year the net profit was only $780,000, and that it increased at 4 per cent thereafter. Assume further that every year from the start the city was obliged to pay $700,000 as interest at 4 per cent on any bonds issued for the plant, but in the first five years was only able to pay into the sinking fund sufficient to buy $250,000 of those bonds, the sixth year, to buy the difference between $780,000 and $700,000, or $80,000; the next year the difference between $780,000 compounded at 4 per cent, or $811,200, and $700,000 or $111,200, and so on for thirty years. At the end of this thirty years the city would have paid for $15,153,806, and in two years longer would be able to pay off $3,000,000 more, if that much were still due. However, I am decidedly of the opinion that it would be wise for the city to insist on having forty to fifty years for paying the bonds, with option of paying them at will sooner, and cancelling the security franchise. The great reason why it is proper for the city to take forty to fifty years while conceding to a private company only thirty years is that a private company is never known to the world over to attempt to repay to its stockholders and bondholders the value of the physical plant. That continues as an investment for the earning of profits. But in this Detroit case the commission is obligating itself to cancel the entire principal or cost of the physical plant, looking forward thus to the time when it will be no longer necessary to earn any interest or sinking fund charge, and when, therefore, fares may be reduced even to two cents or less. Further, in order to introduce three-cent fares, the city must count on the possibility of some reduction of earnings for three or four years, and a very heavy increase thereon afterwards, much beyond probably the normal rate of 4 per cent assumed above, unless contingencies now unforeseen should arise. It is therefore in the interest of the city to avoid any danger of defaulting on its bonds during the first few years, and this could best be secured by making the early payments into the sinking fund as small as possible.

THREE-CENT FARES

With regard to three-cent fares, I would say that the gross receipts per mile of track during the first seven months of 1897, under present rates of fare in the Citizens' Company, were $6,403. For a similar period in 1896, with fares of 3.45 cents, or .8 of a cent less than the year later, the receipts were $6,086 per mile of track. If we assume that the traffic in 1896 would have been fully 6.3 per cent less than in 1897, the receipts of 1896 would have been expected to be only $6,023, or 1 per cent less than they actually were. Since scarcely any increase per car mile of track was required to take care of this increased traffic, this basis of computation is not far out of the way, although in the course of years, increase of traffic would require some increase of equipment, and, therefore, of the interest charged per mile of track.

While the gross receipts were favorable under eight tickets for a quarter, because of the fact that increased traffic met reduced fares, the greater number of stops that the car must make per mile to take on and let off the larger number of passengers, the 1-7 more passengers per car mile and other reasons led to the fact that the expenses per mile of track in 1897 were $3,326, and in 1896 were $3,691, so that the net profits per mile of track, which were $3,077 per mile of track in 1897, were $2,395 in 1896, leaving a reduction of $682, that is, 28.3 per cent of the $2,395. Assuming that traffic would increase no faster under three-cent fares than it has done under four-cent fares, namely, 6.3 per cent yearly, it would have required about four years to have brought receipts per mile to the amount actually received in 1897, $3,077, that is, it would take four years to secure one year's gain, and it would require a fifth year, and possibly a sixth, to recover the losses of the first two years of the reduced fares. To-day the average receipts per passenger on all of the lines are 4.1 cents, although on the Citizens' line they are 4.244 of a cent per passenger. It should be stated that when the reduction was made in 1896, the state of war between the Citizens' and the Detroit Electric Railway compelled the Citizens' Company, according to their claim, to disregard many economies in the running of cars, which ordinarily would have been secured, and second, that since no one secured the advantage of cheaper fares except by ticket it did not reach the masses, who do not, as a matter of fact to-day, buy tickets by the quarter as much as do the rich and well-to-do.

This indicates considerable possibility of development of railway transportation with a straight three-cent rate.

Again, owing to the war then under way between two Detroit companies, a boycott was enforced against the Citizens' Company by many sympathizing with the efforts of the then Mayor, Mr. Pingree, to introduce low rates through the new Detroit Electric Railway. I should think, however, that it would be fair to consider that the average profit for the first five years under three-cent fares, would be about the average profit of the year just closed, namely, $750,000. It might be, of course, a little less, but could not be alarmingly so. A reduction of one cent of fare on the present 45,000,000 passengers would still leave $300,000 out of the $750,000, and, inasmuch as the traffic this year is already about 10 per cent more than last year, and would undoubtedly jump very much more than that for a while under three-cent fares, that item of increase alone would probably double this $300,000 in five or six years, to say nothing of various economies which would follow the increased traffic and saving incidental to municipal operation. And then in about five years the city might reasonably count on a 4 per cent rate of growth of net earnings upon $750,000. Giving 50,000,000 and more passengers yearly, a one-cent gift means half a million dollars a year, or 5 per cent on $10,000,000,

and when the traffic doubles, of course the benefit to the public would be proportionately increased. The people must pay the existing rate of fare to somebody for an average of seventeen years at least under private ownership, or give an equivalent for it in giving a company the right to exist during twenty or thirty years longer with a new franchise at higher rates of fare than the actual cost of transportation in future would render necessary.

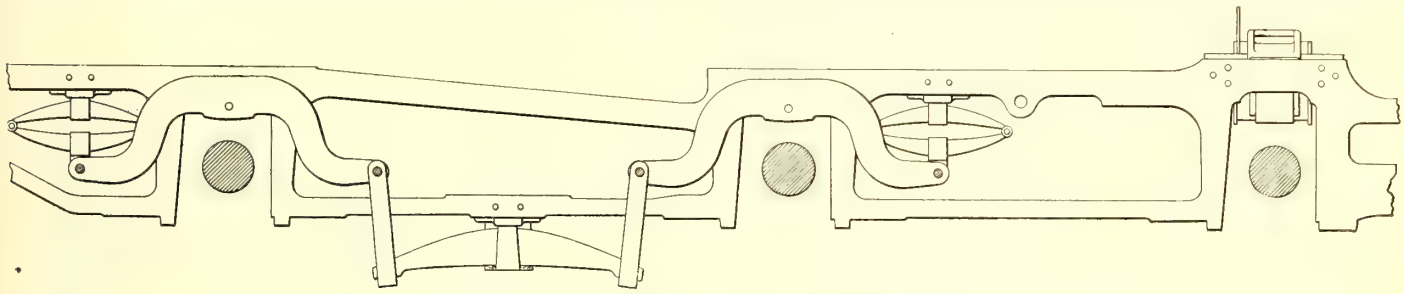
With regard to the practicability of universal transfers, I would say that while I have not much data on the transfer question, it has not seemed likely that universal transfers would diminish revenues more than they would increase them in the long run, because transfers would encourage many to ride who now walk.

EDWARD W. BEMIS.

The Functions of the Electric Truck II.

BY EDGAR PECKHAM

In the June issue of the STREET RAILWAY JOURNAL I took the position that the electric truck and the framing of a locomotive were not comparable, because of the difference in the burden and the duties imposed upon them. That I may still further substantiate this position, I have taken the framing of the Brooks express passenger locomotive of modern type, illustrated in the May issue, and propose to show that the horizontal and vertical stresses are very different in their ratios and intensities from that imposed upon an electric truck.



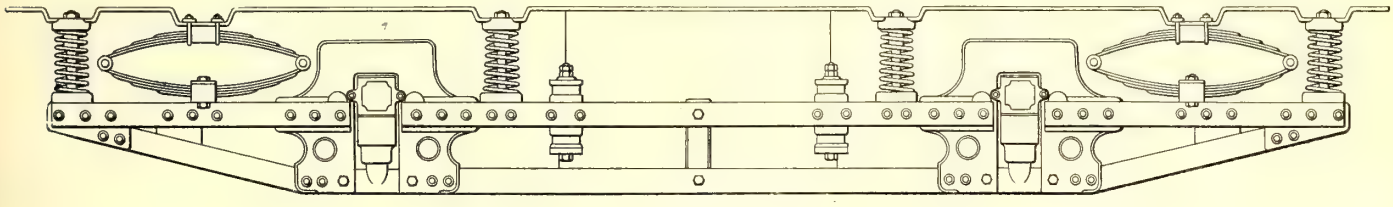
SIDE VIEW OF FRAMING OF BROOKS LOCOMOTIVE

Attention has already been called to the fact that an electric car is merely called upon to propel itself with an occasional trailer, while the locomotive is designed and intended to haul a heavy load, while its own propulsion is merely an incident to the work by which its earning powers are measured. In the case of the locomotive under consideration the cylinders are 18 ins. in diameter, with a piston stroke of 26 ins. With a steam pressure of 180 lbs. per square inch, this piston will produce a horizontal stress upon the frame of 45,800 lbs.; a stress that must be carried from the cylinder back to the front driving wheel pedestal, beyond which it is reduced for distribution to the other wheels. But there are positions of the crank when the whole of this enormous force must be carried by the frame back to the main driving wheel pedestal, a distance of 12 ft., so that the frame must be constructed with all the elements of a column capable of sustaining that load without buckling. Under such circumstances it is essential that the frame should have a high degree of lateral, as well as vertical stiffness. The former is obtained in the case in hand by using bars 4 ins. wide, and the latter by using two bars, thus obtaining a total depth of 23½ ins. between the pedestals, which is amply sufficient to meet any demands that may be made upon it. This is the American practice, and it is rapidly coming to be considered the best, though it is by no means universally acknowledged to be so. The plate frame must be stiffened laterally in order to meet these demands.

In the matter of vertical stresses the case is quite different. The front end of the frame carries no load whatever. The whole of the weight of the cylinders, the smoke-box and the front end of the boiler, with all of the extra attachments, such as the pilot and the like, at the forward end, rest directly upon the truck and the front drivers without any intervening vertical stresses on the frame. In fact, the whole front end of the frame is *carried* by the cylinder castings, and the only demands that are made upon it vertically are that it should have sufficient strength to carry its own weight; a condition that is very easily fulfilled, and which does not call for the great width and depth that are always given to these frames.

The rear end of the frame carries the back end of the boiler, and it is here that the only vertical stresses of the structure are to be found. Let us see how these weights are distributed. The bottom of the fire-box rests at two or three points on top of the upper rail, back of the main driving wheel. The frame itself is carried on three points. The equalization is such that one-half of the burden is carried by the two outside springs, and the other half by the one in the center. It will be seen, from an examination of the engraving, that the rear support is located directly beneath the fire-box, so that the vertical stress upon the bar of the frame at that point is merely a crushing stress upon the metal, and need not be considered. At the front end there is the same weight to be carried, and this does put a vertical stress on the frame. It comes from the weight of the frame itself, and that portion of the fire-box weight that is carried forward to it. As the distance out to the point of support is short, and as the stress is carried to it by that portion of the frame which is the heaviest, it may be disregarded and our attention turned to where the greatest stresses are to be found.

It will be seen that this is at the central portion, and that one-half of the total weight imposed upon the driving boxes is carried on the lower rail running between the pedestals of the main and rear drivers. This rail has a width of 4 ins., a depth of 2½ ins., and a length of 5½ ft., that may be attributed to this section. The stress put upon the rail is well within the elastic limits of the iron from which the frame is forged, as the load imposes a fiber stress of less than 6000 lbs. per square inch upon the metal when standing, and which does not rise to more than 9000 lbs. under the most unfavorable conditions of running, for the actual static load carried at this point is about 10,500 lbs. To this, 50 per cent may be added for the running load when moving over a rough track.



SIDE VIEW OF FRAME OF CANTILEVER TRUCK

It appears, then, that the builders of the modern first-class locomotive fully realize that the duty of the frame is to haul a load and not to carry one, and they therefore design accordingly.

Let us now consider the electric truck. The framing illustrated is that used to carry the ordinary electric car. The conditions are that it shall carry a car body weighing about 8300 lbs., and in addition thereto about one-half the weight of two motors, or 2500 lbs. more, which is distributed on two points of support. To the weight of 8300 lbs. must be added that of the passengers, which may be taken at 15,000 lbs. more, for a maximum, making a total of 25,800 lbs., which, owing to greater liability to track inequality than in the case of steam roads, should, with the motor weight, be increased by 50 per cent. This gives a total running load to be carried by the truck of 38,700 lbs., making a running load of 9675 lbs. for each axle box.

Again, as the total weight of the loaded car, including wheels and axles, is about 33,100 lbs., we may take one-quarter of this as the effective weight at the rail for each wheel. If we assume the

coefficient of friction between the wheel and the rail to be .35, the propulsive force exerted by each wheel at the rail will be:

$$\frac{33{,}100 \times .35}{4} = 2721.25 \text{ lbs.}$$

Deducting that due to the wheel and one-half the motors, which are taken to be equal to 1100 lbs., and treating this weight in the same way, we have 2336 lbs. as the propulsive effect of each axle box upon its pedestal; a thrust whose intensity is divided between the cantilever overhang and the central portion of the truck, in proportion to the weights carried on these parts respectively, and which will now be shown.

Reverting the vertical stresses which the cantilever truck is called upon to sustain, and which it is capable of sustaining, carefully conducted tests have shown that the cantilever will sustain a load of 5 tons at a distance of 38 ins. from the center of the oil box without being strained beyond its limit of elasticity, showing no permanent set after the removal of the load, while a load of more than 10 tons was required to buckle the lower bar and distort the frame. This places the sustaining power of the cantilever truck frame at 190 inch tons, or 380,000 inch lbs.

With the ordinary running load of 9675 lbs. per wheel, that has been assumed, the spring deflection ordinarily used has been found to be 2⅜ ins. The weight is carried by three helical and one elliptic springs. Calibrations of these four springs show that the stresses applied by them to the frame, when deflected 2⅜ ins., are as follows:

	Pounds.
Helical spring between boxes	2,753
Elliptic	2,749
Intermediate helical	2,753
Outer helical	1,420
	9,675

The distances of the elliptic, the intermediate helical and the outer helical springs from the center of the axle box are 22 ins., 38 ins. and 47 ins. respectively. Multiplying these weights carried by the springs by their several distances from the axle center, we find that the total running load upon its cantilever is 231,832 inch lbs. or exactly 61 per cent of a load that is still within the limits of elasticity of the structure.

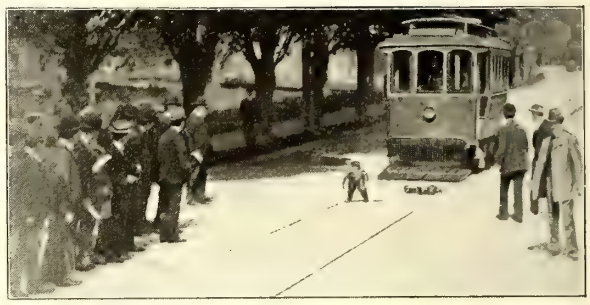
What I wish particularly to emphasize at this point is the fallacy of that position which assumes that the stresses upon a locomotive frame and that of an electric truck are at all comparable. I have shown that the horizontal stresses in the former amount to 45,720 lbs., which must be sustained by a column 12 ft. long, whereas in an electric truck the horizontal stress on the cantilever is but 2336 lbs., divided into items of less than 800 lbs. each, located at distances of 20 ins., 36 ins. and 45 ins. from the base. When the relative dimensions of the column are considered, any comparison of the horizontal stresses imposed simply become ridiculous.

The same absurdity appears when the vertical stresses are taken into account. With the locomotive having a total weight of 130,000 lbs. the greatest vertical stress on the frame is 10,000 lbs., while the horizontal thrust is 45,720 lbs., or a ratio of .24 to 1. In the case of the electric truck, on the other hand, with a total weight on the wheels of 33,100 lbs., the vertical stress amounts to 6922, while the horizontal stress is but 2336 lbs., giving a ratio of 3 to 1, or a difference in ratios of about 1 to 12. It is no wonder, then, that the lines upon which the framing of the locomotive and the successful electric truck have been developed are quite different. They are intended for different purposes, and naturally they do not and ought not to resemble each other either in design or in the distribution of the metal of which they are composed.

Now, as to the durability of the riveted cantilever truck frame. The first Peckham cantilever trucks of their present design were furnished to the Brooklyn City Railway, of Brooklyn, in 1892, for use under its 20-ft. closed (28 ft. over all) cars. As these were the first electric cars constructed of this length, they were considered experimental, it being a question as to the ability of a single truck with a 7-ft. wheel base to support a 20-ft. closed car. To determine this and the truck best adapted for the purpose, the Brooklyn City Railway gave every truck maker an opportunity to test his truck under these cars, and ten or eleven different styles of trucks, including the solid forged truck, were represented. As the result of this trial the Peckham extra long cantilever truck was adopted, and over 1200 were supplied to the Brooklyn City Railway during the years 1893, 1894, 1895, all of which are now in service. The rivets in these trucks are still tight, and give no evidence of becoming loose. Twenty-five trucks of this design were also furnished to the Broadway Cable Railway in 1893 for use under its 22-ft. closed (30 ft. over all) cars, and have been in constant use, winter and summer, ever since, and no trouble has been experienced on account of broken or loose rivets, although at that time the riveting was done by hand instead of by pneumatic power, employed the past four years. Considering the severe service to which they have been subjected under these heavy cars, which are frequently overloaded, the fact that they have run such a length of time (seven years) without the rivets becoming loose demonstrates the shallowness of the claim that the rivets are an element of weakness, and likely to work loose as a result of the jars to which they are subjected, and also as to the ability of the cantilever truck to successfully support a 20-ft or 22-ft. closed car under the most severe conditions. As to the comparison of the service between the cantilever and the solid-frame trucks, it would be very interesting to know the history of the solid-framed trucks put into service in 1892 and 1893, and how many changes have been made in their design and construction since that time to overcome their demonstrated defects, and also as to their ability to carry 20-ft. or 22-ft. car bodies without the aid of an auxiliary pipe truss, which is never used under closed cars with the cantilever truck.

Photographing a Fender Test for the Mutoscope

In these days of business activity, when Yankee genius and energy are being taxed to the utmost to develop new and successful methods of increasing trade and selling goods, an idea, to deserve special mention, must be exceedingly novel and valuable. To the







VIEWS SHOWING FENDER IN SERVICE

Hipwood-Barrett Car & Vehicle Fender Company, of New York, however, unquestionably belongs the credit for furnishing one of the cleverest and most unique schemes of advertising that has appeared for some time.

This company's fender has been in operation for about twelve months on the Newton & Boston Street Railway, of Newtonville, Mass., and in that time has fully demonstrated its value as a life-saving device. So sure were the inventors that the fender would pick up any object in its way under all conditions that they opened negotiations with the American Mutoscope Company for taking photographs of a practical demonstration of the device, for re-

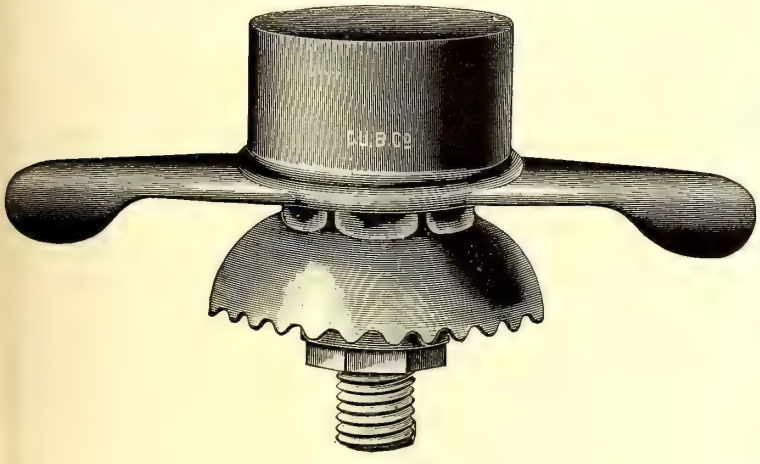
production in the mutoscope and biograph throughout this country and Europe, on the grounds that a moving picture of this kind could not fail to excite general interest. These negotiations were successful, and on May 10 a very satisfactory test of the fender was made at Newtonville, and photographed by the mutoscope camera. The picture secured makes one of the most interesting views owned by the Mutoscope Company, and will be shown in nearly every city in America and in the largest cities abroad. It was shown at Boston, and also daily for two weeks at Keith's Theatre in New York, to large crowds, who never failed to manifest special interest when it was thrown on the screen. The fender company also has a mutoscope at its New York office, showing the test. Although taken primarily for its popular interest, the picture is, of course, a splendid advertisement for the Hipwood-Barrett fender, and the company is to be congratulated on its enterprise in arranging the details for the mutoscope demonstration. While the views were being shown in New York, representatives from nearly every street railway company within a radius of 25 miles accepted invitations from the fender company to attend the performance at Keith's, and, of course, saw about as forcible an argument as to the ability of the device to save life as could be desired.

Some of the details of the demonstration will be of interest. Two dummies stuffed with sand and sawdust were employed, one weighing about 30 lbs. and the other about 50 lbs. The smaller one was laid upon the track with its head upon one rail, and one of its arms extending out in the direction from which the car was coming. It is particularly noteworthy that this arm was only about 1 in. in diameter. The other dummy was placed about 10 ft. from the first, and in a standing position. The car was started at full speed, nearly two blocks from where the dummies were placed, and was going at about 15 miles an hour when it reached the spot. The fender was dropped 1½ ft. from the first dummy, and picked up both of them without the slightest difficulty. No marks or tears of any kind appeared on the bodies. The mutoscope camera was directed toward the car through the entire operation, and every detail is very clearly brought out in the picture. The photographic film was 160 ft. in length, and there were 1200 separate views. It took just twenty-seven seconds to complete the test. In the accompanying engravings are shown three of the scenes that go to make up the complete picture.

Straight Line Hanger

The accompanying illustration shows a straight line hanger known as "The Gem," manufactured by the Central Union Brass Company, of St. Louis, and sold through the Central Electric Company, of Chicago, as general agents.

The hanger was designed on the well-known West End lines, but changed so that, it is claimed, there is no possibility of trouble



"THE GEM" STRAIGHT LINE HANGER

from the loosening of the cap which holds the insulated bolt in place, due to the continual vibration of the trolley wire.

It will be noticed that this hanger has no cap to jar loose, the skirt of the hanger being that part which holds the insulator bolt in place by the pressure of the span wire against the corrugation in the neck of the skirt. The skirt in the hanger has a fluted or beaded edge, which, in heavy rain storms, forces the water to run off in streams, therefore cutting down the leakage to a minimum. In this manner of construction it is possible to make several combinations of materials, such as using a malleable iron body with a bronze skirt, or malleable iron skirt with a bronze body or all iron or all bronze. The threaded portion of this hanger is so well protected that it is absolutely impossible for any moisture to get through into the insulation.

When double-petticoat glass insulators were first placed upon the market they became a universal standard, owing to their having less leakage than any other insulator made at that time.

The beaded skirt of "The Gem" is claimed to offer the same amount of protection against the leakage of current as the double petticoat does to the glass insulator.

Mechanical Power Brakes

The subject of brakes is one of the most important to be considered in the equipment of the modern electric railway. That the increased weight and high speed of the modern motor car demand a more powerful and effective brake than was necessary for slow-moving horse cars is generally admitted. Since the general adoption of electricity on street railways, various brakes have been put on the market, operating by compressed air, electricity and other agents. One of the most widely adopted substitutes for the old-fashioned chain and spindle brake is the Sterling safety brake, made by the Sterling Supply & Manufacturing Company, of New York, and introduced about five years ago. Since that time the brake has been extensively adopted, and its reliability and efficiency proved in service. A severe test of this brake has been made at Troy, N. Y. The line of the Troy City Railway extends for the greater part of its distance over a series of grades, some of them being over 10 per cent. The company has from thirty-five to forty of its cars equipped with the Sterling brake, and the management states that it is fully efficient and reliable. The brakes have also been used for three years by the Buffalo Railway Company, which has had seventy equipments. The Sterling Company also reports brakes in use in Rochester, N. Y.; Worcester, Mass.; Manchester, N. H.; Indianapolis, Ind., and many other cities. Its salient features are safety, ease of operation, great power and durability, and these advantages are realized with extreme simplicity of design.

It is, strictly speaking, a mechanical power brake, and is made up of a double sprocket wheel carrying two continuous chains and geared to the brake staff. The ratio of gearing is sufficient to afford easy and positive operation without sacrificing quickness of action, multiplying the motorman's power and enabling him to manipulate the brake shoes so as to greatly overcome the sliding of wheels. The wear on chain and gears is reduced to the minimum, being equally distributed, and there is not the continual "grinding," wearing through and replacing of chain, common to the ordinary brake. This is quite an important item, as the old-fashioned chain on a spindle shaft wears out on an average in from four to ten months, and costs considerable for maintenance. The Sterling brake is also adaptable to either single or double truck cars, and can be easily applied to old as well as new cars. With this device the motorman is enabled to control the car in any emergency with comparative ease.

Naturally it is argued that heavy cars and heavy grades create the principal demand for safetey brakes, and in service, the Sterling brake has proven fully effective as a medium of safety on heavy cars and grades. However, its adoption and use has not been limited to roads having heavy grades, as experience has proven to the majority of managers that even on a level, or a slight grade only, emergencies arise which require more safety and efficiency than is afforded by the ordinary brake. Hence the Sterling safety brake has been adopted, not alone because of its efficiency on heavy grades, but on any grade, and because of the medium of safety it affords against accidents, and suits for damages consequent thereto.

Sales of Hose Bridges

The portable hose bridge manufactured by the Ohio Brass Company, of Mansfield, Ohio, and which was described in the last issue of the STREET RAILWAY JOURNAL, is meeting with an increasing demand. The manufacturers report recent sales among some of the largest and best known street railway companies in the United States, bridges having been shipped within the last month to the Syracuse Rapid Transit Company, Chicago City Railway Company, Toledo Traction Company, Nashville Street Railway Company, Knoxville Traction Company, the People's Railway Company, of Dayton, Ohio, and numerous others.

The Provincial Council of Macerata, Italy, has voted a subsidy to the town of Camerino to construct an electric railway between that city and Castelraimondo.

Surface Contact System at Tours

The tramway company of Tours, France, has recently installed the Diatto surface contact system for electric railways, and the first section of this line was put in operation April 22, before a large assembly of French electrical engineers and tramway managers. Considerable interest has attached to this system, owing to its adoption on such a large road, as the tramways in Tours measure 23 km. (14 miles) in length, and of this 12 km. (7 miles) will be equipped with the surface contact system, and the rest with the trolley system.

The principle of the Diatto system consists in the operation of a plunger by magnets carried on the car, the plunger making contact between the main source of supply and a surface knob, from which the current is taken by a skate to the motors. The special features of the system consist mainly in the method of improving the magnetic circuit about the plunger, so as to secure better control over it from the car.

A section of one of the contact boxes is given on page 487. The upper part of it consists of a block of asphalt, in the center of which is a button, *C*, of soft iron, resting in a flange, *A*, of bronze or other non-magnetic metal. The button *C* terminates in a carbon contact point, *D*. The plunger, which is of iron with a carbon head, is shown at *K*, and slips inside of an ebonite tube, which is partially filled with mercury, so that the plunger floats normally in the position shown in the cut.



SECTION OF COMPLETED TRACK



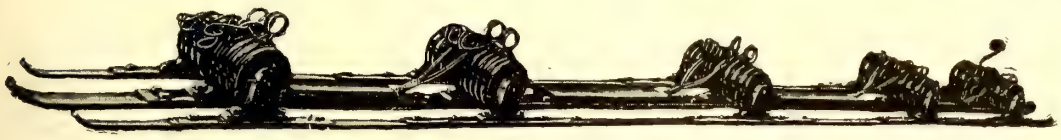
LAYING THE TRACK

The lower part of the mercury is connected with the main source of supply, *Q*, and at the upper end of the plunger is a carbon contact button of proper shape to engage with the button *D*. On each side of the plunger tube are two large soft iron wings, *M*, embodied in the asphalt, and with upturned extremities, so as to assist in completing the magnetic circuit as they are turned up toward the magnets carried on the car.

The skate, or collector, on the car is composed of three bars with upturned ends, as shown on page 487, between which is mounted a set of electric magnets, so arranged that the central shoe will be of north polarity, while the outside shoes are of south polarity. When carried on the car the central shoe passes directly over the contact knob and the outside shoes over the extremities of the flanged magnetic yoke in the asphalt. The plunger will then be attracted upward, when it will be brought into contact with the carbon button on the surface knob, and current will be taken into the cars through the central shoe.

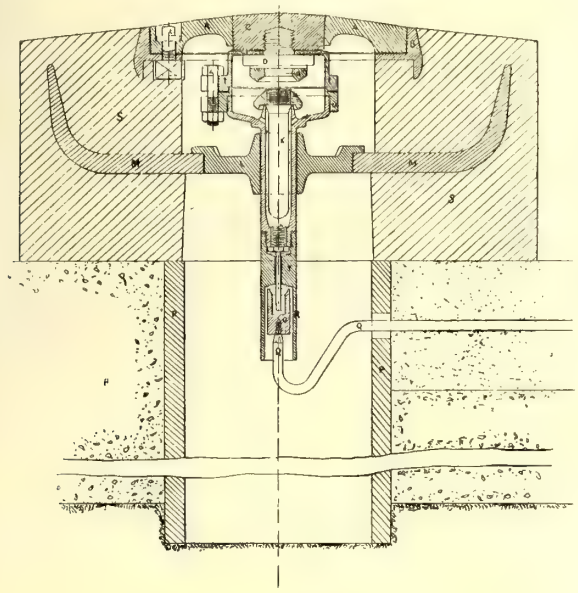
After the car has passed, the plunger drops down to its original position by gravity. Owing to the curved shape of the ends of the contact shoes, it is claimed that the electrical contact will be broken before the magnetic circuit. Consequently, any arcing which may occur from breaking the circuit will take place between the shoe and the contact button, and not inside the contact box, as no current will be passing from the button when the plunger falls back to its original position by gravity. It is claimed, however, that there will be no arcing whatever, as the skates are long enough to span two contact buttons. It is claimed that the amount of residual magnetism possible to be retained by the soft iron contact block is insufficient to overcome the weight of the plunger, and that consequently there is no possibility of the latter sticking in a raised position. Nevertheless, to satisfy the City Council of Tours, the railway company has attached to every car

a short circuiting device, consisting of a grounded brush, which is carried at some distance behind the car. If this brush should pass over a live contact block it will sound an alarm and also blow the main fuse of the car. To operate the magnets at starting, a small storage battery is carried on the car.



SKATE OF TOURS CAR

The length of the line now operated in Tours on the Diatto system is 2 km., and on the trolley system, 3.6 km. The Tours Tramway Company is building a large electric power station to operate its lines. There will be three 300-h.p. engines, built by Piguet & Co., Lyons, each belted to a 200-kw. generator, supplied by the Société d'Applications Industrielles. The generators will be wound for a voltage of from 550 to 600, with 12 per cent compounding. The cars of the company were supplied by the Compagnie Générale de Construction, of St. Denis, and the material for the overhead line, rail bonds, I. T. E. circuit breakers, etc., by R. W. Blackwell & Co.



SECTION OF CONTACT BOX

The Diatto system will also be installed at Lorient and Rheims, France.

New Cars for the Chicago City Railway

The new closed electric cars for the Chicago City Railway Company, which are now being completed by the John Stephenson Company, Ltd., at its Elizabeth works, are extremely tasteful in design and finish. The cars are 20 ft. long over corner posts, and 30 ft. over all. They have concave and convex paneled sides, with body 7 ft. 6 ins. wide at belt rail, and 6 ft. 2 ins. wide at sills.

The platforms are 4 ft. 6 ins. long, and are enclosed by vestibules having three drop windows, angularly placed. The front of the vestibule, however, is curved in form below windows, and is faced with sheet steel. The platforms have entrances at both sides, and are fitted with three-part doors, folding against vestibule. The steps are pressed steel, with rubber treads. The platforms are also fitted with angle-iron buffers.

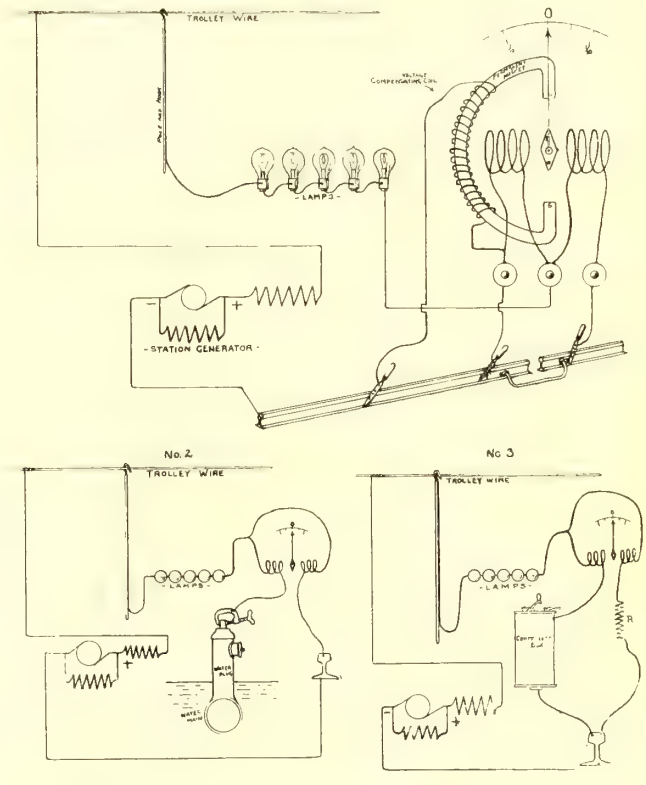
The body has six windows on each side, and all glass and sash frames are set in specially molded rubber pockets, which prevent all rattle whatever from this source. The interior finish is in cherry, stained dark, with hand-carved window and door pilasters and pressed mouldings, giving a very rich and handsome appearance. The ceiling lining is birdseye maple veneer. The seats are of the side pattern, with spring cushions and backs, covered with olive green carpet, and were supplied by the Hale & Kilburn Company. The metal trimmings are extra heavy bronze throughout.

Cars are painted in olive green in varying shades, the deck sash being set in green rippled glass to match. On the hoods are Hunter illuminated signs. The cars are wired for two light circuits, *i. e.*, eight lights in the body, arranged four in each corner of the monitor and two along the sides of the monitor, and one over the door on the platforms. The cars are also wired for conductors' signal, with buzzers on each platform and push buttons in the window pilasters.

The weight of the car body is 9000 lbs., and it will be mounted on Moore electric trucks with 9-ft. wheel base, equipped with Price power brakes.

A Resistance Detector

The accompanying diagram shows a differential resistance detector recently invented by John C. Henry, of Denver, Col., for determining slight differences of resistance. Fig. 1 shows its application to track joint testing. The indicating needle is normally held at zero by a permanent magnet. One-half an amp. is taken through the instrument from trolley to ground. This current divides between the solenoidal coils within the instrument, depending upon the resistance of the joint which is being measured, and moves the needle proportionately. The coil surrounding the permanent magnet is placed in shunt with the rail, the spaces depending upon the weight of the rail, and it is intended to balance



RESISTANCE DETECTOR

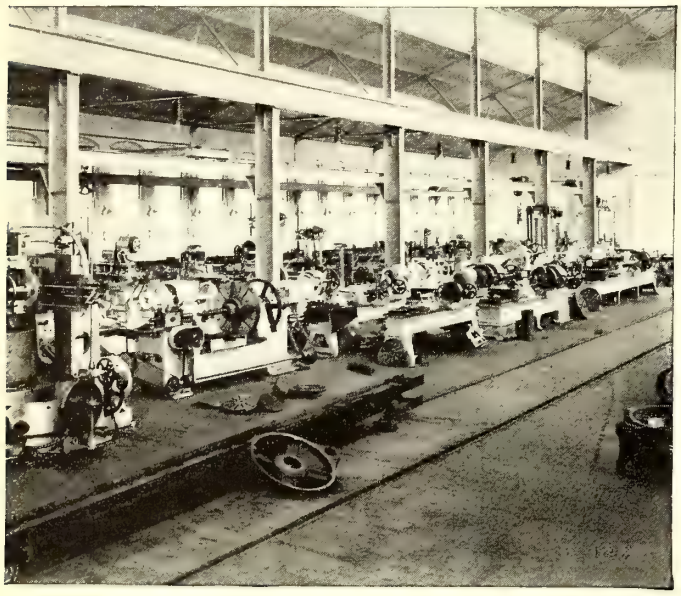
the variation in the resistance of the joint, which is caused by fluctuations of the current. For other purposes, when it is desired to compensate for drop in voltage, the coil can be connected in shunt with one of the lamps. Where the tests are made at night, when the cars are not running, the compensating coil need not be used. Where there are two bonds, one of which is in good condition and the other not, or where the current can be shunted around the bond through a cross connection, the instrument, of course, would not show the defect, but this is also true of most other detectors.

Fig. 2 shows the connections used to compare the relative conductivity of the track and water mains. In this case the deflection of the needle also indicates the direction of any current and voltage between the conductors. Fig. 3 shows the method of using the instrument to test controller connections. In this case the controller is then turned a notch at a time, and the indications noted on the dial, which should correspond with the known proper resistances of the different combinations.

Works of the Bullock Electric Manufacturing Company

The works of this company were completed last summer, and are located at East Norwood, Ohio, one of the suburbs of Cincinnati, and less than 5 miles from the heart of the city. The B. & O. S. W. Railroad cross the tracks of the Pennsylvania Railroad at this point, and both roads have switches entering the works, giving the Bullock Company excellent facilities.

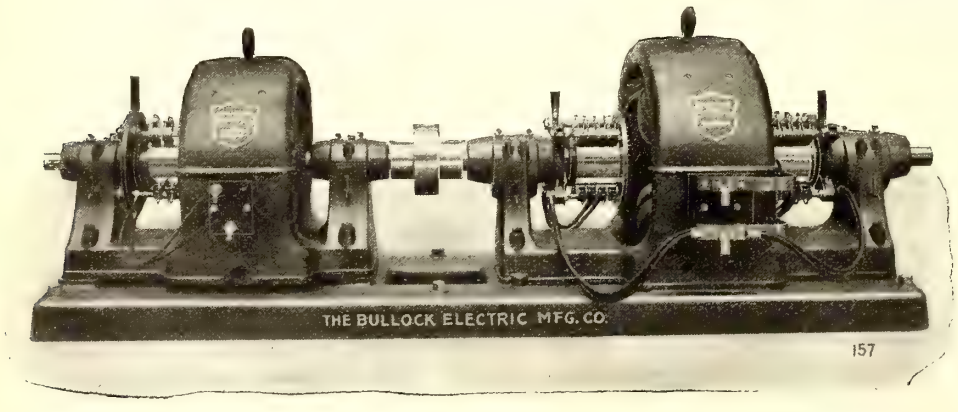
The company manufactures a large variety of electric machinery, including motors, boosters and generators, and some of its apparatus has been illustrated in the columns of this paper. It has recently gone into the manufacture of large generators for railroad in sizes up to and including 800 kw. These machines are built on the same lines as the other standard Bullock machines.





INTERIOR VIEWS OF WORKS

The Bullock electric machinery is used for power distribution purposes, and throughout the works of the company there is no line shafting and counter shafting, but each machine is equipped with a Bullock electric motor. Among the tools equipped in this way are cranes, power presses, planers, drills, milling machines, hydraulic presses, boring mills, etc. The motors used for driving these tools are specially designed and adapted for the work which they have to perform. The economies effected by the application of motors to machine tools, though in the first cost slightly more expensive than the use of the line shafts, belting and counter-shafts, soon justify the additional expenditure.



BOOSTER

The power house is provided with vertical water tube boilers, and equipped with automatic stokers. A cross compound engine, directly connected to two of the Bullock Electric Manufacturing Company's engine type generators, supplies current, not only for the lighting system, but for the Bullock multiple voltage power system used throughout the entire plant. The accompanying engravings show views of the company's machine shop and a standard booster for railway work.

The Eastern Massachusetts Consolidation

The prospectus of the new "Massachusetts Electric Companies," which is a virtual consolidation of thirty-one street railway and several electric lighting companies, covering the greater part of the territory north of Boston as far as Newburyport and Gloucester, and Nashua, N. H., and south as far as Fall River, Newport and Providence, R. I., has just been issued, and is an interesting document. It is a "voluntary association," managed by a board of fifteen trustees, who hold the title to its assets. The declaration of trust contains strong provisions against the creation of any indebtedness whereby any stockholder or trustee can be held personally liable. The board of trustees includes some of the best known and most highly esteeemed citizens of Massachusetts, five of whom are elected for one year, five for two years and five for three years.

The board of trustees have issued certificates of participation to the amount of $12,000,000 in 4 per cent common shares, and $12,000,000 in 4 per cent preferred shares, and each holder of a certificate will be entitled to a proportionate interest in each and all shares of stock held by the trustees. These securities are offered at public subscription at a price of $1,050 for ten preferred shares and five common shares.

The new company controls 647 miles of track, 1426 cars and eighteen power stations, the latter having a total rated capacity of 28,423 h.p. The earnings in 1897-1898 applicable to dividends upon the new shares of the Massachusetts Electric Companies were $733,233, equivalent to a 4 per cent dividend on the $12,000,000 preferred shares, 2 per cent dividend on the $12,000,000 common shares, and a surplus of $13,232.

It seems reasonable to expect that by a consolidation of these properties, substantial economies can be effected, particularly in the distribution of load among the many power stations of the system.

The "Compagnie Générale d'Enterprises Electrique de Para" is the title of a new company organized May 10 in Brussels, Belgium, to operate the electric tramway and lighting system of Para, Brazil. The capital stock is frs. 1,000,000. The board of directors consists of the following: MM. Jules de Borchgraeve, manager of the Compagnie Générale Coloniale pour Favoriser l'Industrie et le Commerce au Congo; Paul Macau, of Bruxelles; André Van Iseghem, of Bruxelles; Otto Fuerth, manager of the Société La Brésilienne, of Para; Arthur Brown, consul at Londres; Fernand de L'Abre, of Antwerp.

Traveling Link Grate

In the accompanying illustration is presented an endless chain grate for boiler furnaces. This grate, while resembling in general appearance some of the traveling grates already on the market, has some special features which make it very desirable. It has now been on the market for about three years, and has been, or is being, installed in steam plants of an aggregate of 16,000 h.p. Among the recent equipments are six grates for the boilers of the new power station of the Milwaukee Electric Railway Light Company, of Milwaukee, Wis. Each of these grates is approximately 10 ft. wide and 9 ft. effective length of grate surface, making a total of 90 sq. ft. Among the largest purchasers and users are the Cincinnati Edison Company, United States Glue Company, of Milwaukee; Armour Packing Company, Kansas City; Metropolitan Street Railway Company, Kansas City; Swift & Co., St. Joseph, Mo.; Brown Building, St. Louis; West Side Street Railway Company, Chicago.

One of the principal features in which the grate differs from others of its class is that the clips or links are so formed as to be readily removed or replaced in the chain without removing cross-rods or any of the principal parts. For this purpose the clips, or links, which are about a foot long, are slotted on the underside. There are two of these slots, which are enlarged into a circular opening, and which are provided to receive the transverse joining bars. The latter are oval, and of such shape as to allow the clips to be slid over them when held in a certain position. All the clips being in place on the adjoining bars, each bar is canted so as to bring its largest diameter across the opening, and being held in this position, the links cannot drop off or be removed. The joining bars are held in this position by means of outside links, known as binders, which have slotted openings to admit the ends of the joining bars when turned to the proper angle, and which the binders hold in the same position. The binders themselves are held in place by cotter pins. When it is necessary for any cause to remove or replace these slotted clips or links, the binding links of a pair of bars are removed, when, with a wrench, the bar is partly turned, permitting the links to be lifted off and replaced, and when in position it is again brought to its proper angle and the binders replaced.

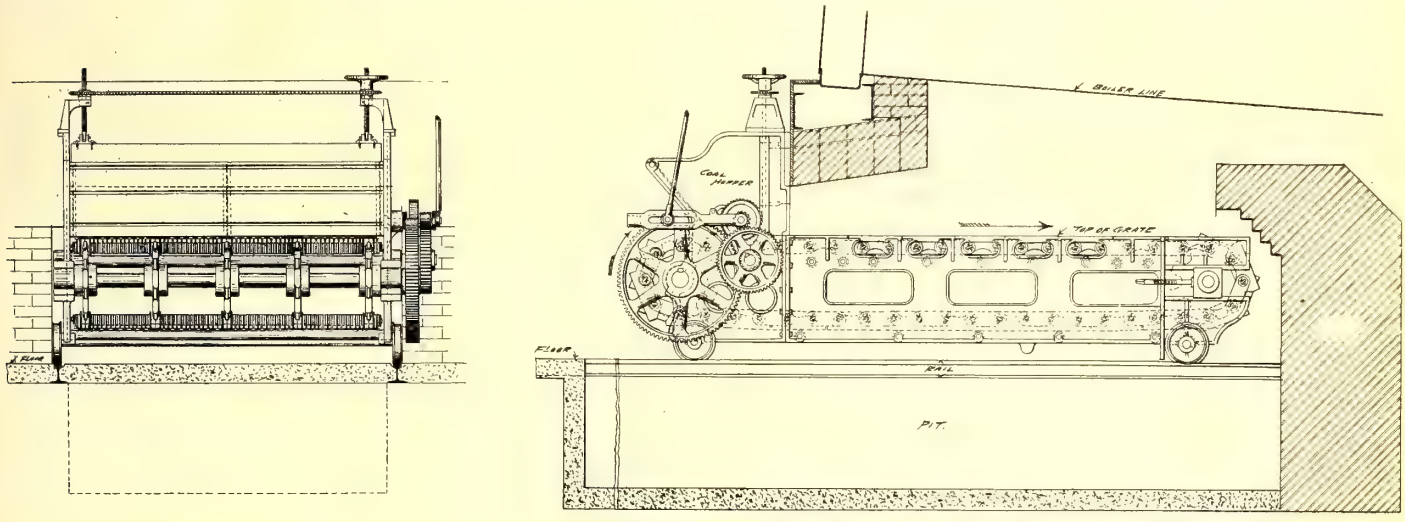
Another feature is the method of providing bearings on which the chain rides. These bearings consist of heavy steel piping, mounted at their ends upon roller bearings, the ends being reamed or recessed so that the rollers rest in the nest of bearings, thus making a double roller bearing for each roll. By this means easy and positive motion is secured without the use of lubricants. The roller bearings are housed in so that they are entirely protected from dust and ashes.

The chain is moved by means of sprocket wheels, which are mounted upon the front driving shaft, and which engage with peculiar shaped driving links, which are placed in rows in the face of the grate chain, so that the sprocket wheels engage with lugs on these special designed links. A second set of wheels is mounted on the rear shaft, which is horizontally adjustable, to provide for the chain tension. The individual clips or links are corrugated on their upper surface and are air spaced, according to the character of coal and strength of draft. The grate is mounted on an iron carriage having wheels which run upon track especially provided, and which extend in front of the boiler to permit of the grate being entirely withdrawn from the furnace without interfering with the boiler setting.

The driving mechanism of the grate consists of a train of gears actuated by a ratchet, as shown, and is operated by a lever or rod, which is connected to an eccentric upon an independent shaft. In the case of the Milwaukee plant, this shaft is located in the basement, and is operated by a small 6-h.p. engine. Besides the lever and ratchet, there is an attachment for operating the grate by hand, independent of the power connection.

A coal hopper is provided, together with a feed regulating gate, and is supported by means of the side frames of the carriage, which are extended upward. There is also a removable hopper curtain. The regulating gate is lined with fire brick, and moved up and down within vertical guides, and is operated by means of two screws, which are connected with a sprocket chain, power being applied by means of a hand wheel, as shown.

Another interesting feature in connection with these grates is the method of supporting the roof of the fire-box at igniting arch. This is composed of specially designed fire brick, having grooves which permit of their being slid over steel channel bars, which are securely supported to the brick work. By this means, a plain, slanting surface is provided above the fire, instead of the arched construction which is usually employed. The economic features of chain grates of this type are in the direction of smokeless and economical combustion, even when a low grade of bituminous slack is employed for fuel. The other features include low cost of attendance and low cost of maintenance and repairs. Recent tests made by one of these grates in the plant of the United States Sugar Refining Company, of Chicago, using Illinois crushed lump and slack, show that a 350-h.p. boiler developed power in different tests ranging from 359 h.p. up to 506 h.p., the evaporation ranging from 8.83 lbs. to 9.63 lbs. of water from and at 212 degs. evaporated per pound dry coal, with an efficiency of 73 to 77 per cent, and an average of 15 per cent Co_2 in the gases above the furnace. The coal used ranged in value from 11,500 to 12,500 B. T. U. per pound dry coal.



END AND SIDE ELEVATIONS OF LINK GRATE

These grates are manufactured and sold by the Green Engineering Company, of Chicago. This company not only manufactures grates above described, but contracts to provide a complete installation of power plants, either for electric lighting purposes, street railway plants or power plants of any description. The company is special agent for the Edgemore water tube boilers, but install any type of engines or generators. The personnel of the company includes W. M. Green, president; John R. Gent, vice-president; P. A. Poppenhusen, treasurer, and H. A. Poppenhusen, secretary. All these gentlemen have had practical experience in the installation of steam plants, having been connected with some of the leading engine and boiler manufacturers in the country.

Underground Conduits for Chicago

It is stated that the Chicago Union Traction Company, the consolidation of the North and West Side systems, will ask the municipal authorities for permission to use the underground trolley system for the lines in the down town districts, including the cable loops of the North and West Chicago Companies, and that permission will furthermore be asked to substitute the trolley for the cable on the lines north and west of the river.

Special Catalogue

The new catalogue of the Central Electric Company, of Chicago, Ill., is, as in previous years, one of the most elaborate issued by any electrical supply house. It is bound in cloth, contains 537 pages, and on every page is found from one to half a dozen cuts of some tool or apparatus used in the generation or distribution of electric currents. A complete index at the back of the book enables the intending purchaser to find the reference in the catalogue to any particular supplies he may be in need of. The catalogue should find a place in the library of every railway manager in the country.

Personal

MR. P. F. SULLIVAN has accepted the position of general manager of the Massachusetts Electric Company.

MR. MITCHELL JEANNES has been chosen general manager of the Fox River Electric Railway, of Green Bay, Wis.

MR. W. A. BELCHER, manager of the Ithaca (N. Y.) Street Railway Company, has resigned his position, to take effect July 1.

MR. J. W. BROWN has secured an interest in the Dubuque (Ia.) Light & Traction Company, and will assume the management of that property.

MR. H. F. PARSHALL, of London, has been appointed local honorary secretary for Great Britain by The American Institute of Electrical Engineers.

MR. JAMES S. FITZMAURICE, of Sydney, has been appointed local honorary secretary for Australasia by The American Institute of Electrical Engineers.

MR. O. B. VINAL is the new electrician of the Schenectady (N. Y.) Railway Company. Mr. William Steers has been appointed purchasing agent of the railway department.

MR. C. W. BLACKINGTON has resigned his position as superintendent of the Millbury division of the Worcester & Suburban Street Railway. He has held the place about a year.

MR. JOHN GRANT has taken up the duties of assistant manager of the Indianapolis Street Railway Company, having left the Detroit roads with which he has been connected for a long time.

MR. JOHN R. GRAHAM, president of the Quincy & Boston Street Railway Company, is to be general manager of the local division of the Massachusetts Electric Company, with headquarters at Quincy.

MR. E. C. HATHAWAY has taken up his duties as general manager of the recently consolidated street railway companies at Lexington, Ky. He was formerly connected with the street railway at Charlotte, N. C.

MR. THOMAS WILSON, who has had charge of the engineering work in connection with the extensions being built at Harrisburg, Pa., has accepted a position as assistant engineer with the Buffalo Traction Company.

MR. ARTHUR M. CRAM, of Walpole, Mass., who has been one of the superintendents of construction of the Norfolk (Mass.) Southern Street Railway Company, has left for Vermont, where he will engage in some important electric railway construction.

MR. W. A. HELLER, who recently resigned the position of superintendent of the Lewiston & Youngstown Frontier Railroad Company, of Lewiston, N. Y., it is stated, has accepted a similar position with the Niagara Falls & Lewiston Railroad Company (the Gorge road).

MR. C. C. LEWIS, formerly of the Pennsylvania Steel Company, has been appointed engineer of way of the International Traction Company, the recently consolidated system of electric roads of Buffalo, N. Y., and vicinity.

MR. J. A. MAXWELL, who recently resigned as superintendent of motive power with the Cortland & Homer Traction Company, goes to Troy, where he has accepted the position of master mechanic of the Troy City Railroad Company.

MR. CHARLES F. THOMPSON, secretary, treasurer and director of the Lane & Bodley Company, Cincinnati, has resigned his position in those capacities, to take effect July 1. Mr. Thompson has been with the company thirty-five years.

MR. H. C. BENAGH, superintendent of the Savannah, Thunderbolt & Isle of Hope Railway Company, has tendered his resignation, to take effect July 1. Mr. Benagh will probably return to Nashville, Tenn., which city he left when he went to Savannah.

MR. PIERRE OTIS KEILHOLTZ, chief engineer of the United Railways & Electric Company, of Baltimore, will hereafter, in addition to the duties of his office, act as general manager of the United Electric Light & Power Company, of Baltimore.

MR. F. E. SMITH, auditor of the Lynn & Boston Railroad Company, has accepted a similar position with the Massachusetts Electric Company, which has effected a consolidation of the principal suburban electric railways of Eastern Massachusetts, and has entered upon his new duties.

MR. FRANKLIN WOODMAN, of Haverhill, Mass., has been appointed general manager of the Merrimac Valley division of the Massachusetts Electric Company. Mr. Woodman was formerly manager of the Haverhill division of the Lowell, Lawrence & Haverhill Street Railway Company.

MR. F. L. HART, formerly of Baltimore, has been appointed general superintendent of the system of street railways at Washington, D. C., recently purchased by a syndicate for the purpose of consolidation. Mr. Hart has been for some time engineer in charge of the re-equipment of the Anacostia road.

MR. HENRY VILLARD is preparing for a journey to Alaska, and will start about July 1. In the course of his trip he will celebrate the twenty-fifth anniversary of his first visit to Washington—a visit which has had enormous consequences to the people of the great Northwest and the Northern Pacific Coast.

MR. HARRY D. LIVERS, formerly connected with the Tamaqua & Lansford Electric Railway Company, of Tamaqua, Pa., on June 1 succeeded J. A. Bonnell as superintendent of the Carbon County Electric Railway Company, Mauch Chunk, Pa. Mr. Livers has recently arrived home from active service in the Spanish war.

MR. G. SACCO ALBANESE, a well-known engineer, both in America and Europe, and who has been engaged in the construction of a large number of electric railways in France and French colonies, has recently been honored by the French government with the decoration of an officer of the Academy of Arts and Sciences.

MR. HENRY C. MOORE, president of the Trenton Street Railway Company, has been appointed vice-president of the United Power & Transportation Company, which controls about fifteen street railway properties in Philadelphia and the surrounding country. Mr. Moore still retains the presidency of the Trenton road.

MR. ELWIN C. FOSTER, general manager of the Lynn & Boston Railroad Company, has been given largely increased responsibilities in connection with the new consolidated system of the Massachusetts Electric Company, and will be in charge of the entire North Shore section of the system, from Boston to the Merrimac Valley.

MR. FRANK G. LOTT, who has held the position for some time of superintendent and general manager of the Buffalo & Niagara Falls Electric Light & Power Company, has been appointed superintendent of the Lewiston & Youngstown Frontier Railroad Company, of Lewiston, N. Y. He takes the place of Mr. W. A. Heller, resigned.

MR. H. A. EVERETT has been elected president, Mr. Will Christy vice-president, Mr. J. R. Nutt treasurer, Mr. C. S. Moore secretary, and Mr. L. S. Beilstein general manager of the Northern Ohio Traction Company, which is a consolidation of the Akron Traction & Electric Company and the Akron, Bedford & Cleveland Railroad Company.

THE METROPOLITAN ELEVATED RAILROAD COMPANY, of Chicago, has elected a new board of directors, including Dickinson MacAllister, the president; W. W. Gurley, Byron L. Smith, George B. Harris, John P. Wilson and George Higginson, Jr., of Chicago, and C. F. Dieterich, R. S. Hays and James J. Higginson of New York.

MR. WILLIAM D. BUCKNER, assistant chief engineer of the Guayaquil & Quito Railroad (a steam road), of Ecuador, is in New York city. His visit to the United States is for the purpose of attending to some improvements for the road, making purchases of construction outfit and engaging engineers. His address is 49 West Thirty-first Street.

MR. ALLEN F. EDWARDS, who, for the past year, has been the general superintendent of the Yonkers Railroad Company, is now general manager of the Virginia Traction Company, of Petersburg, Va., and also general manager of the Electric Light Company, of the same place. These two companies have been purchased by the same syndicate, and will shortly be combined.

MR. PHILIP DAWSON, engineer with Messrs. Robert W. Blackwell & Co., of London, has been traveling in the West during this month, particularly in Chicago and Milwaukee. In Chicago he has been looking very carefully into the operation of elevated electric railroads, and in Milwaukee is inspecting some of the engines recently ordered by Mr. Blackwell on British contracts.

MR. HUGH J. McGOWAN has been elected vice-president and general manager of the Indianapolis Street Railway Company. Mr. J. Grant, formerly superintendent of the Citizens' Street Railway Company, Detroit, is assistant general manager. Mr. W. F. Milholland, formerly treasurer and assistant secretary, has been re-elected to the same position, and Mr. Miller Elliott re-elected as superintendent.

MR. F. S. PEARSON, chief engineer of the Metropolitan Street Railway Company of New York, sailed for Sao Paulo, Brazil, on June 5, in order to inspect the city and determine on certain general problems connected with the development of the street railway and lighting system of Sao Paulo, for which franchises have recently been obtained by himself and associates. He expects to return in August.

MR. R. C. BROWN, who has been for some years connected with the Whitney-Elkins-Widener syndicate as one of its most trusted engineers and street railway managers, sailed for Sao Paulo, Brazil, on June 5, in order to take charge of the construction, equipment and (temporarily) the operation of the large electric tramway and light enterprise which is being developed there by a New York and Canadian syndicate composed of F. S. Pearson, William McKenzie and others.

MR. F. P. BROTHERS, MR. NORMAN S. RANKIN and MR. SHIRLEY DAVIDSON, who have been for some time in Kingston, Jamaica, superintending the construction of the West India Electric Tramway of that city, have returned to Montreal, their native city, for a short vacation. These gentlemen report that the Kingston road has been practically completed as far as track construction is concerned, and the line will be in operation soon. It is about 30 miles long, and steel ties were used exclusively, owing to the climatic conditions and wood-boring insects.

MR. JOHN A. RIGG, president and general manager of the United Traction Company, of Reading Pa., has accepted the position of president of the United Power & Transportation Company, the formation of which is mentioned elsewhere in this issue. He has been a leading spirit in perfecting this consolidation, and its successful consummation is due largely to his energies. Mr. Rigg has been actively engaged in street railway work for over a quarter of a century, and has been prominent in the affairs of the American Street Railway Association, in which he has held various offices.

MR. F. H. CHEVALLIER BOUTELL, general manager of a large trust company of Buenos Aires, resident director of the Buenos Aires & Belgrano Tramway Company, of Argentina, and resident director for two important railroads and several industrial enterprises in Buenos Aires, in which London capital is interested to the extent altogether of $150,000,000, was in the United States for a brief pleasure trip, and returned to London on June 28,, and will reach Buenos Aires in August. He visited New York, Philadelphia, Washington, Chicago, Detroit, Niagara Falls, Schenectady and Boston, and derived a great deal of enjoyment from his first American experience. A report appeared in the Chicago papers soon after his visit to that city that he had placed an order for $5,000,000 worth of cars in that city, but this was wholly false. Mr. Bouteil also very carefully investigated American locomotives, his disposition being to purchase future supplies for his Argentina enterprises as largely as possible in America.

MR. O. T. CROSBY, through whose efforts, in combination with those of Mr. C. A. Lieb and F. C. Stevens, the general consolidation of street railway properties in the city of Washington has just been made, sailed for Europe recently, with Mrs. Crosby, to secure a much needed rest. He has given up official connection with all of the Washington properties in order to free himself completely for a prolonged pleasure-seeking and health-restoring trip. In 1895 Mr. Crosby went to Washington with Mr. Lieb, and the two bought a controlling interest in the Georgetown & Tenalleytown Railway. In the latter part of the same year they also secured control of the Potomac Power Company, then located on the Virginia side of the river, together with pole and wire privileges in the District. A little later the Potomac Light & Power Company was organized, and Mr. Crosby extended his railway and lighting interests until the consummation of the recent general consolidation.

MR. H. S. COOPER, who has recently resigned from the superintendency of the Schenectady Railway Company, of Schenectady, N. Y., was born in Isle of Wight, England, in 1856, and came to America in 1865. He was educated at Farnum School, Beverly, N. J., and worked as office boy, clerk and salesman in Philadelphia from 1870 to 1876. In 1876 he went into the manufacturing of agricultural machinery in the South, first at Raleigh, N. C., and again at Jacksonville, Fla., and in connection with this business had, during 1884 and 1885, the charge of the electrical work on two lines of steamers on the St. Johns River, and of much work on the two lighting stations then in Jacksonville. From this time until 1893 he had charge of numerous electric railway and lighting installations, and in that year, at the urgent solicitation of the owners, he accepted the managership of the Schenectady properties of the Electrical Development Company, these properties consisting of the entire electric and gas lighting and railway and motor business of the city. These properties were then in desperate shape, and the business depression of 1893 necessitated the placing of them in the hands of a receiver. The receiver was changed in 1894, and in 1895 the properties were sold under foreclosure of the bonds, and then reorganized. Since taking charge, in July, 1893, the properties have been entirely and absolutely under Mr. Cooper's management, and without outside aid of any kind—financial or otherwise—they have been developed from their own resources until they are now in fine physical condition and on an excellent paying basis, and have the good will and co-operation of the entire community, both private and municipal.



H. S. COOPER

AMONG THE MANUFACTURERS

THE GENERAL ELECTRIC COMPANY, of Schenectady, has published recent bulletins on grooved trolley wire, the G. E. 55 railway motor, and the C. E. motor.

THE AMERICAN IMPROVED RAIL JOINT COMPANY, of Chicago, has taken a contract to cast weld some 5000 joints in Indianapolis, and work on the same has already commenced.

THE FUEL ECONOMIZER COMPANY, of Matteawan, N. Y., after July 1 will be known as the Green Fuel Economizer Company. The new works are very busy, running to their full capacity.

THE CONSOLIDATED PUBLIC WORKS COMPANY, of Philadelphia, has acquired the business interests formerly owned by the Wheeler & Boody Company, the latter company having recently been dissolved by mutual consent.

J. G. SATTERTHWAIT, formerly with Walker & Kepler, is now connected with the C. & C. Electric Company, at its Philadelphia office. Mr. Satterthwait will be pleased to answer any inquiries regarding dynamos or motors, either direct connected or belted.

THE NORTH AMERICAN CONSTRUCTION COMPANY, of Chicago, which secured the contract for the deck work on the Northwestern Elevated, has commenced laying the material, and expects to have this finished within the next three months.

THE PITTSBURGH FEED WATER HEATER COMPANY, of Pittsburgh, Pa., has just issued a new illustrated catalogue of the Pittsburgh feed water heaters and purifiers, showing both the open and closed types manufactured by it. The cata-

logue is illustrated with numerous cuts, and a copy can be had by writing to James Bonar & Co., Pittsburgh, Pa.

THE COLUMBIA ELECTRICAL SUPPLY COMPANY, formerly at 329 Fourth Avenue, New York, has removed to 93 Liberty Street, where it has one of the handsomest arranged stores to be found in the electrical supply trade. The company carries a large stock of electrical goods, to which will gradually be added a line of street railway material.

THE MICA INSULATOR COMPANY, of Chicago, has received during the past month its usual large number of orders for its insulating materials, viz., micanite plates, segments, rings, etc., "Empire" insulating cloths and papers and M. I. C. compound. The company's business during the last two months shows a very heavy increase over the corresponding period of last year.

THE GARTON-DANIELS ELECTRIC COMPANY, of Keokuk, Ia., since Jan. 1, 1899, has shipped its arresters into every State of the Union, and has made over fifty shipments abroad. It also states that the sales of these devices from Jan. 1, 1899, to the present time are equal to the total sales of any preceding year. This is convincing proof of very high merit in these devices.

EDWARD ROBINSON, proprietor of the Wells Light, 44 and 46 Washington Street, New York, returned from England on the steamer Umbria a few days ago, after a very pleasant trip, taken partly in the interest of the Wells Light business and partly for pleasure. During his absence abroad 1500 of the now famous Wells Lights were sold to the Russian government for use upon the railroads in that country.

H. W. JOHNS MANUFACTURING COMPANY, of New York, will hereafter be represented in Chicago by the Manville Covering Company, with offices at 173 Randolph Street. H. A. Reeves, manager of the electrical department of the latter company, and long known in connection with the Chicago office of the H. W. Johns Company, will be in charge. He reports an immense demand for molded mica, vulcabeston, etc.

THE DORNER TRUCK & MANUFACTURING COMPANY, Cleveland, Ohio, has under way a new factory at Logansport, Ind., which will be fully equipped with all the modern machinery for turning out trucks and other street railway specialties, including the new friction brake recently brought out by this company, track cleaners, etc. The company reports quite a large number of orders for trucks, brakes and track cleaners.

THE ROBB ENGINEERING COMPANY, of Amherst, N. S., recently shipped, via New York and London, two 350-h.p. engines for the Perth Tramways Company, Perth, West Australia. These engines are tandem compound, side-crank type, and are for direct connection to General Electric 225-kw. dynamos. The order was placed through J. G. White & Co., of New York, who have the contract for the complete equipment of the tramway.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., has adopted a somewhat unique method of proving the claims made for the Sturtevant system of ventilation and heating. This consists of an artistic pamphlet containing some fifty-three pages, and devoted exclusively to a list of buildings and steamships wherein the system has been installed. About 2500 names are given, and the list contains some of the very best plants in the country.

THE E. W. BLISS COMPANY, of Brooklyn, N. Y., manufacturers of presses, dies, shears and special machinery for all classes of sheet metal work, is sending out a neat pocket-size pamphlet containing small cuts and a brief, yet comprehensive description of many of its more important machines. The company carries in stock a complete line of standard tools, and makes a specialty of designing and manufacturing machinery for special purposes.

THE WESTINGHOUSE MACHINE COMPANY, of Pittsburgh, Pa., is calling attention to the Westinghouse Junior engine through a tasteful catalogue just issued. This engine is equal in every detail of workmanship and material to the regular Westinghouse standard engines, but is built in small sizes only. It is of the simple single valve automatic type, and its economy of operation, together with its comparatively low first cost, makes it a very desirable machine for a small plant.

THE PITTSBURGH FEED WATER HEATER COMPANY, of Pittsburgh, Pa., has published a new catalogue, setting forth the economy and efficiency of the different types of feed water heaters and purifiers which it manufactures. These devices have been considerably improved since first placed upon the market, and the manufacturers now claim they have the most efficient, simplest and most economical heater in the market, citing a number of features substantiating this claim.

J. G. WHITE & CO., of New York, are designing and supervising the erection of a brick power house, complete, for the Detroit & Lake Orion Railway Company, and are furnishing and erecting two 250-h.p. Cahall boilers, two 300-h.p. Ball & Wood engines, two 200-kw. Crocker-Wheeler railway generators, direct connected, one 60-kw. Crocker-Wheeler booster, together with chimney, piping, condensers, feeders, pumps, switches, wiring and all accessories; also one 90-kw. lighting generator.

THE H. C. ROBERTS ELECTRICAL SUPPLY COMPANY, of Philadelphia, reports a steady increase in the demand for its products, among the recent sales of trolley and feeder wire being large quantities to the interurban electric railway from Dayton to Xenia, Ohio, the Schuylkill Valley Electric Railway Company, of Pottsville, Pa., and the Norfolk Terminal Company, Norfolk, Va. The company's wire has also been shipped to Lewiston, Pa., Cincinnati, Ohio, Rising Sun, Ind., and numerous other places.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, of Pittsburgh, Pa., has issued the following catalogues: No. 110-E, devoted to transformer fuse blocks of 1000 to 300 volts capacity; No. 188-B, describing the Westinghouse No. 38-B single reduction railway motor; No. 229, describing belt-driven railway generators; No. 200-A, describing generators and rotary converters for electrolytic work; No. 168-C, describing the Shallenberger integrating wattmeters for alternating circuits.

THE CHICAGO OFFICE of the Westinghouse Electric & Manufacturing Company has received a contract from the Muskegon Street Railway Company, of Muskegon, Mich., for an addition to the latter's electrical plant. This consists of a 275-h.p. belted generator, to be driven by a steam engine, and also an elaborate switchboard for regulating and manipulating the electrical current. This new generator will be worked in connection with those previously installed, and will supply power for the cars running upon the newly extended lines of the street railway company.

THE TURNER ENGINEERING COMPANY, of Bucyrus, Ohio, will erect at once a complete boiler plant for the Marion Steam Shovel Company, including a large self-supporting steel chimney, brick lined, after special designs. This latter company sends its shovels and dredging machinery to all parts of the world, and maintains its plant strictly up to date, with the most modernly improved money and labor saving devices. After careful and exhaustive consideration of all water tube boilers, the management decided to use the Turner boilers as possessing the greatest general merit and economy.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., early recognized the demand for electrically driven fans which was sure to follow the general distribution of electricity for power purposes. Its first fan motors were built about ten years ago, since which time designs have been perfected, the number of types greatly increased, and a large electrical department established. Some of the recent products of this company in the way of special electric fans are presented in its bulletins H and M. The former relates to the inclosed fans, the latter to propeller ventilating wheels.

THE CHRISTENSEN ENGINEERING COMPANY, of Milwaukee, Wis., as an adjunct to its regular line of air brakes for street railway purposes, is also engaged in the manufacture of a complete line of air compressing appliances, including portable compressors, air hoists, air jacks, etc. The value of compressed air for performing a variety of work is rapidly coming to be recognized in a number of industries, and the demand for a simple and effective compressing apparatus is continually increasing. The Christensen portable air compressor was described in the last issue of the Street Railway Journal.

THE FALK COMPANY, of Milwaukee, Wis., recently lost by fire its complete blacksmith and special work shops. Shortly after the fire, however, the company had made arrangements for continuing the manufacture of its special work. The Falk Company has in process of erection several extensions to its plant at Milwaukee, and expects to be in a position within a short time to again take care of all orders. Eight acres of ground close to the present shops have been purchased, and new buildings will be erected thereon. These will consist of a machine shop, 100 ft. x 200 ft.; a foundry equipped for casting steel, also 100 ft. x 200 ft.; a power house, 60 ft. x 40 ft., and an office building, 40 ft. x 60 ft.

THE WAGENHALS MANUFACTURING COMPANY, Cincinnati, Ohio, reports that its new controller handle, which was described in the STREET RAILWAY JOURNAL for May, 1899, is creating considerable interest among street railway managers, and that its value as a current saver is coming to be recognized. These handles are now in use on the Union Traction Company's line, of Philadelphia; Cincinnati Street Railway, Cincinnati, Ohio; Detroit & Pontiac Railway, Detroit, Mich.; Syracuse & Suburban Railway Company, Syracuse, N. Y.; Camden & Suburban Street Railway Company, Camden, N. J., and several of the St. Louis lines. Orders have also been received from the Cape Town Tramways, Cape Town, South Africa.

THE TRADE PAPER ADVERTISING AGENCY, of New York, is sending out a unique and very artistic brochure, containing a number of original designs for advertising purposes, which were drawn by the special artist of the Trade Paper Advertising Agency. These are extremely striking, and many of them have appeared in the leading technical papers of the United States. This concern is prepared to take charge of the advertising of any reputable house, however large, and will attend carefully to all the details, thus giving the manufacturer the benefit of an expert knowledge of the design and arrangement of advertisements. Edward Caldwell, who was at one time business manager of the STREET RAILWAY JOURNAL, is manager of this advertising agency.

THE HOPPES MANUFACTURING COMPANY, of Springfield, Ohio, reports repeat orders from the following well-known firms: The Kelly Axe Manufacturing Company, Alexandria, Ind., 400-h.p. live steam feed water purifier and 400-h.p. exhaust steam feed water heater; the Deering Harvester Company, Chicago, Ill., two 1250-h.p. purifiers; Louisville Railway Company, Louisville, Ky., three 625-h.p. purifiers; E. L. McClain Manufacturing Company, Greenfield, Ohio, 400-h.p. purifier and 350-h.p. heater; Danville Gas, Electric Light & Street Railway Company, Danville, Ill., 1000-h.p. purifier; South Dakota Hospital, Yankton, S. D., 200-h.p. purifier, 400-h.p. exhaust steam feed water heater; Jeffrey Manufacturing Company, Columbus, Ohio, 500-h.p. purifier and 500-h.p. heater.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has received during the past few weeks a contract for building several new plants of considerable importance. Among these are the extensions to the plant of the Wheeler & Wilson Manufacturing Company, a warehouse building at Dutch Guiana, and a new furnace building at Perth Amboy, N. J., for the Raritan Copper Company. Among the foreign orders is one from the Council of Rangitikei County, New Zealand, for a highway bridge consisting of a single span of 204 ft., designed to carry a distributed load of 1500 lbs. per lineal foot. In transmitting this order the chairman of the Council said, "As far as I know, this is the first order of the kind ever sent to the United States, and the experiment is being watched by other local boards."

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, on June 14, in the United States Circuit Court, at Boston, Mass., secured a preliminary injunction against the Quincy & Boston Street Railway Company, restraining the latter from using and operating the elements of the Hatch storage battery installed at South Braintree, Mass., and used as an auxiliary to the trolley system. It is held that the Hatch battery infringes upon the Brush patents owned by the Electric Storage Battery Company, and which are fundamental patents underlying all forms of storage battery. This injunction becomes effective on August 1, as the railway company was given until that time to remove the infringing batteries. This is only one of four or more suits which are the outgrowth of that in which a preliminary injunction was granted against the Hatch Battery Company on May 5 last.

THE CREAGHEAD ENGINEERING COMPANY, of Cincinnati, is sending out a new catalogue, which will be found unusually complete. It describes the company's electric railway overhead line material and electrical supplies, and should be in the hands of every railway general manager. In addition to the well-known Creaghead type of insulators, mechanical ears, and other overhead supplies, all of which are fully illustrated in the catalogue, are notices and full descriptions of the Creaghead flexible and rigid brackets, trolley harps, wheels and poles, protected rail bonds, Garton lightning arresters, Weston electrical instruments, cut outs and switches, construction tools, and enclosed arc lamps. The company calls particular attention to the fact that the excellence of all its materials is the result of several years' experience in the construction of electric railways, and the devices described in the catalogue have been thoroughly tested. The catalogue will be sent on request.

HARRISON SAFETY BOILER WORKS, of Philadelphia, Pa., report the following recent sales of the Cochrane feed water heaters and purifiers: Haverhill (Mass.) Electric Company, 1000 h.p.; Alabama Steel & Wire Company, Ensley, Ala., 6000 h.p.; Ohio Steel Company, Youngstown, Ohio, 10,000 h.p.; Hoopes & Townsend, Philadelphia, 1000 h.p.; Barrett Manufacturing Company, Philadelphia, 450 h.p. special; American Steel Foundry Company, St. Louis, Mo., 850 h.p.; Telephone & Improvement Company, Sweetwater, Tenn., 100 h.p.; Detroit Reduction Company, Cripple Creek, Colo., 425 h.p.; E. Sutro & Son, Philadelphia, 150 h.p. special; Barnard & Leas Manufacturing Company, Moline, Ill., 100 h.p.; Dickson Manufacturing Company, Scranton, Pa., 200 h.p.; Mound Coffin Company, St. Louis, Mo., 200 h.p.; Munger Oil & Cotton Company, Mexia, Texas, 250 h.p.; Cocheco Manufacturing Company, Dover, N. H., two 250 h.p.; Vulcanite (N. J.) Portland Cement Company, 1000 h.p.; also the following recent sales of the Cochrane separators: Law Building, Chicago, Ill., two 5-in. vert.; James Clements & Son, Bay City, Mich., 8-in. and 3½-in.; Franklin Mining Company, Hancock, Mich., 14-in. and 6-in.; Carnegie Steel Company, Pittsburgh, three 16-in. and one 10-in.; Laughlin & Co., Ltd., Pittsburgh, six 5-in., five 10-in., one 7-in., one 4-in., two 6-in. and two 12-in.; Cambria Steel Company, Johnstown, Pa., two 12-in.; Cedar Rapids (Ia.) Electric Light & Power Company, 12-in.; Cunard Steamship Company, New York, 4-in. and 4½-in.; Haverhill (Mass.) Electric Company, 7-in.; American Blower Company, London, England, 4-in., and many others.

New Publications

Soft Coal Burning. By C. M. Higginson. Paper. 18 pages. Illustrated. Published by the "Railway Master Mechanic," Chicago.

This is the fifth edition of this pamphlet, and is a valuable treatise on the subject of soft coal, giving the relative economy of this fuel, and describing the best methods of burning it.

Verbatim Report of the Seventh Annual Meeting of the Pennsylvania Street Railway Association. Paper. 67 pages. Published by the association.

This is the report of the meeting held at Scranton, Pa., Oct. 19 to 20, 1898, and contains the papers read, the discussions upon same, the speeches at the banquet, copy of the constitution, and a list of the active members.

The Influence of Mechanical Draft Upon the Ultimate Efficiency of Steam Boilers. By Walter B. Snow. Paper. 22 pages. Illustrated. Reprinted from the "Columbian Engineer," of Columbia University, New York.

This is a lecture delivered by Mr. Snow, of the engineering staff of the B. F. Sturtevant Company, of Boston, before the Engineering Society, on Dec. 1, 1898. An abstract of the lecture will be found in the last issue of the STREET RAILWAY JOURNAL.

Duncan's Manual of Tramways, Omnibuses and Electric Railways. Cloth. 428 pages. Price, 3s. 6d. Published by T. G. Whiting & Sons, Ltd., London, England.

This is the twenty-second annual issue of Duncan's Manual, which has now come to be the recognized authority on financial statistics concerning the tramways of England and in the colonies which are owned by London capitalists. The manual is similar in typographical features to issues of previous years.

Derrah's Street Railway Guide. Compiled by Robert H. Derrah, of Boston. Paper. 210 pages. Illustrated. Price, 15 cents. Published by the compiler.

This is the fourth edition of this guide, and contains complete time tables, together with full information of all the street railway lines in Eastern Massachusetts. Everything that the tourist in this section might require is included in the book. A large inset map of the region covered is one of the features.

The Steam Engine Indicator (compiled from the regular issues of "Power"). Cloth, 208 pages. Illustrated. Price, $1.50. Published by the Power Publishing Company, New York.

Although there are a number of books on the construction and use of the indicator, we know of none which takes up the subject in a clearer or more systematic way than that whose title is given above. The valuable lessons on engine design and regulation which the indicator can teach are carefully explained, as well as the methods of computing the area of the diagram, mean effective pressure, steam consumption, etc. The book is fully illustrated.

L'Electricité en Amérique. By Marcel Delmas. Paper. 81 pages. Reprinted from "Le Genie Civil," Paris.

This pamphlet contains some notes on the application of electricity to industrial and railway purposes, gathered by M. Delmas during a recent visit to this country. The first chapter is devoted to electric traction, the installations described being the elevated roads of Chicago and (briefly) the surface systems of New York, Chicago, Buffalo and Boston, with an extended description of the subway in the latter city. M. Delmas attributes a large amount of the rapid development of industrial enterprises in this country (1) to the wider field that American engineers and manufacturers have as compared to any single country in Europe; (2) to the comparative freedom enjoyed from governmental restrictions; (3) to the greater absence of "red tape" in the conduct of their own affairs, and (4) to the quality of building apparatus and turning out work quickly, even if this sometimes involves a sacrifice of some minor economies.

The Commercial and Business Aspects of Municipal Electricity Supply. By Alfred H. Gibbings, Electrical Engineer to the City of Bradford, England. 270 pages. Illustrated. Price, 15s. Published by the author.

This book discusses many problems which arise in the commercial aspects of supplying electricity from central stations for lighting and power, and the means preferred by the author for dealing with them. They include methods of charging for electrical energy, the renting out of motors, whether lamps should be supplied by the company or by the user, street lighting, etc. Some very valuable tables are also given, showing the average amount of power required by the users of motors in small industries, of light, etc. Mr. Gibbings also gives a number of forms used by him in keeping his records, making charges, etc. The book should be extremely valuable to station managers on both sides of the water.

Municipal Monopolies. A collection of papers by modern economists and specialists. Edited by Edward W. Bemis, Ph. D., Professor of Economic Science in the Kansas State Agricultural College. Cloth. 691 pages. Price, $2. Published by Thomas Y. Crowell & Company, New York.

This recently issued book comprises a number of very interesting monographs on different kinds of municipal service enterprises, which are discussed by writers who are in more or less pronounced sympathy with an extension of municipal ownership over city monopolies, but the attempt has been made to treat the whole problem broadly and in full recognition of the difficulties involved in any suggested solution, and the result is the collection of a mass of information which is extremely valuable to the student of social economics. The subject of "Waterworks" is treated by M. N. Baker, of the "Engineering News;" "Municipal Electric Lighting," by Prof. John R. Commons, of Syracuse University; Prof. F. A. C. Perrine, of the engineering department of Leland Stanford University, and by Prof. Bemis; Max West, Ph. D., of the agricultural department at Washington, describes "Municipal Franchises in New York;" Prof. Frank Parsons, of the Boston School of Law and the Kansas State Agricultural College, treats of "The Telephone" and the "Legal Aspects of Monopoly," and Prof. Bemis discusses "Street Railways" and the problem of "Regulation of Ownership." The book is well worth to street railway and electric lighting managers its very moderate price, if only to obtain the point of view of the municipal ownership advocates.

Regelung der Motoren elektrischer Bahnen. By Dr. Gustav Rasch. Cloth. 140 pp. Illustrated. Price 8 marks. Published by Julius Springer, Berlin.

The "Control of Electric Car Motors" is the title of a new work by Dr. Gustav Rasch, of the Technische Hochschule of Karlsruhe, which forms the first volume of a series on electric railroads, and is the outcome of a course of lectures given by the author. This probably accounts for the fact that the subject is treated in a manner making the book suitable for a text-book, while its numerous mathematical demonstrations, including the use of calculus, will probably forbid its practical and universal introduction among the laymen. The book is thorough in its scope, and contains much valuable matter, which has to be dug out, however, and even after this is done the reader finds references to mathematics in the author's conclusions. The book is divided into eight chapters, dealing respectively with the following subjects: In Chapter I. the author discusses the various train resistances on straight and curved tracks, evolves formulæ for energy consumed on grades and returned on declines, acceleration, and shows how to determine the coefficient of traction. In Chapter II., the well-known e.m.f. and counter e.m.f. formulæ are attained, the various kinds of armature windings are discussed, as well as the questions of efficiency, losses, torque, effort at rim of wheel, the relative advantages and disadvantages of series and shunt motors at starting, speed and load. A general discourse on methods of control is given in Chapter III., and the author proceeds by first enumerating the various methods by which the speed may be altered, viz.: (1) by changing the counter e.m.f., and (2) by varying the magnetic field. The first-named presents two conditions, namely: a constant e.m.f. at the terminals of the motor, and an e.m.f. which may be varied, as in the case of accumulators. The constant e.m.f. can be varied by an external resistance or by connecting the motors together in various ways. The magnetic field may be changed by introducing a shunt resistance to the field, or by splitting up the field coils and connecting the sections to suit conditions. The author presents these various methods in a sort of "family tree fashion," which is highly commendable. In Chapter IV., the method of introducing an external resistance is discussed by curves, diagrams and formulæ. The author contends that the method is not applicable for varying the speed of motors employed for normal service, but is useful when the tractive effort and speed are not widely varying quantities. He further states that if one motor can exert the necessary effort it would be poor economy to subdivide that effort among two motors connected in parallel, unless a rise in speed is desired. As an example of this method, the Schuckert system is cited. Chapter V. is devoted to a discussion of the series-parallel method of control, showing the effect of one-half the e.m.f. on the speed, the starting torque and the use of four motors. He points out that the method is not practical when two motors are used, unless a resistance is inserted to aid in the control, as is the case in the Walker controller, which is described. In comparing this method with the one described in Chapter IV., the author states that the series-parallel method, permitting a great variation of speed, is applicable for city, city and suburban and suburban service, while the resistance method is only permissible for the first named. He devotes no space to accumulator traction, as the number of accumulator roads is continually on the decrease. The method of shunting the field coils is treated in Chapter VI., and this, the author states, permits a simpler controller construction than the series-parallel method. The former method, however, is only applicable where the traffic conditions are uniform or vary between very small limits, that is, for city or suburban service, and not for the combined. In Chapter VII. the method of connecting field sections in various ways is discussed, which simply implies a variation of the ampere turns in the field. This method is preferable to the shunt resistance method, where high speeds are employed, but the advantages of the one and the disadvantages of the other about balance each other. Electric braking forms the subject of the eighth and last chapter, and the author contends that for braking purposes series motors can be used as well as shunt motors. If, however, it is desired to win back some of the energy, the series motor cannot be employed, whereupon he discusses the question of winnig back the energy. This introduces the question of storage batteries where the method of electric braking has a distinct advantage. The author reaches the conclusion, however, that the advantages of returned energy are very frequently overrated.

Trade Catalogues

Advertising Designs. Published by the Trade Paper Advertising Agency, of New York.

Bulletins. Published by the General Electric Company, of Schenectady.

Catalogue. Published by B. F. Sturtevant Company, Boston, Mass. 53 pages. Illustrated.

Machine Tools. Published by E. W. Bliss Company, of Brooklyn, N. Y. 16 pages. Illustrated.

Various Catalogues. Published by the Westinghouse Electric Manufacturing Company, Pittsburgh, Pa.

General Catalogue. Published by the Central Electric Company, Chicago, Ill. 537 pages. Cloth. Illustrated.

Westinghouse Junior Engine. Published by the Westinghouse Machine Company, Pittsburgh, Pa. 35 pages. Illustrated.

Electric Railway Supplies. Published by the Creaghead Engineering Company, Cincinnati, Ohio. 85 pages. Illustrated.

Compressed Air Appliances. Published by the Christensen Engineering Company, Milwaukee, Wis. 16 pages. Illustrated.

Feed Water Heaters and Purifiers. Published by the Pittsburgh Feed Water Heater Company, Pittsburgh, Pa. 140 pages. Illustrated.

Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, AUGUST, 1899. No. 8.

THE ELECTRIC RAILWAY SYSTEMS OF QUEBEC, CANADA

On July 1, 1899, the Quebec District Railway, or, as it is now known, the Q., M. & C. Railway, meaning the Quebec, Montmorency & Charlesvoix Railway, successfully completed its second year of operation, notwithstanding the many and varied difficulties, perhaps greater and more serious in their nature than usually confront a street railway company.

The first of these difficuties is the hilly—indeed, one might almost say mountainous—nature of the city. To those who have not had the pleasure of viewing this quaint



VIEW OF LOWER TOWN, QUEBEC

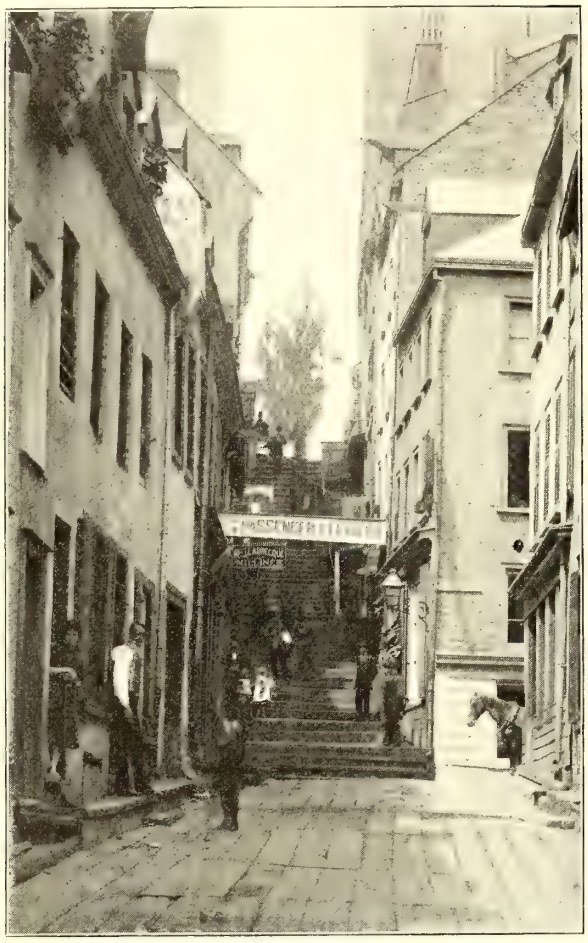
battleground where French power made its final and unold city, rich in olden time relics, with its population of French Canadians, its grand citadel and the old wall of fortification encircling the Upper Town, extending along the very brow of the hill, it will be difficult to fully comprehend the nature of the exacting conditions under which an electric railway is operated in this city.

The Upper Town has grown, expanded and pushed out beyond the fortifications, the new portion being principally residential. Here are the famous Plains of Abraham, the successful stand for the disputed possession of Canada. The Lower Town, situated at the water's edge, lying around the base of the hill—indeed precipice in many places—is perfectly level, and is the chief business district. The Upper Town, on the other hand, possesses many grades, the maximum track elevation above the Lower Town being 320 ft., which must be reached in one way or another.

To overcome the difficulties presented by these hills several methods are adopted, it being obviously impossible to ascend directly even for a horse slightly loaded. One street, Cote St. Abraham, ascends the hill obliquely, and though very steep is yet feasible, and here is located one cross-town route; a profile of the grades encountered is given on page 498. On this hill the heaviest grade is at Crown Street, one of 14.15 per cent—the heaviest traversed by the cars in Quebec—with, moreover, a 40-ft. radius curve at the top, half of it being on the grade.

It was necessary, however, to provide another cross-town route at the other end of the city, but here it was im-

possible to ascend the streets. After much thought had been devoted to the subject, a trestle, a side elevation of which is given, was finally adopted—the alternative being an elevator to raise or lower the loaded car—and constructed in a convenient location. This trestle ascends the first portion of the hill obliquely with a grade of 7 per cent. On reaching a certain point, where the trestle meets one of the cross streets, a curve was located on a level section on the trestle, after which the grade is 11 per cent for 300 ft., then 4 per cent till the Upper Town is finally reached.



TYPICAL STREET IN THE OLD QUARTER OF QUEBEC

The second hindrance, and a most important one in Northern countries, is the handling of the snow, which falls very heavily in these regions. Snow of itself is bad enough, but snow and hills combined are enough to dishearten the most optimistic of managers. Nevertheless, the regular runs are performed with, perhaps, much shorter intervals of stoppage than in larger cities further south, where they are unprepared to cope with such a difficulty. For instance, the snow fall last winter was 120.6 ins., the largest on record, and of this 44.6 ins. fell in March alone, yet there was no interruption in the regular service. This record was achieved by the diligent and continued use of sweepers, levelling plows and numerous box sleighs. Though there are but 18 miles of track, six snow sweepers are ever ready for operation.

When a snow storm occurs in the daytime the load upon the sweeper motors is very much greater than during night storms, for to prevent interference with the regular service it is necessary to run the sweepers in the same direction as the cars; that is, up hill on one track of a double-track road. On the other hand, during a night storm it is the practice for the sweepers to sweep down one track, return the same way, and then clear the remaining track also down grade. Meantime, levellers drawn by horses are also at work throwing the snow still farther from the track, whence it is removed in box sleighs.

The total equipment for the disposal of snow consists of six sweepers, each equipped with two standard 12 A 30-h.p. Westinghouse motors for traction purposes, and another motor of the same type placed in the cab for revolving the brooms, several horse-drawn levellers and numerous box sleighs. No 12 B. & S. copper wire is used as a fuse on the sweepers' motors, and will not blow before 230 amps. are drawn by the two traction motors.

CAR SERVICE

There are two principal routes, one in the Lower and one in the Upper Town; the schedule running time on both is at the rate of 8 miles an hour, and the average car mileage per day 106 miles; the headway on the principal streets is five minutes. Besides these two routes, there are two cross-town lines on which free transfers are issued from the main lines. Open cars are not used on these cross-town lines, on account of the excessive current required by the motors in ascending the heavy grades with ordinary loads and the greater danger of open cars becoming overcrowded. In ascending all heavy grades the motors are run in parallel, and in most cases momentum is secured before entering the grade, to aid the ascent, but on one grade of 11 per cent at the summit of the trestle previously mentioned power is shut off to pass around the curve at the foot of the grade. Extreme caution is exercised in descending heavy grades, the speed not being permitted to exceed 4 miles an hour, an ordinary walking pace.

In a city such as Quebec the braking system should be of special interest, yet nothing but ordinary brake shoes, the average life of which is three months, are used. These shoes are made of a specially soft cast iron, with the flanges perforated to permit the mud to percolate freely, and are supplied with a brake leverage of 10 to 1. Under these conditions it may be not a little surprising to find that skidding is very uncommon; in fact, the average number of wheels worn flat is only 14 per cent out of the total num-



CITY GATE

ber of worn out wheels, and these are mostly due to a slippery track in winter.

The wheels are 33 ins. in diameter, with a 4-in. axle, weigh 425 lbs. each, and are manufactured at the Rochester Car Wheel Works; the average life is 24,834 miles, including those worn flat, though no less than six pair have reached as high as 49,720 miles. Of the total number of wheels removed since July 20, 1897, 56.5 per cent were worn out; 15.55 per cent were worn flat, due to skidding; 4.44 per cent were replaced, due to chipping flanges, and 3.33 per cent were loose on the axle. One detriment to the life of the wheels on the Lower Town route is a certain quality of mud or grit which collects on the brake shoes, and there cakes to such extreme hardness that it is only possible to remove it with a cold chisel. This not only shortens the life of the wheels, but renders braking very difficult.

The summer service consists of forty-four cars per day, and the winter service of twenty-five cars per day.

ROLLING STOCK AND EQUIPMENT

The rolling stock consists of thirty-eight closed and twenty-four open cars and the six sweepers previously mentioned, the closed cars, of course, performing the greater service. These standard closed cars are very solid in their construction, and were built by the Ottawa Car Company, of Ottawa, Ont. The car body measures 18 ft. in length, with closed vestibules at each end and double sliding doors. The length over all is 28 ft. Each is capable of seating thirty passengers, and weighs fully equipped 7½ tons. The interior is very attractive, being finished in natural cherry, with birds-eye maple ceilings, and is brilliantly lighted by three clusters of four lamps each, set in brass fixtures. Each car is furnished with two electric reflector headlights, one at each end. The temperature of the interior is maintained uniform at 55 degs. F., or thereabouts, even in the coldest weather, by means of four electric heaters located under the seats, each consuming 1.1 kw. per hour.

The open cars are of the same dimensions as the closed cars, but have a seating capacity of fifty, and weigh 8 tons each, fully equipped, the average weight being 16,700 lbs. from an actual test. The bodies and side posts are of seasoned oak, with ceilings of birds-eye maple, and all handles and fixtures are solid brass.

Fares are collected from each passenger by a Coleman fare box. Sterling registers are also used. All car bodies are mounted on standard Taylor double side-braced trucks, having a 7-ft. wheel base.

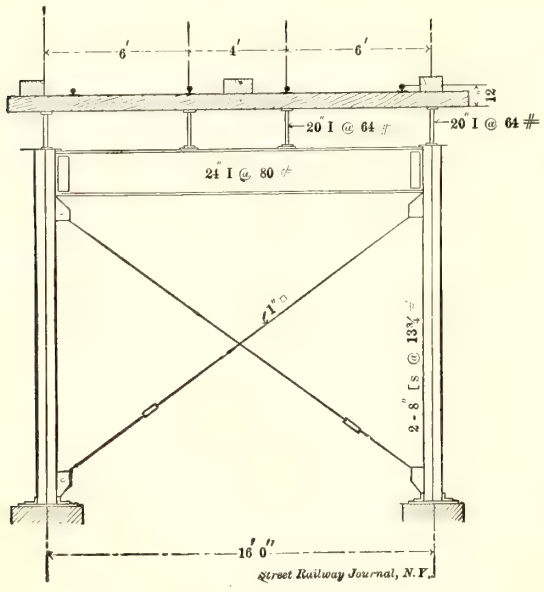
The motor equipment is Westinghouse throughout, and was supplied through Ahearn & Soper, of Ottawa. Two 12 A 30-h.p. motors are used on each car, and are regulated by series parallel controllers of the 28 A type. The gear ratio is 4.85. The fuse is No. 14 B. & S. copper wire, which will carry 175 amps. for a short time, such as may be required in ascending one of those short, steep grades so common in Quebec, or 150 amps. indefinitely in the winter.



MAP OF QUEBEC, SHOWING ELECTRIC RAILWAY SYSTEM

During the winter months the open car motors are transferred to the sweepers, which, as stated, require three each—two for driving the car and the other in the cab for operating the brooms, to which it is connected by chain gearing. No. 12 B. & S. copper wire is used as a fuse in all sweepers, being capable of carrying 230 amps for a short time without blowing, which amount is sometimes required in winter during a big storm. The total motor equipment consists of sixty-two double sets of motors and controllers.

A test was made recently to ascertain the current consumption in ascending the heaviest grade—one of 14.15 per cent, 90 ft. long, with a 40-ft radius curve at the summit, half of which is on the hill. It is customary to throw the power completely off the moment the car enters the curve, and as the car commences to lose momentum the power is thrown on again. Under the most favorable summer conditions the maximum current drawn by the two motors during the ascent until the curve was reached was 65 amps. at 520 volts, then after being turned off on reaching the curve and again thrown on the maximum reading was 130 amps., still at 520 volts. The average



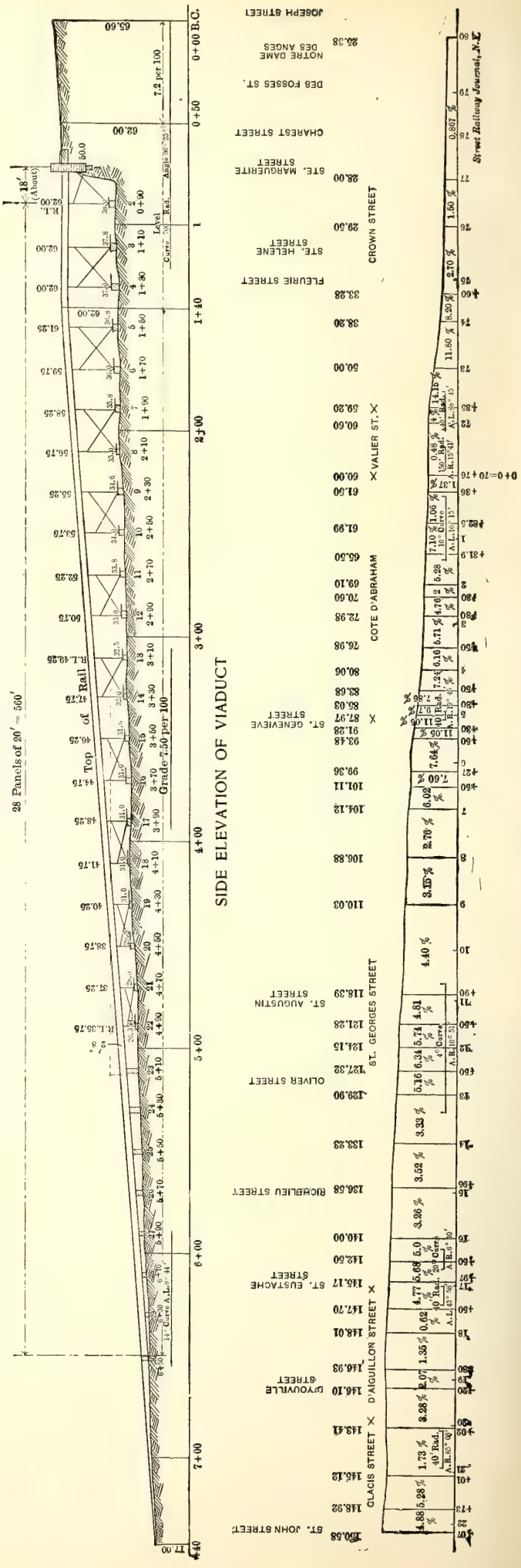
SECTION OF VIADUCT

speed of the car was 4.5 miles per hour, and the estimated weight 9 tons. Under average winter conditions the current consumption rises to nearly 100 amps. on the grade, and to about 195 amps. on rounding the curve.

In descending all heavy grades the motormen are obliged to come to a standstill at the top to ascertain if the brakes are in good working order, after which the speed down grade must not exceed 4 miles per hour, so that a stop may be made, if necessary, on the hill. As all excessively steep grades are short, the time lost in going slow is very small.

The average power consumed in summer, as obtained by the integrating wattmeter in the station, is 8.3 kw. per car per hour, the average for the whole year being about 9.5 kw. per car per hour. The average mileage per car per day is 106.

The trolley wheel is of soft brass, $4\frac{1}{4}$ ins. in diameter, and as it is carefully greased every day it seldom leaves the trolley. Its average life is 10,000 miles, or about 95 days. Commutators run 25,000 miles before being sent to the lathe. The greatest wear on the commutator has been a decrease of 3-16 ins. in the diameter, the average has been $\frac{1}{8}$ in. The brushes used are of the Le Valley Vitae manufacture.



ROADBED

Double tracks are used in all streets wide enough to permit them. The roadbed is of the standard construction, with ties on well tamped beds 2 ft. between centers. During the process of laying asphalt pavements, since the inception of the street railway, concrete has been thoroughly tamped around the ties, and the usual method of placing paving blocks inside and outside the rails has been adopted. English T-rails, weighing 72 lbs per yard in 32-ft. lengths, are used almost exclusively. They are double bonded at each joint with two No. 00 copper wires, and cross bonded every fifth rail. The ends of the bond wires are tinned and are connected to the rails by Eclipse bonding caps, supplied by the Ohio Brass Company. Four ground returns, of 500,000 c.m. each, run on poles from the station. Three of these are connected to the nearest heavy traffic rails, a short distance away; the remaining wire is connected into the Upper Town rails. The object of the latter is to reduce the drop in the rails, as there are only two single-track lines connecting the Upper and Lower Town lines.

The following is a list of the longest grades over 8 per cent, over which the cars operate.

Ninety feet of 14.15 per cent, with a 40-ft. radius curve at the top, half on the hill;

Three hundred feet of 11 per cent (on trestle), with a curve of 70 ft. radius at the bottom;

Seventy-five feet of 9.7 per cent, with curves at top and bottom, and

Three hundred feet of 8 per cent, on which there is a 40-ft radius curve, connecting with 400 ft. of 4 per cent grade.

In two separate portions of the city reverse curves are required. Of these one has a 40-ft. radius on the entrance curve, but the reverse curve has a 34-ft. radius. This was necessary to round a shorp corner into a very narrow street.



SWEEPER AND TOWER WAGON



ENTRANCE TO CAR HOUSE

OVERHEAD CONSTRUCTION

Tubular poles, 28 ft. long, and weighing 700 lbs., and spaced 90 ft. apart, are used throughout. The overhead appliances are of the "Dirigo" type, and the trolley wire is No. 00. Four feeders, each of 500,000 c.m., run from the station, which is approximately in the electrical center of distribution. Lightning arresters of the Wurts non-arcing railway type are situated on the poles wherever the feeders tap the trolley.

At one point, where the railway crosses a drawbridge spanning the St. Charles River, which is navigable for small ships, it became necessary to place the feeder either under the river or at such a height that it would clear the masts of all passing ships. The latter course was adopted,



STANDARD CLOSED CAR



CURVE AT TOP OF AN 11 PER CENT GRADE

and two poles, each 150 ft. high, were placed on each bank, the feeder crossing on top. Each pole is built up of two separate pieces spliced together and the whole well guyed. For the ground return here a No. 0000 bare copper wire crosses the river on the bottom, and is connected to the bridge rails and to the rails on the opposite side of the river.

CAR HOUSES, REPAIRS, ETC.

There are two car houses. The main car house, which is the one illustrated, is a one-story brick structure 210 ft. wide x 120 ft. long, contains fourteen tracks, and has a capacity of fifty cars. There are seven pits, with the usual hydraulic jacks, etc., for motor handling. Opening out from the pits is a machine shop where motors may be repaired, and in which all the machine work in connection with the road and equipment repairs is performed. Situated under the car shed are the storerooms, blacksmith shop and oil room. This latter is a fireproof vault. On the ground floor are the superintendent's and engineer's offices and the employees' room, where orders are given, and where an employee may come and spend a sociable evening.

The remaining car shed is also of brick, and is 310 ft. long x 60 ft. wide. It is used only for storing cars, and contains three tracks, with a capacity of twenty-five cars.

Every night each car is overhauled, the gears and trolley wheels are greased, the commutators are examined, the controllers are thoroughly cleaned, the tips are sandpapered and oiled, the brake shoes and nuts are examined, and the car is washed. Trifling repairs are done on the spot by the inspectors. It requires but three or four men to overhaul all the cars necessary for operation, and the perfect condition of the equipment more than repays the company for the expense incurred. Should a car wheel be worn flat, due to skidding, it is at once removed and replaced.

The repair staff consists of: Day staff—One foreman, two mechanics, one electrical mechanic, one blacksmith, one carpenter, one painter, one laborer. Night staff—One foreman, three greasers and repair men and two cleaners.



SNOW SCENE

Some of the results noted by this system might almost be known as "records," for during the two years' operation only one armature has been burnt out, and only two armatures have been destroyed by worn bearings; no controller has yet been destroyed, and the covers are as good as new; no gear or pinion has yet been destroyed or replaced, and the braking is perfect, one special feature being the noticeable ease with which the motormen stop a car on a grade.

The patrol wagon makes a complete circuit of the whole line once a week, attending to any repairs necessary and testing the span wires for insulation. As a result there has as yet been only one break in the trolley line.



MONTMORENCY FALLS, SHOWING DAM

Taking the eleven months of the last year's operation, the last month's accounts being not yet completed, for the year ending June 30, 1899, the total number of car miles was 914,926, and cost of maintenance $87, 008, or .095 per car mile. Of this amount .016 per car mile was chargeable to snow removal. This amount may be better appreciated when one understands that this sum means that every car must earn $1.70 a day to pay the expenses of the snow removal alone. Payment of all unsalaried employees amounted to .064 per car mile, and was by far the greatest item. The cost of maintenance of electrical equipment was .0019 per car mile; that of car bodies and trucks, .0050 per car mile, and that of ways and buildings, .0081 per car mile.

POWER DEVELOPMENT, POWER HOUSE AND SUBSTATION

This electric railway, together with all electric lights and motors used in Quebec, is operated from water power developed at the celebrated Montmorency Falls, 7 miles distant from the city.

The total height of the fall is 267 ft., down which the water falls perpendicularly in a beautiful white, foaming turmoil of water to the rocky chasm beneath. An im-

mense concrete dam, 250 ft. wide, has been constructed across the river, 100 ft from the brink of the falls, which, though in no manner despoiled of their beauty, are yet turned to some industrial account. A cribwork wing dam has also been erected, containing several large openings in the bottom acting as water passages, permitting the water to enter the forebay free of all rubbish, which is left floating on the surface, and also free of frazil ice, that bugbear to Canadian water power development, this being completely swept away and over the falls by the swift current outside the forebay. The entrance to the penstock is in the gate house, situated at one end of the dam, whence the water flows in the huge enclosed steel pipe, 8 ft. in diameter, to the power house, 2560 ft. distant, following a sinuous path under the very brow of the hill.

The power house, a one-story limestone structure, 150 ft. long x 50 ft. wide, is located on the side of the hill, 208 ft. below the brink of the falls; the actual working head, however, is only 195 ft., the remainder being destroyed by frictional loss. The equipment consists of four 52-in. water wheels, each delivering 1000 h.p. at 286 r.p.m., built by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, the speed being regulated by four Geisler electro-mechanical governors, which raise or lower the cylindrical wheel gate, controlling the admission of water to each wheel. Each wheel is direct-connected to a 600-kw. two-phase S. K. C. alternator, generating current at a frequency of 66 cycles per second, and at a pressure of 5500 volts, at which it is transmitted direct, but is reduced by line drop to 5000 volts at the substation. Two 30-kw. bi-polar exciters, direct-connected each to a 11-in. wheel, rated at 50 h.p. at 1200 r.p.m., furnish current for the generator fields.

From the wheels the water passes into a discharge tank, whence a certain quantity is delivered to a cotton mill situated some distance below, the head being sufficient to operate 1000 h.p., the amount contracted for.

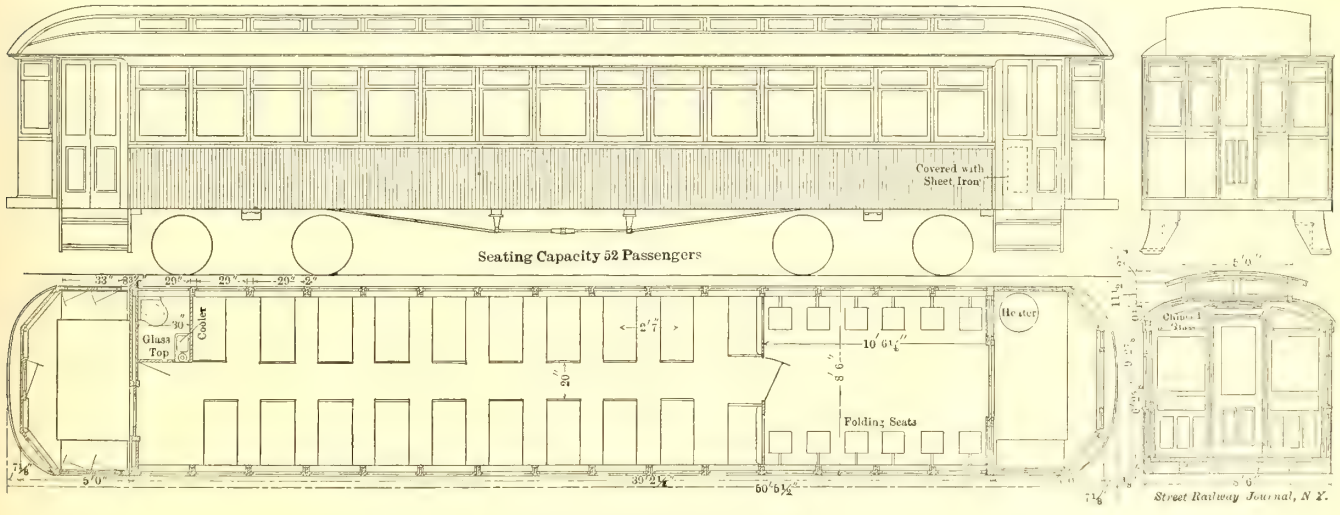
From the power house the current is transmitted to the substation by means of two separate pole lines, each carrying eight wires—four from each machine. The generators are not coupled in parallel at the power house, but are run separately, this being found necessary on account of the violent fluctuations of the street railway load affecting the city lights when all were operated in parallel. The machines, however, not running the railway load are coupled in parallel at the substation for the incandescent lighting and power service.

The substation, situated in Quebec near the St. Charles River, is a two-story limestone structure, containing the office of the lighting and power department, besides the electrical installation, testing and storerooms. For lighting and power purposes in the city the pressure is reduced to 2000 volts by step-down transformers of the Stanley make. For arc lighting two 200-kw. two-phase S. K. C. synchronous motors are each coupled direct to two 125-light Brush arc machines.



INTERIOR OF CHURCH OF ST. ANNE DE BEAUPRÉ

For the street railway load there are two motor-generators, each consisting of two separate machines direct-connected by an insulating leather coupling. The alternating current side is a 600-kw. two-phase S. K. C. synchronous motor running at 286 r.p.m., and operating under a pressure of 5000 volts direct from the line; the direct current side is a six-pole 450-kw. Canadian General Electric generator, delivering current to the street railway at 550 volts. Each motor-generator is started and brought up



CAR FOR HIGH SPEED RAILWAY

to the speed of synchronism by a 30-h.p. two-phase S. K. C. induction motor, after which the synchronous motor takes the load. Two 30-kw. Bullock exciters direct-connected to two S. K. C. induction motors are used for exciting the fields.

The switchboard is of the standard General Electric railway type, consisting of five white marble panels. A Thomson integrating wattmeter is placed on this board, and the amount of power consumed by the street railway may thus be accurately determined. Formerly the street railway was a distinct and separate company and purchased power from this station at a certain contracted price per kw. hour, this leading to the introduction of the wattmeter.

SUBURBAN EXTENSIONS

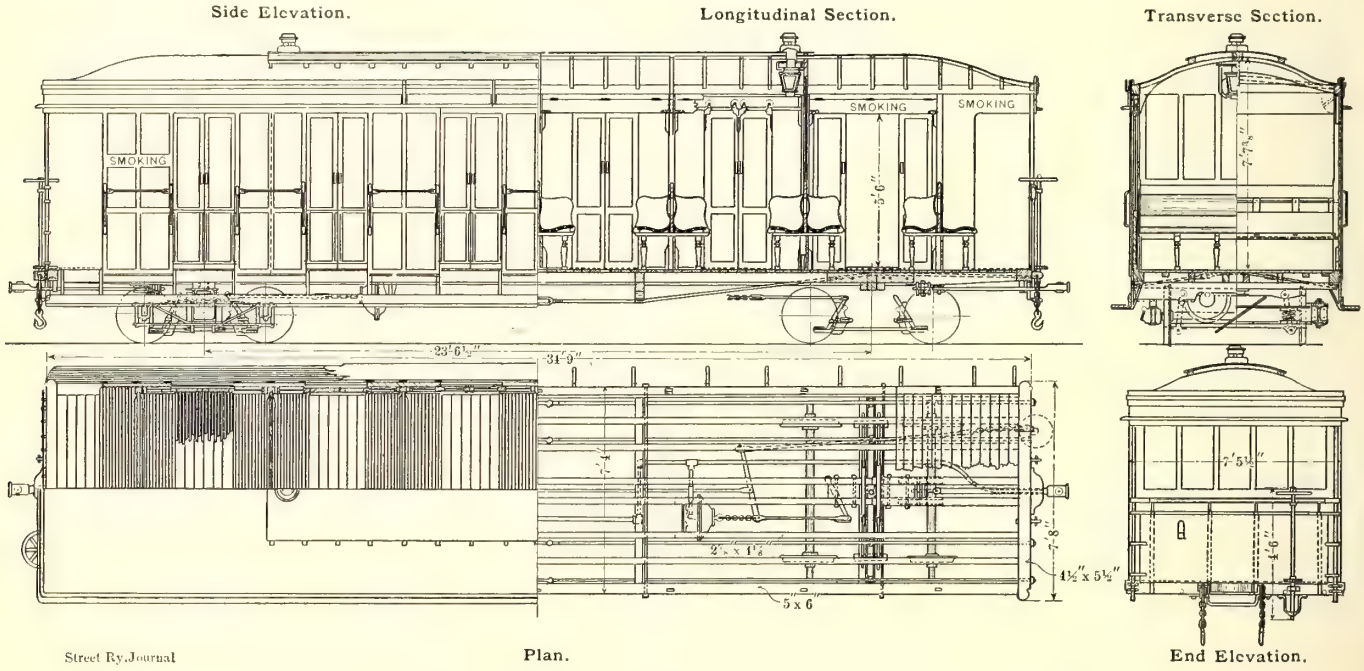
The Q., M. & C. Railway Company, besides running the Quebec city system and supplying the street and residential lighting and power, operates a steam railroad 21 miles long, from Quebec to St. Anne de Beaupré, a celebrated Roman Catholic shrine, this, in fact, being its original business. This latter road will shortly be converted to electricity, the main line being extended 9 miles, making a 30-mile run, and a branch line of 6 miles to be constructed. The total length when completed will be 36 miles, all of single track.

The same roadbed will be used, the 56-lb. rails being bonded with two No. 00 copper bonds. The overhead construction will be standard, wooden poles, of course, being used. There will be two trolleys side by side, in multiple, each with a No. 0000 copper wire. No feeders are required, as the size of the trolley wire will keep the drop within bounds.

The road will be equipped with 50-ft. cars, double trucked, of a type similar to that used on the Detroit-Ypsilanti road, and are illustrated herewith. Each will provide seating capacity for fifty-two passengers, and will be operated by four 50-h.p. Westinghouse motors, capable of attaining a speed of 50 miles an hour. Two trolley poles, arranged tandem on top of the car, will supply all the power required for starting or running up a heavy grade, without sparking in the least. Each car will be provided with Westinghouse standard air brakes, and will weigh 4 tons, made up as follows: Car bodies, 25,000 lbs.; truck, 12,000; motor and equipment, 10,800.

The ordinary service will be hourly, but during the summer months it is thought that it will be necessary to reduce it to half-hourly on account of the rush of pilgrims to the shrine at St. Anne de Beaupré.

For supplying power to this road one 600-kw. Westinghouse double generator is to be installed at the Montmorency Falls power house. The direct current side of this will deliver current at 550 volts, feeding directly into the two trolley lines at the power house, and taking care of the first 10 or 12 miles; the alternating current side will generate a two-phase current at a nominal pressure of 400 volts, which, by means of two 125-kw. single-phase transformers using the "Scott connection," will transform to a three-phase at a pressure of 1000 volts, at which it will be transmitted to a substation located 10 miles from the eastern end of the line. Here it will be reduced to a two-phase again, and operate a 200-kw. Westinghouse rotary converter, thus obtaining current at 550 volts to feed that end of the line.



LIGHT RAILWAY CAR USED BY THE SOUTH WALES GOVERNMENT RAILWAYS

The officers of the Q., M & C. Railway Company are: H. J. Beemer, president; E. A. Evans, general manager; W. R. Russell, general superintendent; William Langford, hydraulic engineer; D. E. Blair and Lewis Burran, electrical engineers, in charge of the street railway and the lighting and power departments respectively.

Light Railway Car

The accompanying diagram shows plan, side elevation and section of the standard car for steam tram or light railway service used by the New South Wales Government upon the steam tramways owned by it. These cars have been in service for from fifteen to eighteen years and seem admirably suited for the work they have to perform. Their seating capacity is seventy passengers, but when heavily loaded and the standing room is occupied they frequently carry 130 to 140 people. The weight empty is 11,200 lbs., including trucks. The latter are, of course, very light and are equipped with cast steel wheels. The drawing is reproduced through the courtesy of W. Thow, chief mechanical engineer of the New South Wales Government.

Some Electrical Features of the Power Station of the Consolidated Traction Company of Pittsburgh

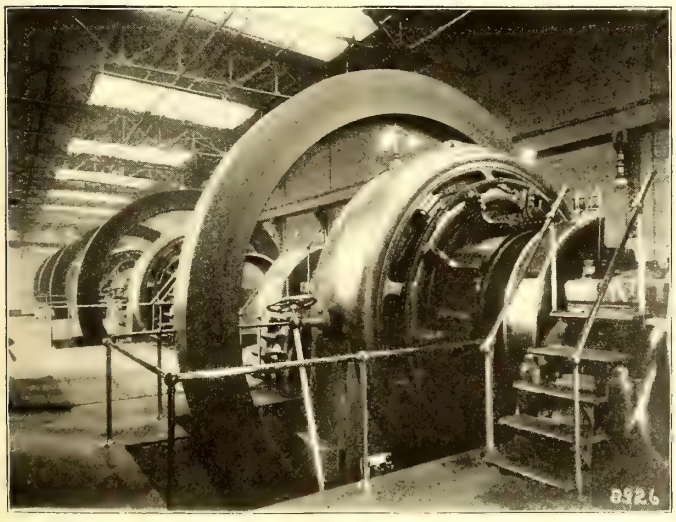
An extended description of the electric railway system of the Consolidated Traction Company of Pittsburgh was published in the STREET RAILWAY JOURNAL for March. This system, as will be remembered, is a most extensive one, and the power station which has recently been completed, includes a number of radical innovations from standard practice. The extent of the subject, and the fact that the station at the time of going to press was not entirely completed, precluded the description of a number of details of interest in regard to the station equipment, and these will be briefly mentioned herewith.



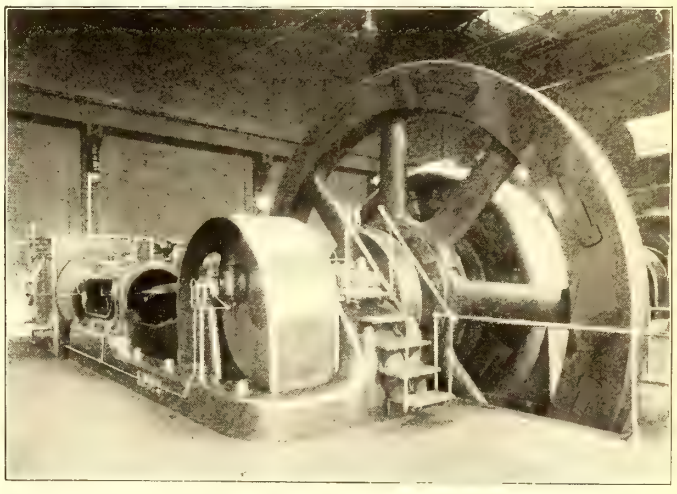
COAL CONVEYOR



INTERIOR OF BOILER ROOM



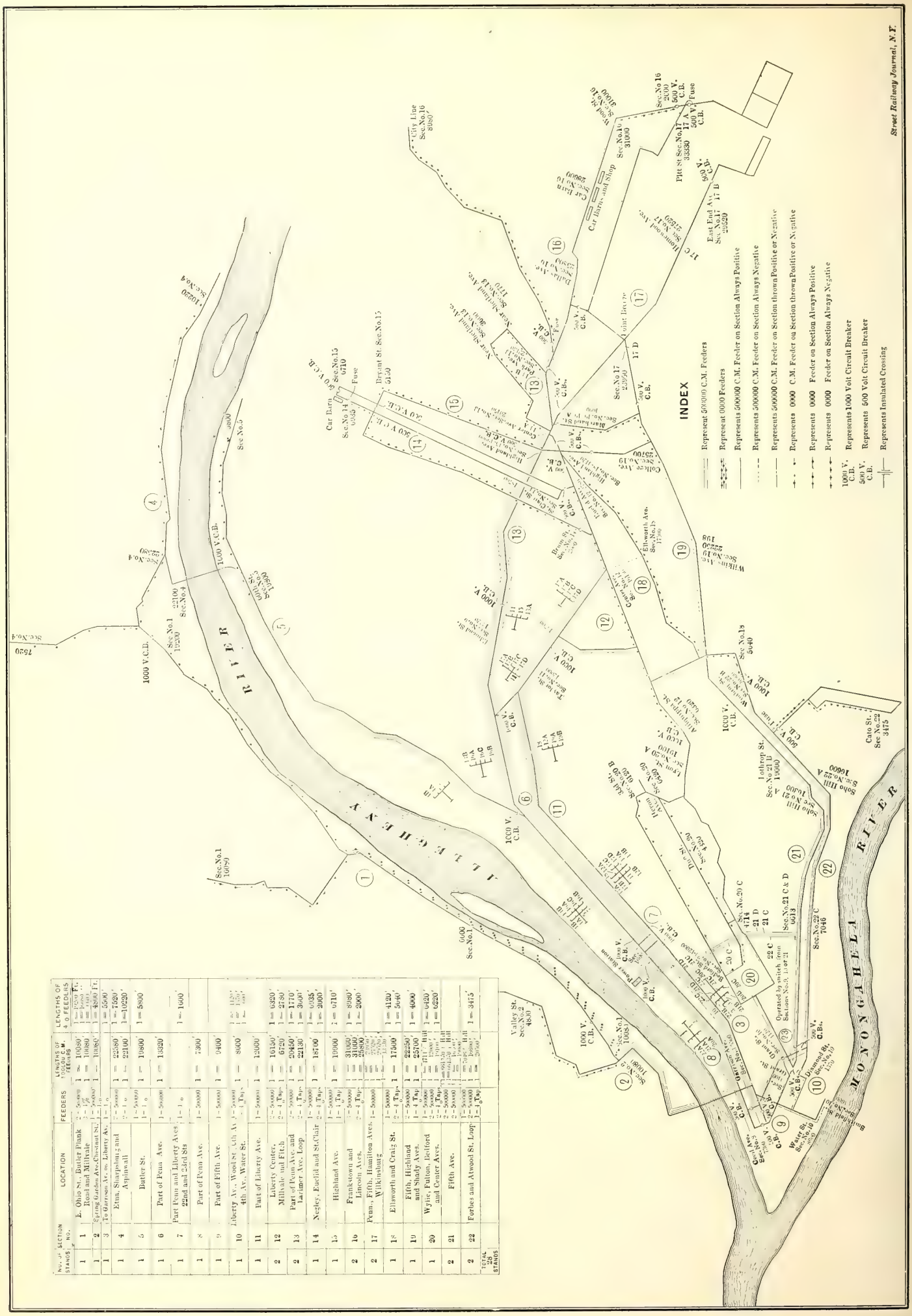
GENERATOR SIDE OF UNIT



LOW PRESSURE SIDE OF UNIT

The power station is located at Twentieth Street, on the Allegheny River, from which water is obtained for condensing purposes. The tracks of the Baltimore & Ohio Railroad and the Pennsylvania Railroad are close to the station. Coal can be secured from either, or from barges on the river. The station itself is built of Pompeian brick, with Cleveland sandstone trimmings, and measures 275 ft. x 115 ft. The coal is received at the river end of the station. The cars run over a receiving hopper, into which they discharge their load. The coal is being carried by a Meade coal conveyor, with automatic weighing bucket, to a second hopper, or coal storage bin, located over the boilers. The conveyor is driven by a 16-h.p. electric motor, and has a capacity for handling 40 tons per hour. A view of the receiving end of the conveyor is shown in one of the accompanying engravings.

The boiler room contains six batteries of sectional water tube boilers of a special design, made by the Babcock & Wilcox Company, and each battery is provided with a separate unlined iron smokestack. Each stack is 66 ins. in diameter, and rises 147 ft. above the grate bars. The furnace is of the Hawley down-draft type. In order to economize floor space the boilers are made shorter and higher than usual. Each boiler contains about 4000 sq. ft. of heating surface and is made up of eighteen sections of

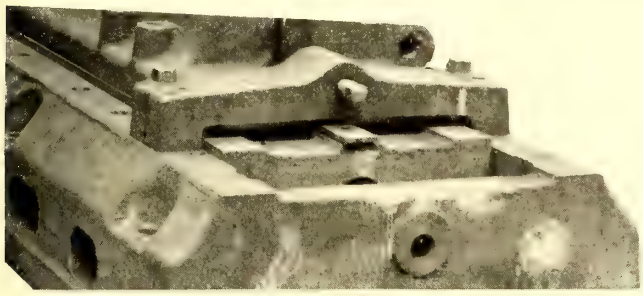


No. of Section Stands	No.	Location	Feeders	Lengths of 1/0000 C.M. Feeders	Lengths of 4/0 Feeders
1	1	L. Ohio St., Butler Plank Road and Millvale	1 — 56000 2 — 1/0	1 — 11030'	1 — 12250 Ft. 1 — 11030' 1 — 4300 Ft.
1	2	Spring Garden Ave. Chestnut St.	1 — 56000 1 — 1/0	1 — 11080'	1 — 4300 Ft.
1	3	16 Garrison St. on Liberty Av.	1 — 1/0		1 — 5500'
1	4	Etna, Sharpsburg and Aspinwall	1 — 56000 1 — 1/0	1 — 22580 1 — 22100	1 — 7520' 1 — 10220'
1	5	Butler St.	1 — 56000 1 — 1/0	1 — 11800	1 — 5800'
1	6	Part of Penn Ave.	1 — 56000	1 — 13320'	
1	7	Part Penn and Liberty Aves., 22nd and 23rd Sts	1 — 1/0		1 — 1600'
1	8	Part of Penn Ave.	1 — 56000	1 — 7300'	
1	9	Part of Fifth Ave.	1 — 56000	1 — 9400'	
1	10	Liberty Av., Wood St. (5th Av.) 4th Av., Water St.	1 — 56000 1 — 1/0	1 — 8060'	1 — 1120' 1 — 1120' 1 — 4000'
1	11	Part of Liberty Ave.	1 — 56000	1 — 12060'	
2	12	Liberty Center, Millvale and Fitch.	1 — 56000 2 — 4 Tap.	1 — 10150' 1 — 6720'	1 — 6320' 1 — 2730'
2	13	Part of Penn Ave. and Larimer Ave. Loop	1 — 56000 2 — 4 Tap.	1 — 20450' 1 — 22130'	1 — 1170' 1 — 3600'
1	14	Negley, Euclid and St. Clair	1 — 56000 2 — 4 Tap.	1 — 16700	1 — 6035' 1 — 2000'
1	15	Highland Ave.	1 — 56000 1 — 4 Tap.	1 — 19900	1 — 6710'
2	16	Frankstown and Lincoln Aves.	1 — 56000 2 — 4 Tap.	1 — 31400' 31400' 25880'	1 — 8980' 1 — 2000'
2	17	Penn, Fifth, Hamilton Ave. Wilkinsburg	1 — 56000	27700' 11320'	
1	18	Ellsworth and Craig St.	1 — 56000 2 — 4 Tap.	1 — 17500'	1 — 4120' 1 — 5640'
1	19	Fifth, Highland and Shady Aves.	1 — 56000 1 — 4 Tap.	1 — 22250'	1 — 4000'
1	20	Wylie, Fulton, Bedford and Center Aves.	1 — 56000 1 — 4 Tap.	1 — 25700'	1 — 6420'
2	21	Fifth Ave.	1 — 56000 2 — 56000	1 — 7080' Hill 1 — 9420' Hill	1 — 6220'
2	22	Forbes and Atwood St. Loop	1 — 56000 1 — 4 Tap.	1 — 7080' Hill 1 — 3000'	1 — 3475'
TOTAL 26 STANDS					

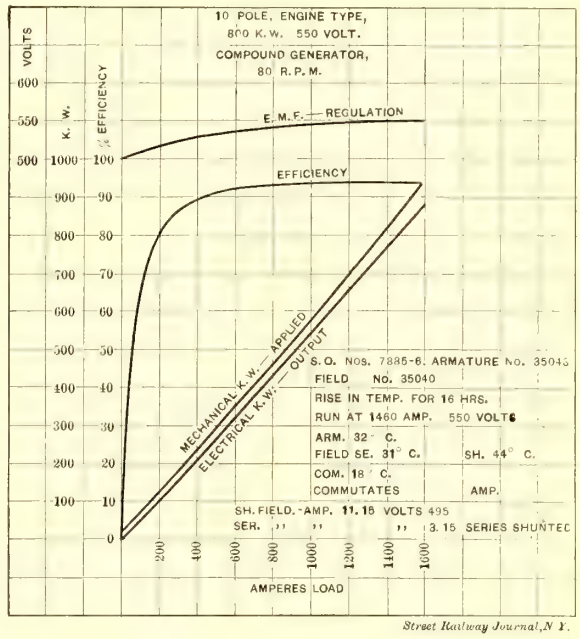
DIAGRAM OF FEEDERS FOR OPERATING ON THE THREE-WIRE SYSTEM, CONSOLIDATED TRACTION COMPANY—PITTSBURGH

tubes, each 15 ft. long with three 36-in. drums, 20 ft. long. The boilers are designed to carry a pressure of 200 lbs. to the square inch and were tested under hydraulic pressure to 300 lbs.

The interior of the engine room is of Pompeian brick, and is finished with enameled brick wainscoting with slate cap. It measures 270 ft. x 55 ft.; and is designed to contain eight units, of which six are at present installed. Each unit consists of a 1560-h.p. cross-compound condensing Corliss engine, built by the Pennsylvania Iron Works Company, and connected to an 800-kw. generator. The engines run at 80 r.p.m., and their cylinders measure 30 ins. and 54 ins. x 48 ins. stroke. An automatic oiling system is used for all the bearings. The main supply of oil is kept in a reservoir placed near the roof of the building, and from



VERTICAL ADJUSTING DEVICE FOR GENERATOR



DATA CURVES OF GENERATOR

that point is piped to the different bearings. After passing through the bearings it descends to the basement, from which point it is filtered, and is then pumped back to the tank. An automatic arrangement is provided by which if there is any lack of oil supply in the tank a whistle is blown in the engine room.

The generators are of the standard Westinghouse rail-



VIEW OF POWER STATION

way type, with a nominal capacity of 1460 amps., and actual capacity of considerably more under different conditions, as mentioned later. The generators run at 82 r.p.m. at no load, and give then 500 volts. At nominal load, which is 1460 amps., they are designed to run at 80 r.p.m., and give 550 volts; and at 75 per cent overload they run at 77 r.p.m. The generators are guaranteed to carry 1820 amps. continuously, with a rise of not more than 40 degs. Cent. in any part of the machine; and also to carry 2560 amps., which is 75 per cent overload, with not less than 550 volts for a short period. The commercial efficiency of the machine at one-fourth load is 90 per cent; one-half load, 92 per cent; three-fourths load, 93 per cent, and full load, 94 per cent. The output of the machine at different rates of loading is shown diagramatically in the accompanying data curves. The machine is also guaranteed to produce no sparking within the limits of no load and 50 per cent overload, or to require any shifting of brushes between these limits. It is also guaranteed not to buck at the opening of the circuit breaker at 2500 amps. The machine is tested before leaving the works to stand an alternating e.m.f. of 3500 volts. The frame is mounted on an adjustable bed plate, which provides for both a lateral and vertical movement. The former is cared for by regular guide rails; the latter is intended to provide for the wear in the bearings, and is accomplished by means of a large wedge-shaped casting which supports the generator and can be moved in either direction by means of a screw adjustment. This device is illustrated in one of the accompanying engravings.

The generators are over compounded, so that the potential at the terminals increases about 10 per cent from no load to full load. The shunt and series coils are separately wound, and are removable at will. The armature spider is pressed and keyed upon the engine shaft, and may be drawn off when desired, should that ever be necessary.

without interfering with the permanent arrangement of the commutator and windings. The armature windings are made from bars of copper forged into proper shape, on cast iron formers and are insulated with mica and prepared filler board. They are held in the slot by retaining wedges of hard fibre, avoiding the use of bands.



INTERIOR OF ENGINE ROOM—PITTSBURGH

The switchboard, as described in the March issue, is built for the three-wire system, and is of an extremely novel pattern. Although the road is still operated on the two-wire system, the arrangement of the feeders for the three-wire system has been decided upon, and the overhead system is so arranged that a change to the three-wire can be effected without any alteration of the feeders or overhead structure. The method to be employed is, briefly, to operate the down-town sections positive and the suburban sections negative, and provide certain alternate outlaying feeders adjoining each district for transposition from one side to the other. A change, however, to the three-wire system is considered impossible until all the substations now in operation are shut down, and this will prevent a change for some time.

A diagram of the arrangement of feeders for three-wire distribution is shown on page 504. As will be seen, part of the feeders are arranged to be operated positive, part negative and part to connect to either side to balance the system.

The main object in the painting of cars should be to secure a hard, smooth surface which will hold the varnish with the very smallest amount of material; the thinner this surface is the better. From paper at the Boston Convention, 1898.

A Novelty in Car Construction

The accompanying engraving shows a somewhat novel type of open car recently put in service on the lines of the Montreal Street Railway Company. The cars are run on a loop, and the inside of the car is partly closed, the idea being to do away with the wire screens hitherto used, and also to prevent wet seat ends. The cars are fitted with pantasote curtains, which are found very effective in wet weather and on cold days.

The right side of the car, the one not shown in the engraving, is finished similar to an ordinary open car. The photograph is reproduced through the kindness of F. L. Wanklyn, manager and chief engineer of the Montreal Street Railway Company.



NOVEL OPEN CAR—MONTREAL

Life consists of motion, and the more we increase the facilities on the part of mankind to move its individual units from one point of the earth's surface to another point, the more we extend civilization in the higher sense of the term. From address at the Boston Convention, 1898.

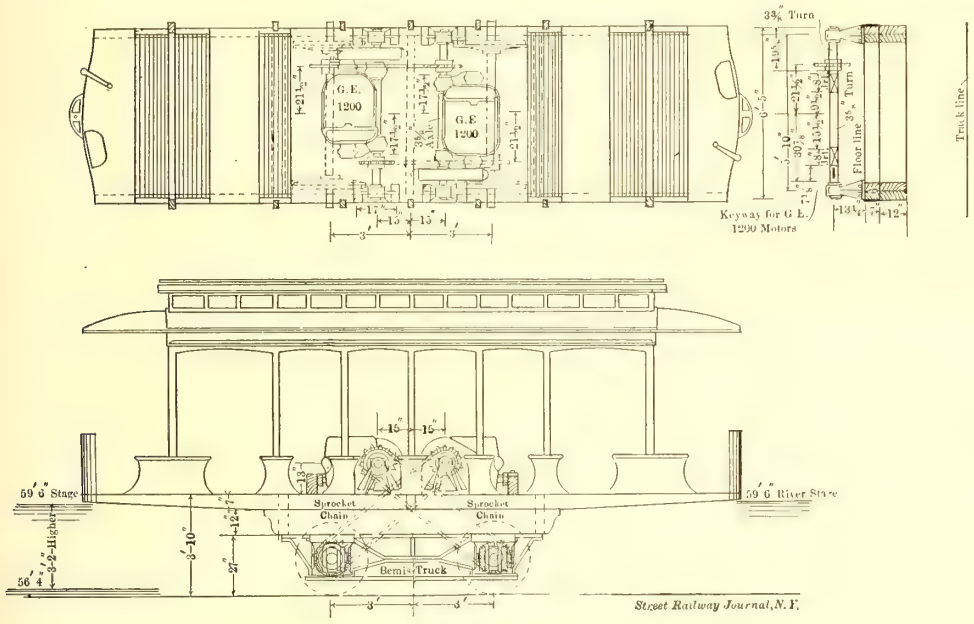
Notes From Cincinnati

The Cincinnati Street Railway Company now controls all the street railway lines operating in the city proper, but permits some of the cars of a suburban line to pass over its tracks to the business center of the city. The system also connects with and receives the passengers at College Hill with the high-speed line that runs between Cincinnati and Hamilton. The double trolley still holds its own, and the grooved type of rail is the standard.

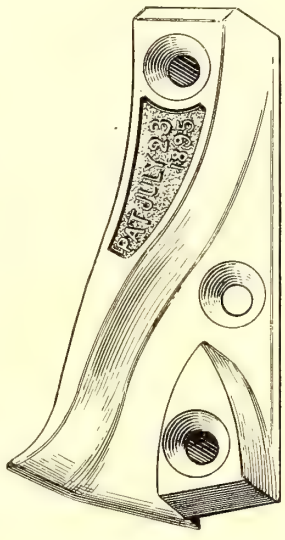
Since the last description in the STREET RAILWAY JOURNAL of the street railway systems of this city the Cincinnati Street Railway Company has bought that portion of the line located between the Zoological Gardens and Fountain Square that was formerly controlled by the Cincinnati Inclined Plane Street Railway Company. Since this purchase the company has abandoned the operation of the inclined plane on which the cars were formerly lifted to the heights, and the cars now reach the top of the bluff by making a detour around it. The company has also absorbed the Mt. Auburn Cable Railway, now known as the Sycamore Street line and which is still operated by cable, being the only remaining cable line in the city. Some recent additions have been made to the power plants, of which there are six still in operation—five electric and one cable—the grades and other conditions being such that a central station is not thought to be practical. Direct coupled units have become the standard for new construction, and the later installations are of this type. In this connection it is interesting to note that this company was among the first to install a direct coupled unit. Its original unit consisted of a Buckeye engine and a Siemens & Halske generator, which are still in operation and giving reasonable satisfaction. During the first year of the service of this unit a great deal was said about the impracticability of direct connection, but the wisdom of the company in its first choice has been fully demonstrated by the results.

Considerable pressure is being brought by the city authorities at Cincinnati against the street railway company to require it to adopt the underground or conduit electric system. To this the company objects for various reasons, chiefly because a good many sections of its trackage are under water during the periods of high water in the Ohio River. The company has recently, at its own expense, made a careful survey of its line and noted the limits of the water level at both the high and low stages, and which are printed in this connection, and which show the depth to which the rails are submerged and also the extreme rise and fall of the water. From this it was found that about 34 miles of the streeet on which the tracks are laid were subject to overflow, and this circumstance, it is claimed, would prevent the operation of the underground trolley.

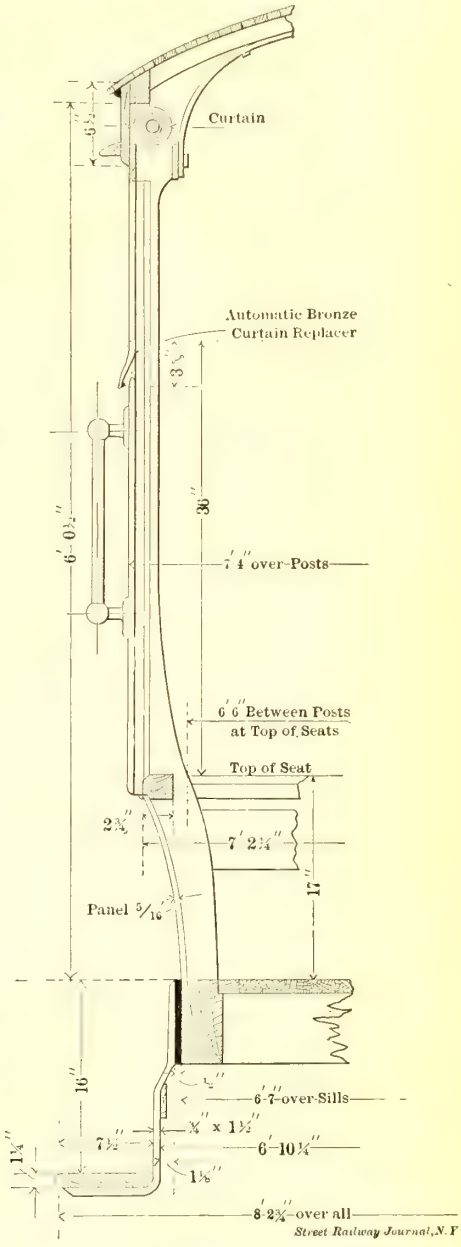
In order to provide for operating the lines over the submerged section of the streets the company has recently designed a train, consisting of a motor and trail car, which will be operated in the stages of high water. The motor car for this purpose is illustrated in the accompanying diagram from which it will be seen that an ordinary open car is employed, but it is raised above the truck by means of beams. The motors are supported on the floor of the car and transmit their power to the axles by means of sprocket chains and gear. It is the intention of the management to increase the weight of the motor car by having a number of discarded motor gears pressed on to the axles. The trail car consists of a nine-seat open car of the same design as the motor car, but without motor. It will be



CAR FOR FLOODED TRACKS



CURTAIN REPLACER



SECTION OF SIDE OF CAR SHOWING CURTAIN REPLACER

raised about 12 ins. above the truck in the same manner, so that it will readily couple to the motor. In connection with this train platforms will be provided on the side of the street at certain locations so that people who are required to patronize the train will have ready access to the cars.

The table showing the portions of the track liable to flood is given below.

Route	Total Length in Feet of Route Under Water When Stage of River is 71'—0½"	Stage of River Necessary to Reach Track at the Lowest Street Level	Stage of River Necessary to Flood Conduit at the Lowest Street Level
East End	25,550	55.92	53.92
Delta avenue	26,200	55.92	53.92
Third and Fifth streets	10,700	56.24	54.24
Chester Park	24,300	57.62	55.62
Sedamsville, to Bold Face Creek only	10,100	57.84	55.84
Colerain avenue	10,600	58.06	56.06
Harrison avenue	13,400	58.65	56.65
John street	7,300	58.65	56.65
Cross Town	5,300	58.65	56.65
College Hill	3,400	59.56	57.56
Clifton and Elm streets	3,400	59.56	57.56
Lock street	1,000	62.06	60.06
Warsaw	3,800	63.99	61.99
Elberon avenue	3,800	63.99	61.99
Fairmount	18,050	64.65	62.65
Seventh street	5,400	64.65	62.65
Clark street	12,400	64.65	62.65
Sixth street	9,000	64.85	62.85
Total	193,700	....	....

A CURTAIN REPLACING DEVICE

All the open cars of the Cincinnati Street Railway system are equipped with a curtain replacing device which was invented by the president of the company. This consists of a brass lug about 4 ins. long, having a curved channel of the same width as the curtain channel in the posts, and is set into the posts on the inner faces about 2 ft. below the top of the post. If for any cause when a curtain is pulled down it leaves the guides, it can be immediately returned to its place by letting it run up outside the posts, when the replacer will turn it back into a proper position, and it can then be drawn down in the ordinary manner. The replacer is held in position by two screws, and is not of sufficient depth to weaken the post. The device is cast in the company's foundry, and finished up in the machine shop, and is a very inexpensive appliance as compared with its advantages.

ILLUMINATED SIGNS

All the cars of the Cincinnati Street Railway Company are equipped with an illuminated sign which can be read in daylight or night time. For their use two stationary plain glass panes are placed in the deck on each side at the middle of the car, and also in the deck lights above the hoods. These are fitted on the outside with grooves or guides, into which the sign proper is slid. The sign consists of a sheet of glass of the same size as the stationary panes, but with the groundwork painted black, leaving the letters outlined; these letters are about 4 ins. in height, and there is a narrow white border around each letter. This makes a sign that is readily read in daylight, and at night it is illuminated by the lamps in the car. These signs can be read for a considerable distance as the car approaches, and are much more satisfactory both to the patrons and operating company than any signs heretofore used.

MOTORS, TROLLEY WHEELS AND BEARINGS

Four types of motors are employed on the cars of this system, the type being adapted to the character of the grades and of the cars. These consist of the General Electric 800 type, the General Electric 1000, the General Electric 1200 and General Electric No. 58. Power for operating the different departments of the repair shop is derived from motors which are made over from the old D 62 type of generators formerly employed. Quite a number of these are in use, and have proved very satisfactory. There are besides twenty small power motors employed about the shops and the different car houses of the system.

The company manufactures its own trolley wheels, the blanks being cast in its brass foundry. These blanks are turned up with automatic tools of special design on a lathe which is operated by an unskilled workman. This man receives only $1 a day, and is able to turn up and finish 125 wheels in that length of time. The wheels are cast from a mixture consisting of eight parts of copper to one of tin.

The company employs bronze bearings for armature journals in preference to babbitt, as it was found that the babbitt would frequently squeeze out from the shell and allow the armature to come down in contact with the fields, and in case of excessive heat would melt.

At one time after the consolidation of the various roads there were fifty-four different types of car axles in use, to suit the various types of motors and trucks. To reduce this number the company selected two types of trucks—the Peckham and the McGuire—and these have consequently been adopted as standard.

REPAIR SHOPS

The new repair shops, which are located at Chester Park (7 miles from the center of the city), and which were illustrated and described in these columns in the issue of February, 1898, are still of ample capacity for all repairs, and are also turning out considerable new work. Thirty new cars have recently been built here, and they are very creditable in design and finish. Some special features in mechanical appliances and methods employed in these shops were published in the June issue.

The different departments of the repair shop are heated by means of the American Blower Company's system, which consists of enclosed fans 140 ins. in diameter and driven by a steam engine. These take the cold air in through a nest of steam pipes, and deliver it through large galvanized pipes to the different parts of the building. Two of these fans are provided for heating the paint shop proper, which is 200 ft. x 300 ft. and 20 ft. high, and during the past winter, with the outside temperature 14 degs. below zero, a temperature of 70 degs. F. was easily maintained in the shops.

In the construction of the repair shop the roof trusses were constructed of wooden beams in preference to metal for the reason, it is claimed, that in case of fire among the cars or in the building the timbers would char and hold up longer under the heat than would a steel structure, which is liable to buckle and give way under excessive heat.

For shifting coal and freight cars about the premises, and for handling the street cars in the yard, an old motor car, with rather a short body, is employed. This car has sufficient power for handling three or four loaded freight cars on a level and around curves, and has proved to be a very convenient and cheap mode of shifting cars.

All transfer tables in the shops and car houses are operated by motors, which take their current from conductors placed below the floor level in slots.

One of the most interesting features of the repair shop is the brass foundry, in which is cast all the brass work required in the operation of the system, including car trimmings, trolley wheels, commutator bars and bearing shells. It is generally supposed that pure copper cannot be cast into commutator bars without there being defects in the

way of blow holes, etc., but in the experience of this company no difficulty is found in making perfect castings, using copper wire scrap. The various parts are cast in groups in a single flask, are afterward separated and trimmed on a band saw, and then smoothed upon an emery wheel.

The twelve forges in the blacksmith department are all constructed on what is known as the down draft system, so that there is no smokestack or flue above the forges. The hood for the down draft is at one side of the forge, and the air is exhausted by a fan located in one end of the shop. This fan is so designed that part of the gases from the furnace are directed into the blast tube and returned to the forge for blowing the fire. By this arrangement the combustion is so perfect that no smoke is ever seen to emerge from the main stack into which the fan discharges its current.

The blacksmith department is provided with a 1500-lb steam hammer, manufactured by the Morgan Engineering Company, of Alliance, Ohio, and the bending tools, shears and punching machines are driven by a motor made over from a D 62 generator, as before described. In this department by the means of the steam hammer the company makes its own dash rods, etc.

Labor Saving Tools and Methods in the Repair Shops of the West Chicago Street Railway Company

The repair shops of this company, which are located at Madison and Fortieth Streets, and which were built in October, 1890, are still among the largest, if not the largest, of any street railway repair shops of the country. The floor space of all the buildings, including that of the wood department, iron department, erecting shop, paint shop, car storage department, and the various offices and auxiliary buildings, aggregates 1,586,552 sq. ft. Here all the repairs of both the cable and electric lines of the system are made. The tool equipment is very complete, and has recently been increased by the addition of new lathes and planers, and by a rail sawing machine, which is illustrated in Fig. 1.

Electric motors have recently been installed for driving the shafting in the different departments, the current being obtained from the trolley line, and the engine and boiler equipments have been abandoned. The rail saw referred to above was recently purchased from the Q. & C. Company, of Chicago, and is utilized not only for sawing rails, but for trimming grip dies and for cutting angle iron or bars of any shape. The bars from which grip shoes are made are first cut up to standard lengths on this saw, several bars being clamped together and cut at the same time. These are then trimmed on the saw by being clamped in groups of six or seven, as shown in the illustration. Formerly this work was performed in a blacksmith's shop, where it was necessary to heat the bars before trimming. Now the work goes on by means of the saw at a greatly reduced cost. In this connection it is interesting to note that the company now manufactures all its own special work, provision being made for erecting under a temporary shed located in the back yard of the machine shop proper. In the construction of crossings a change has been made in the method of abutting the ends of the short rails against the sides of the through rails. Formerly it was the custom to cut off the base of the rail and part of the web, so that the web of the short rail would rest on the base of the main rail. As this gave only a narrow support to the end of the rail, and because it was found to cut into the base, the practice has been adopted of preserving the base of the short rail and causing it to rest upon the base of the main rail. To accomplish this a wedge-shaped piece is cut out of the web next the base, of sufficient depth and length that when the base is bent up after heating, it just fits on the base of the main rail and brings the top of the rail to line, but furnishes a solid support for the end of the short rail.

A double furnace has been installed in the blacksmiths' shop, having doors which are lifted by balance levers, as shown in the engraving Fig. 2. The special feature of this furnace, and one worthy of note, is the location of a 4-in. pipe across the front, just beneath the doors. This pipe is slotted on its upper surface, and conveys a blast of air, which, issuing under pressure through the slot, creates a strong up draft when the doors are opened, and so dissipates the heat that the attendant can stand very near the furnace when the door is open without inconvenience, and with his tongs place new blanks in the furnace or remove those when sufficiently heated.

A brass foundry has also been recently installed, and occupies a portion of what was formerly the iron storeroom. The foundry is 34 ft. x 32 ft., and is provided with four furnaces, as shown in the illustration, Fig. 3. The molding troughs are located on two sides of the room, and the flasks, when the charge is ready for pouring, are arranged as shown in the illustration. A core oven is provided, which stands near the furnace, as shown in the illustration.

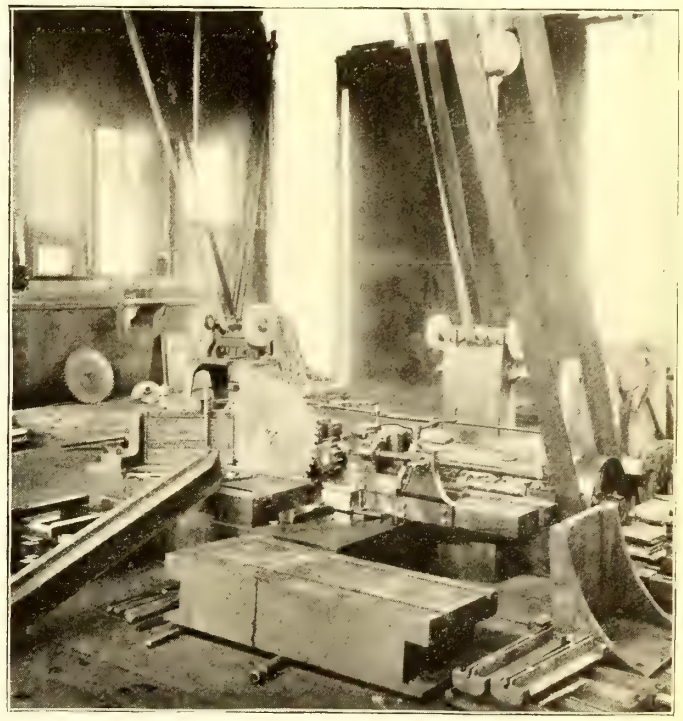


FIG. 1.—METAL SAW

Since the installation of the brass foundry the company manufactures its own brass and copper work of every description, including trolley wheels, trolley harps, overhead switches and car trimmings, as it is now the policy of the company to manufacture all its own supplies, and not to go outside for anything that it is possible to produce in its own shops.

In connection with the machine shop proper a tool room has been partitioned off at one end, in which all the small tools are systematically arranged. This shop is in charge of an attendant who deals out the tools to the workmen on their personal checks, so that a careful record is kept of all tools. In the tool room is located a multiple drill, or rather, a drill with revolving head, which carries tools of

different descriptions to the number of six. This drill is operated by the tool-room keeper, who drills and finishes many of the brass pieces. Here, also, the principal repairs on the registers are made.

Owing to a recent ordinance, requiring that all of the cars of the city be equipped with fenders, the West Chicago Street Railway Company has equipped its cable and electric cars with fenders of its own design and manufacture.

In the matter of motor repairs it is the practice in the motor repair department to renew the motor bearings every sixty days, without waiting for them to be worn down, and at the various depots where light repairs are made in the armature brushes of the General Electric motors they are changed every day and are put to soak in vaseline. By changing brushes a gloss is formed on commutators, and wear is prevented. On one of the electric lines of the West Chicago, quite a number of the Candler self-oiling trolley harps are employed. By the use of these the life of the trolley wheel is greatly lengthened, and they now last on the average of thirty days.

In the motor repair department only four men are employed for making all the armature and field repairs on 400 motor equipments employed on the lines of the West Chicago system proper, and they also take care of the repairs on motors of three or four of the leased lines. Some of the commutators that have been in service for four years have never been turned down. Others have required turning several times. In the opinion of the foreman of the armature department, the damage to the commutator is not from actual wear, but from sparking, due often to the variation in the neutral point of the brushes, but more often to the improper handling of the car. The amount of resistance in the shunt coil, he also claims, has much to do with the flat spots on the commutator. Where two motors are mounted on the same truck with unequal resistance in the shunt coils, it is found that the one with the least resistance receives more current and, consequently, tends to run faster and do more work, hence danger to the commutator and winding is incurred. A remedy is found in mating motors properly.

In repairing armatures of the Westinghouse No. 12 motors, it is customary to wind the armature complete with triple insulated wire. Better success is had than with made up coils. This method gives an opportunity to place additional insulating material in the slots, while the ends are reinforced with a bit of mica, and this method avoids the danger of employing an imperfect coil or injuring the insulation of the coil in putting it in place. The cost of the winding complete (including labor and materials) is found to be only a trifle more than made up coils alone, while the life is materially prolonged.

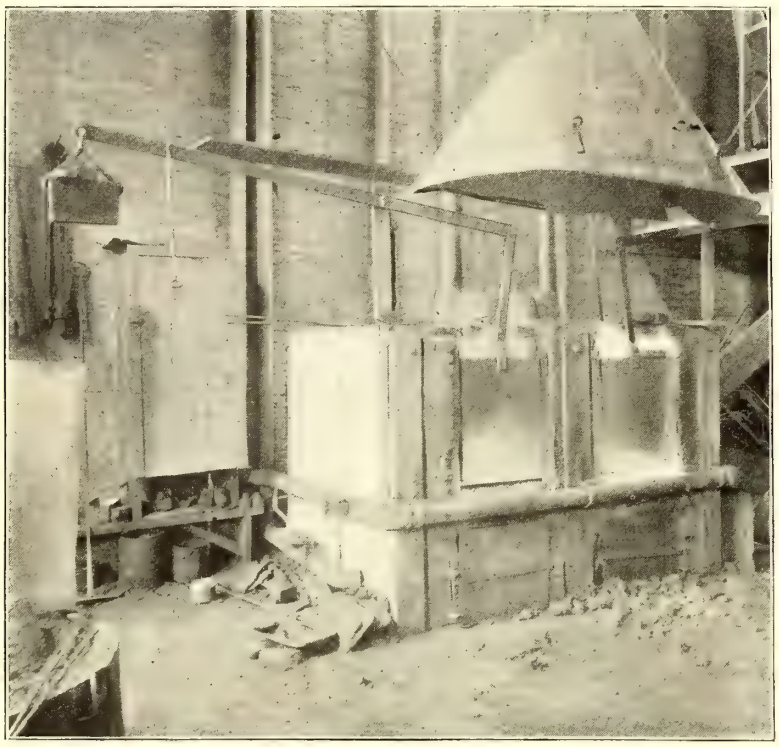


FIG. 2.—REHEATING FURNACE WITH PERFORATED BLAST PIPE FOR COOLING



FIG. 3.—NEW BRASS FOUNDRY

Kinks From Indianapolis

In repairing the armatures of the Westinghouse No. 3 motor the chief electrician of the Indianapolis Street Railway Company has adopted the plan of placing a threaded circular plate outside the commutator. After this plate has been attached the space between it and the end of the commutator is filled with plaster of paris, and taped on the outside to hold it in place. This style of ring is found to be giving better satisfaction than those of mica and other material formerly employed, as one ring or plate takes the place of the four which were previously used, and which were all threaded. The single ring or plate, with the single thread, is much cheaper and much more readily adjusted than the former.

AXLE SLEEVE

The practice has become standard with the Indianapolis Street Railway Company to place a sleeve over the axle from the wheel to the gear to which the motor bearings are attached. For this purpose the axle is turned off to a perfect fit for the entire length, when the sleeves, which are provided with an oil hole at the middle and at each end, are slipped in. This arrangement gives a larger wearing and

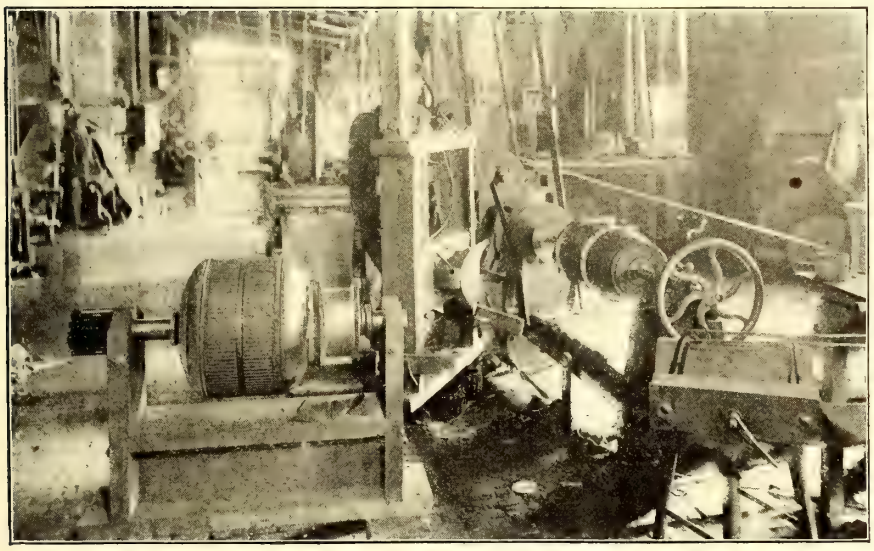
bearing surface, and prevents heating, and, it is claimed, makes the axle run as easily, if not more easily, than the short bearing.

GEAR CUTTING MACHINE

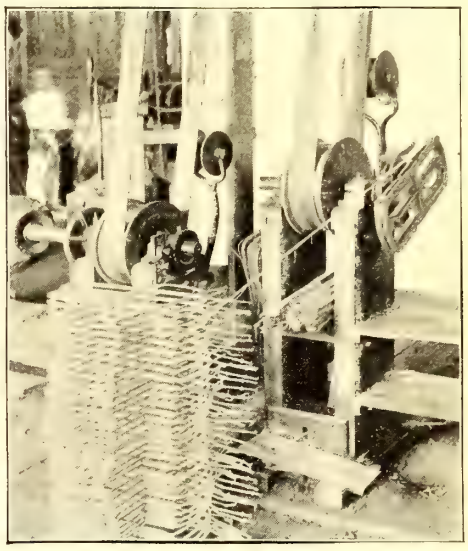
It is the practice in the repair shop to cut gears and pinions from cast steel blanks, bought of manufacturers in Cleveland. The gear cutting machines are of the Gould & Eberhardt type, and there is also a milling machine for cutting the slots in the commutator bars, these being milled in after the commutator is completed.

DEVICE FOR TESTING ARMATURES

The accompanying illustration shows a method of testing an armature while it is still in the lathe, either before or after the binding wires have been put on. For this purpose a laminated field is attached to the side of a swinging gate, as shown. This gate consists of a frame work hinged to a post, so that it can be swung out of the way or brought around so that the field is made to embrace the armature while in position in the lathe. A 3500-volt alternating current is then passed through the field, while the armature is slowly revolved in the magnetic field thus produced. By this means any short circuit or inferior insulation is at once detected; for, in case of any imperfection, the wires will give out a buzzing sound and sparks will be noted between the bars of the commutator. The alternating current for testing this device is obtained from a small motor generator, which is operated from the line current. In connection with this method of testing are a bank of incandescent lamps and other features for regulating the resistance.



METHOD OF TESTING ARMATURES



BENDING FORMS

INSULATING MATERIAL

Boiled linseed oil is employed for treating the armature and field coils. This is applied the same as an insulating paint, when the armature and coils are baked until they are thoroughly dry, one or two days being required in the process. The armature oven is heated by means of electric heaters.

BENDING FORMS

The accompanying illustration shows a brass form which is employed in a lathe for making the coils for the General Electric 800 motor. These coils are made in a simple loop on this form, and then are placed in a wooden clamp, shown in the previous illustration next to the armature. Passing through each end of the clamp is a rod of the same diameter as the small loop to be formed in the coil. After the coil is in position, the curved blocks are brought firmly together by means of a set-screw, when the two parts of the coil are bent, one in each direction, and with a mallet are made to conform to the curve in the wooden form. In this way all the coils come out with similar bends and loops, and conform to each other perfectly when placed over the core. In the repair shop three expert armature winders are employed, with three helpers, so that the six hands do all the repairs for the 135 motor equipments employed on the system.

BRASS FOUNDRY

The company manufactures all its own brass parts, including trolley wheels, overhead appliances and car trimmings; it also makes its own babbitt metal. In casting the trolley wheels the patterns are arranged in groups of four, so that four complete wheels are formed in each flask. These are afterwards sawn apart, and trimmed and finished up on a lathe.

TAPING ARMATURE COILS

For taping armature coils, a machine is used which was illustrated and described in these columns in the May issue, but not all the coils are taped on this machine. The company has in its employ an expert at hand taping. He is a man who was crippled in the service of the company and is now employed in the taping department. He has designed a wooden form which is placed upon a table and which holds the coil in such position that he is able to pass the roll of tape through the loop very rapidly. With rubber tape the folds stick together slightly so that the roll does not unwind readily, but when using canvas strips he cuts up the tape into suitable lengths and winds it on in sections, making proper splices and knowing from experience just how long the strips should be. The objection to using the taping machine, as claimed by this operator, is that the splices in the tape are not detected, and being wound on the coils make an uneven surface.

Iron Rust as an Insulator

While a gang of men were blasting rock on a highway near Rockland, Me., recently, a large ½-in. cable chain, 30 ft. or 40 ft. long, was thrown over a live trolley wire. The wire was broken away from the clip and came down to within 5 ft. or 6 ft. of the track. A bight of the chain lay on the rail and was left in this position for several minutes, without the slightest sign of a short circuit. The chain was taken off the rail by the men, who expected to see some pyrotechnics, but, much to their surprise, there was not the slightest spark from the breaking of the contact, so great was the resistance in the rust on the chain.

The Status of the Indianapolis Street Railway Company

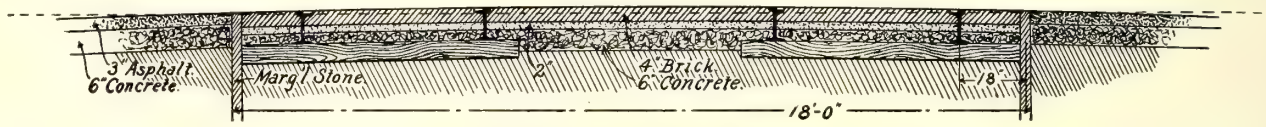
The street railway affairs in Indianapolis, after having been in a very unsettled and unsatisfactory condition for more than six years, owing to litigation between rival companies and between the city and the two street railway companies to whom franchises had been granted, have at last settled down to a satisfactory condition. By an act of Legislature at its last session the way was paved for an amicable adjustment of all the inharmonious conditions, and on April 6, 1899, a new franchise was granted the Indianapolis Street Railway Company, and under the provisions of this document the company has been organized, with the following officers and directors: Hiram P. Wasson, president; Hugh J. McGowan, second vice-president and general manager; J. Augustus Lemke, first vice-president; Joseph S. Neff, third vice-president; W. F. Milholland, treasurer and assistant secretary; Henry Jameson, secretary; C. E. Morgan, 3d assistant secretary and assistant treasurer; directors, Messrs. McGowan, Wasson, Lemke and Jameson, George Brown, Harold B. Hibbard and Randal Morgan.

These officers have assumed control of the street railway affairs of the city.

Under the provision of the act both of the old companies have agreed to surrender all their franchises and rights owned and controlled by them under previous grants from the city and from the County Commissioners and the suburban towns which have now been annexed to the city, and have fully accepted the terms of a new franchise. This franchise is granted for a period of thirty-four years, with the specific statement that the grant is expressly limited to a period of thirty-four years, and must terminate at the expiration of that time; it also requires that the company shall not float any securities to extend beyond the limit of the franchise. One of the provisions of the new franchise is that first-class service shall at all times be provided, and that for the present the overhead electric system shall be employed, but the city reserves the right to compel a change of motive power under the direction of the Board of Public Works and Common Council, provided a superior power shall come into use and be generally adopted in other cities before the expiration of the franchise. There are other stringent measures, which virtually place the company under the direction of the Board of Public Works and the City Engineer.

The new franchise requires that the rate of fare during the period for which the franchise is granted shall be five cents for each passenger over the age of five years, with the right to have transfer privilege over any of the intersecting lines. It also provides that the tickets shall be furnished and sold to passengers by the conductors at the following rates: Six tickets for 25 cents; twenty-five tickets for $1, the transfer privilege going with the tickets as with the cash fare. Some of the further requirements of the franchise are that the company binds itself to pay into the city treasury the sum of $1,160,000 in instalments, which are to be expended for park purposes under the direction of the Public Park Commissioners of the city. The instalments are to be paid as follows: $30,000 on or before the first day of May, 1899, and the sum of $30,000 on or before the first day of May of each year thereafter during the first twenty-seven years of the existence of the franchise; but after the expiration of the twenty-seven years and for the remaining seven years of the existence of the franchise the annual payment is to be $50,000. The above payment is to be in lieu of all license and special taxation, but not to take the place of general taxation. In connection with its property the company binds itself that it will expend, as rapidly as the requirements of the plant and road demand, not less than $1,000,000, and as much more as shall be needed, for adequate and efficient service in buildings, equipment and machinery, and in the purchase of new passenger cars and appliances, as well as new rails and all other necessary materials and labor. The company also binds itself to defend the city and hold the city free and harmless from all damage to any person or persons on account of injury or damage. Another important provision is that the tracks of the company may be used by the suburban lines, so that cars on these lines may reach the center of the city over the company's tracks, under such conditions and at such rental as may be regulated by the Board of Public Works.

Included in the conditions are specifications for lighting, heating and general equipment of the cars in building, life guards, signal buttons, signs and necessary repairs, which can be ordered by the board in case the company fails to keep the rolling stock in good order. The franchise also provides that a sufficient number of cars be operated. Another requirement is that the company shall pave the space between the rails, including the space between the tracks where there are double tracks, and for a distance of 18 ins. on the outside of the outside rails of the track, and shall make all necessary repairs in this space as shall be required by the Board of Public Works, and in connection with this the company is required to keep on deposit to the credit of the Board of Public Works the sum of $1,000, to be known as an emergency fund, and which the board holds the right to use in making immediate and necessary repairs should the company in any way fail to keep this contract regarding paving.



SECTION OF STANDARD TRACK CONSTRUCTION—INDIANAPOLIS

There is also a provision that the company shall execute a bond in the sum of $25,000 to the city, with sufficient securities to insure the faithful performance of the agreements. There are many other important features, but they are too voluminous to be used in this connection. Those interested, however, can get from the city authorities a copy of the franchise, which is known as General Ordinance No. 16, 1899.

Under the paving requirements some of the main streets of the city are at present paved with a combined brick and asphalt surface, and the method of construction is shown in the accompanying illustration. The special features of this are that brick is employed between the rails and tracks for a distance of 18 ins. outside of the outside rail, with a granite border or margin, consisting of a single line of granite blocks placed lengthwise between the brick and the asphalt. This serves to mark a line between the sections for which the city and company are responsible. Brick is also employed in the gutter on each side of the street for a distance of 4 ft. This is to provide a surface that cannot be affected by standing water. The founda-

tions for paved brick and asphalt are to be six inches in depth, as shown in the illustration. The rails shown are of the girder type, but it is understood that in all new construction the city authorities will require the company to use the New York type of grooved rail.

In recent track construction a 62-ft. rail has been employed, with the joints united by the Atlas rail joint, which was the standard with the old company. The track master claims that with this joint he has been able to keep the joints up in better shape than with most any other type of joint used. In attaching these joints to the old rails the old style of fish plates is removed, when the rail is carefully cleaned and the new plates attached. In putting the joint in position the rails are turned up very tight, and the plates are hammered thoroughly with a heavy sledge to bring them to a close fit with the rail. When the new joints are placed, the paving is not finished up until later, or on another day, as it was found that where the plates are tightened up as thoroughly as possible on one day and allowed to remain over night, or for another day or two, another turn may be gotten on the threads. In attaching the new joints to the old rails the old bonds are left when they are found intact, but additional bonds of the horseshoe type are placed in all joints, new holes being drilled in the end of the rails for the purpose.

For riveting the bonds in place a peculiar tool something like a cant hook is employed. This is provided with a bar that reaches the full length of the bond, and which is placed against the head of the bond. This bar is also fitted with a hook, which is attached to the head of the rail, and by pressing down on the long handle a very rigid anvil is provided, so that the lugs are readily riveted in place. By having the heading bar long enough to reach from one lug to another the ends of the rail can be brought well into line, so as to insure proper adjustment when the joint plates are attached.

Most of the special work on the entire system was manufactured by the Indianapolis Frog & Switch Company, and, according to the reports of the track master, is giving excellent satisfaction.

The first order for cars under the new franchise has been given to the American Car Company, and includes twenty-six twelve-seat open cars, which are mounted on double trucks of the Brill maximum traction type. Orders for additional equipment will follow as fast as the needs of the service demand.

The power equipment is also being increased by the installation of a direct-coupled unit, consisting of an Allis engine and a 500-kw. Westinghouse generator. The boiler room is also being enlarged, and two additional boilers of the Babcock & Wilcox type are being installed. In connection with boiler house improvements coal handling devices and conveyors will be installed, and probably some type of smokeless furnaces. For a number of years natural gas has been employed as fuel, but coal is now used. It is interesting to know that some of the Short generators which were installed at the early application of electric power on these lines, and described in our issue of August, 1894, are still running and giving reasonable satisfaction.

It can be shown that the only benefit received by the companies for carrying the mails on street and interurban railways is the compensation allowed by the Government for the same; hence the railways should work with the end in view to make this compensation enough to justify them in looking upon the carrying of mails as a profitable business, and one which should receive their careful attention. From paper at the Boston Convention, 1898.

Overhead Line Construction, III

BY ALBERT B. HERRICK

PROPORTIONING FEEDERS

After the current for the feeders has been determined, as described last month, the next question is the location of the feeding sections and the proper disposition of the copper in order to get maximum potential delivery. This copper may be in one or several feeders. Where it is combined into one feeder the cost of copper, per volt drop, is least. The cost of supporting this feeder is less, and the strains which it imposes on the pole line and the surface it presents to wind pressure, are all in favor of the single feeder. The sub-division of the feeders and the connection of these separate divisions to different circuit breakers in the station is for safety. The sub-division of the feeders may be said to have been originally due to the employment of fuses as safety devices. The action of the fuse required the dividing of the feeding systems up into small independently fed sections, but the modern circuit breaker, being much more prompt in its action, provides ample safety for the electrical machinery. Fuses, if placed between separate feeders on the line, will open when any section is grounded, so that in rewiring or reconstructing old distribution systems it is desirable to inter-connect the neighboring feeders by fuses, and thus get the most effective use of the copper.

In determining the size of feeder it is necessary to first fix upon the voltage drop, the amount of current required and the distance from the station. If the former has been selected the product of the other two gives the distance of current demand, since the ampere feet with a fixed drop for each size conductor has a certain value. The practical application of this to a railway problem will now be considered. It is usually most convenient to locate the feeding points about 500 ft. apart, then the current taken at the first point located, multiplied by the distance of its location to the station, will be the ampere feet at that point. Each point along the road can be located, and ordinates erected to some scale of ampere feet, until the whole road is graphically laid out by these ordinates. The current consumed can be found by the use of the table in the July number of the JOURNAL.

The diagram on page 514 shows the application of this principle of locating feeders to a road 16,500 ft. long, on which the cars are 500 ft. apart with a 12 per cent. drop; ordinates are drawn every 500 ft. or for each car, and their length represents the ampere feet required at each point. To apply this diagram to the case of a road with cars a greater or less distance apart the ampere feet required will be inversely proportional to the car spacing; thus with cars 3000 ft. apart the values in ampere feet will be one-sixth of the values given in the diagram. A column of ampere feet is given in column 15 in the table on the inset, from which the different conductors can be readily selected and applied to find the least feeder cost for this distribution.

It will be seen from this diagram that the feeding sections grow smaller as the distance increases from the station, so also this method of laying out feeders gives each feeder uniform service. The limiting distances for No. 0, No. 00 and 000 feeders, applied to the problem worked out are shown in the diagram. The ordinates below the date line show the current consumed by the cars at each point. This current, multiplied by the distance from the station, gives the ordinates above the date line, which are the ampere feet. With a road in which the feeders traverse short cuts, the problem would have to be arranged so that the distribution takes place from the intersection of the

feeder and trolley, and the distance in feet to the station from this point, would be the feeder length.

The table on the inset page shows all the dimensions of copper wire, and their electrical and mechanical properties, from 1,000,000 c.m. No. 1, B. & S.

The first column of this table gives the diameter of the wire in thousandths of an inch and B. & S. gage.

The second column gives the area of wire in c.m.

The third column gives the outside diameter of the stranded conductors.

The fourth column gives the outside diameter of the triple braided weather proof wire in nearest thirty-seconds of an inch.

The fifth column gives the weight per thousand feet of conductor.

The sixth column gives the weight of triple braided weatherproof per mile of conductor.

The seventh column gives the weight of the bare copper.

The eighth column gives the usual per centage of weight of insulation to total conductor weight.

The ninth column gives the stranding of conductors, as usually employed.

The tenth column gives the breaking strain of these conductors. One-sixth of this should be used for the line strains.

The eleventh column gives the resistance per thousand feet in international ohms at 60 degs. F.

The twelfth column gives the resistance in international ohms per mile 60 degs. F.

The thirteenth column gives the number of feet the wire will carry its full current carrying capacity with 12 per cent drop, 500 volts.

The fourteenth column gives the current carrying capacity of this wire as given by the Underwriter's rules for suspended wire in open air.

The fifteenth column gives ampere feet capacity of conductor with 12 per cent drop.

The sixteenth column gives the weight of wire between 100-ft. spans.

The seventeenth column gives the wind area in square feet presented by each size wire, triple braided 100-ft span.

It will be seen from the table of the weight of wire insulated, that for a dollar in the larger size cables we get more conductivity, since the ratio of the weight of the covering to the weight of the copper grows as the diameter of the wire decreases.

WIRING DIAGRAM FOR SIMPLE TRANSMISSION

Below this table is a diagram from which the correct size of wire to use in power transmission can be determined, from a distance of 1000 ft. to 25,000 ft., and from no drop to 200 volts drop. On the lower margin of this table will be found current in amperes. On the right vertical edge will be found distance in feet. On the left vertical edge will be found volts drop. On the top of the sheet will be found sizes of wire, with a heavy line vertically through the table for for each size of wire.

Any wiring problem within the values given on the diagram can be solved as follows: Suppose we had 200 amps. to carry three miles with 50 volts drop Start at the bottom of the diagram at 200 amps., follow this vertical line up until it intersects the horizontal line from 50 volts on the left hand vertical scale, pass along the radial line from this point until the horizontal line from 3 miles is met. The vertical line passing through at this point will lead upwards until the scale of wire in circular mils is reached, and this will be 67,500 c.m., the value sought. Any three terms of railroad feeder being known the fourth can be determined graphically by this table. For instance, suppose we had 0000 wire and wished to find out how far this would take 100 amps. with 75 volts drop. This problem can be solved by finding the intersection of the 100 amps. and 75 volts lines and passing along the radial line intersecting this point until the vertical line extending from the c.m. scale from 0000 wire is reached. Then the horizontal line intersecting at this point from the scale of feet will give the distance in feet that the current can be carried with this wire and with this loss. The problem of finding the current, having given distance, size wire, and

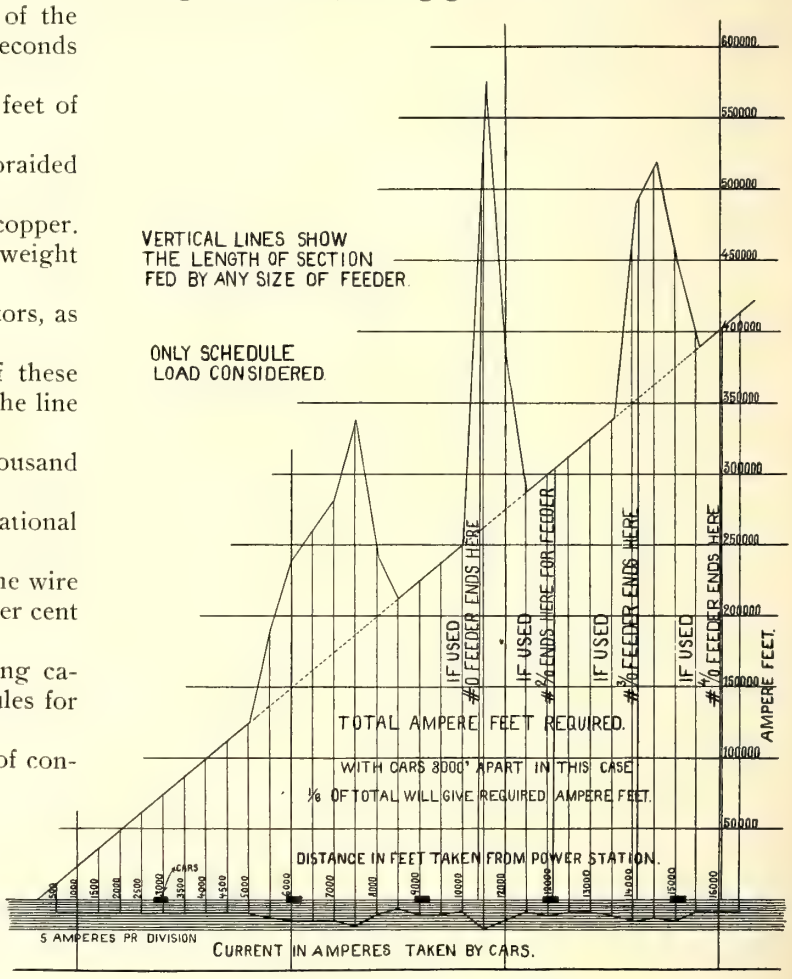


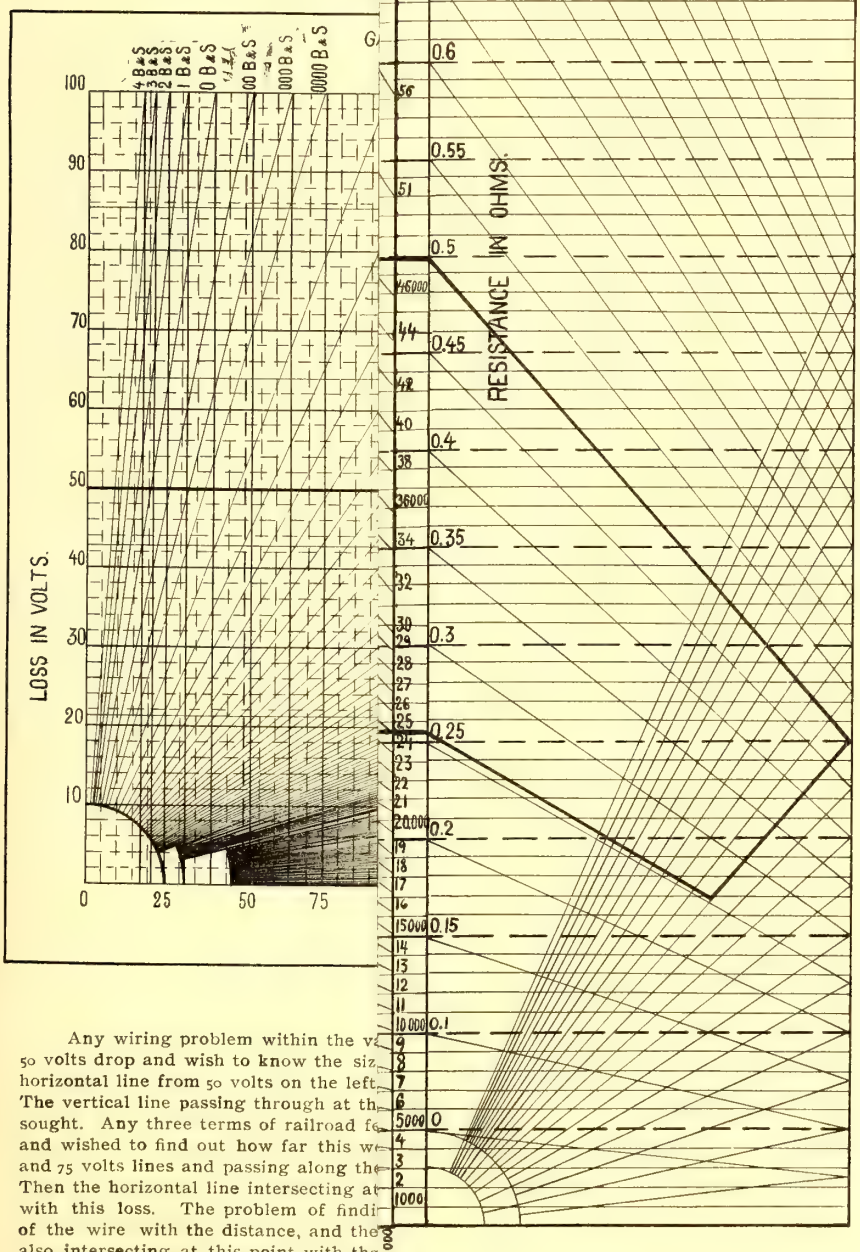
DIAGRAM FOR LOCATING FEEDERS

drop, can be solved as follows: First, find the intersection of the wire with the distance, and then pass along the radial line intersecting at this point until the volts drop is reached. Then the vertical line also intersecting at this point with the radial drop line will lead to a horizontal scale in amperes and satisfy the other conditions of this equation. The other required problem, to find the volts drop when the size of wire, current and distance are given, can be worked out in the same way. The conductor length is given in feet single distance and the table should not be used for a metallic circuit; for in that case it shows only half the amount of copper necessary.

MULTIPLE FEEDING

Another problem that often arises in railway feeders is to find the multiple feeding resistance of several conductors when the current is delivered at one point. The rule for this is to multiply together two resistances, and divide their product by the sum of their resistances. If another conductor is feeding in multiple with these two and the correct resistance of these three conductors in multiple is sought, the combined resistance of the first two must first be determined, and then combined with the third conductor in the same way. This soon becomes a very involved problem if a number of conductors are considered feeding

1 Size of Wire in 1-1000 of an inch and B. & S. Gage.	2 Area in Circular Mils.	3 Outside Diameter of Stranded Conductor.	4 Outside Diameter Weather Proof Triple Braided. Nearest 32nd of an inch.	Weatl Triple We	5 Per 1,000 Ft.
1,000	1,000,000	1.152	1½		3,550
950	950,000	1.125	1 15-32		3,380
900	900,000	1.092	1 13-32		3,215
850	850,000	1.062	1⅜		3,060
800	800,000	1.035	1 11-32		2,880
750	750,000	.999	1 5-16		2,713
700	700,000	.963	1 9-32		2,545
650	650,000	.927	1¼		2,378
600	600,000	.891	1 7-32		2,210
550	550,000	.855	1 3-16		2,043
500	500,000	.819	1⅛		1,875
450	450,000	.770	1 3-32		1,703
400	400,000	.728	1 1-16		1,530
350	350,000	.679	1		1,358
300	300,000	.630	15-16		1,185
250	250,000	.590	29 32		1,012
0000	211,600	.530	¾		775
000	168,100	.470	11-16		630
00	133,225	.420	9-16		490
0	105,625	.375	17-32		400
1	83,521	.330	½		306
2	66,564	.291	15-32		268
3	52,441	.261	7-16		210
4	41,616	.231	⅜		164



Any wiring problem within the v
50 volts drop and wish to know the siz
horizontal line from 50 volts on the left
The vertical line passing through at th
sought. Any three terms of railroad fe
and wished to find out how far this w
and 75 volts lines and passing along the
Then the horizontal line intersecting at
with this loss. The problem of findi
of the wire with the distance, and the
also intersecting at this point with the
other required problem to find the volt
length is given in feet single distance a
necessary.

EEDING DIAGRAM

To find the combined resistance of two conductors, the length and size of which are given, follow along the curved line branching from the given length in feet, until it intersects the vertical line indicating the proper size. Then follow the horizontal line at this intersection to the resistance scale. Locate, in the same way, the resistance of the other conductor in multiple with this. Then follow the diagonal line from the highest resistance conductor to the deflector line at the extreme right, then pass along this same line towards the resistance scale until the diagonal line from the lower resistance conductor is reached. Opposite this point of intersection can then be read the resistance of the two conductors in multiple. This multiple resistance can then be used as a single conductor resistance and the resistance of another conductor in multiple with this can be determined by the same method. As an example suppose we had a No. 0 trolley, feeding 5000 ft. in multiple with the No. 0000 feeder of the same length. Follow along the 0 line until the curved line from 5000 ft. is reached; the value on the resistance scale will be .5 of an ohm. Then follow along the 0000 feeder until 5000 ft. is reached, and the reading on the resistance scale will be found to be .25 of an ohm. Pass along the diagonal line from the higher of these two resistances, and continue along this line after it has changed its direction until it has intersected the lower diagonal line from the 0000 feeder resistance. From the point of intersection follow back the horizontal line to the resistance scale and the reading there will be the combined resistance of these two conductors, viz: .17 of an ohm.

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TABLE OF SIZES, WEIGHTS, ETC., OF WIRE

1 Size of Wire in Thousandths of an Inch and B. & S. Gauge.	2 Area in Circular Mils	3 Outside Diameter of Stranded Conductor.	4 Outside Diameter Weather Proof Triple Braided. Nearest 32nd of an inch.	Weather Proof Triple Braided Weights. 5 Per 1,000 Ft.	5 Per Mile.	7 Bare Per 1,000 Feet.	8 Per Cent of Insulation to Total Conductor Weight.	9 Stranding Usually Employed. Heavy Type B. W. G. Light B. & S. SIZE OF WIRE Diam .8 .117	.9	.10	.11	.12	.13	.15	.16	10 Breaking Strain in Pounds Use 1/5 for Line Strains	11 Resistance per 1000 Feet. International 5 Ohms at 60° Fah.	12 Resistance per Mile. International 5 Ohms at 60° Fah.	13 Distance Wire Will Carry 1 K.W. Three Miles Only with 1% Drop 500 Volts.	14 Maximum Amperes Carrying Capacity Underwriters Rules.	15 Ampere Feet Capacity of Feeder With 1% Drop.	16 Weight of Wire Between 100 Ft. Spans.	17 Wind Area Presented by Each Wire per 100 Ft. Span in Square Feet
1,000	1,000,000	1.152	1⅛	3,550	18,744	3,050	16.3	61								21,100	.01015	.05350	5,920	1,000	5,920,000	335.0	10.6
950	950,000	1.125	1 15-32	3,380	17,750	2,898	16.6					89				19,950	.01060	.05644	5,850	960	5,616,000	318.3	10.4
900	900,000	1.092	1 13-32	3,215	16,975	2,745	17.1	12			49					18,300	.01126	.05945	5,800	920	5,336,000	321.5	9.9
850	850,000	1.062	1⅛	3,060	16,120	2,593	18.0					76				.....	.01196	.06315	5,700	880	5,016,000	304.8	9.7
800	800,000	1.035	1 11-32	2,880	15,200	2,440	18.0		42			19				15,900	.01273	.06721	5,615	840	4,716,000	288.0	9.5
750	750,000	.990	1 5-16	2,713	14,325	2,288	18.5		15			46				15,598	.01355	.07154	5,550	800	4,440,000	271.3	9.2
700	700,000	.963	1 9-32	2,545	13,438	2,135	19.2					65				.....	.01454	.07677	5,430	760	4,126,800	254.5	8.9
650	650,000	.922	1⅛	2,378	12,556	1,982	19.9					60				.....	.01564	.08258	5,330	720	3,837,600	237.8	8.8
600	600,000	.891	1 7-32	2,210	11,668	1,830	20.7				37			24		12,675	.01695	.08959	5,220	680	3,549,600	221.0	8.6
550	550,000	.855	1 3-16	2,043	10,787	1,678	21.6					51				.....	.01840	.09746	5,125	635	3,254,375	204.3	8.4
500	500,000	.819	1⅛	1,875	9,900	1,525	22.9		37							10,300	.02034	.10739	5,025	590	2,964,750	187.5	7.9
450	450,000	.770	1 3-32	1,703	8,992	1,373	24.0					42				.....	.02258	.11922	4,880	545	2,659,600	170.3	7.7
400	400,000	.728	1 1-16	1,530	8,078	1,220	25.4				25	12				8,500	.02539	.13368	4,770	500	2,385,000	153.0	7.5
350	350,000	.679	1	1,358	7,170	1,068	27.1						25			7,100	.02908	.15354	4,500	450	2,065,500	135.8	7.0
300	300,000	.630	15-16	1,185	6,257	915	29.5				37					.....	.03388	.16888	4,450	400	1,773,000	118.5	6.6
250	250,000	.590	29 32	1,012	5,343	762	32.8		7			13				5,265	.04066	.21468	4,420	334	1,476,280	101.2	6.4
211	211,600	.530	¾	775	4,092	645	20.1				14	6				4,708	.04811	.25402	4,000	312	1,248,000	77.5	5.3
000	168,100	.470	11-16	630	3,326	513	22.8					5	14			4,200	.06056	.31975	3,780	262	990,360	63.0	4.8
00	133,225	.420	9-16	490	2,587	405	20.6					6	13			3,821	.07642	.40349	3,575	220	786,500	49.0	3.9
0	105,625	.373	17-32	400	2,112	322	21.1					6		13		2,768	.09630	.50803	3,375	185	624,375	40.0	3.7
1	83,521	.330	⅜	306	1,616	255	20.0								19	1,682	.1219	.64363	3,180	156	496,080	30.6	3.5
2	66,564	.291	15-32	268	1,415	203	32.0				6	1				1,482	.1529	.80731	3,010	131	394,310	20.8	3.3
3	52,441	.261	7-16	210	1,109	160	31.2					6	1			1,174	.1941	1.0095	2,810	110	309,100	21.0	3.1
4	41,616	.231	⅜	164	866	127	29.1						6		1	895	.2446	1.2914	2,670	92	245,000	16.1	2.6

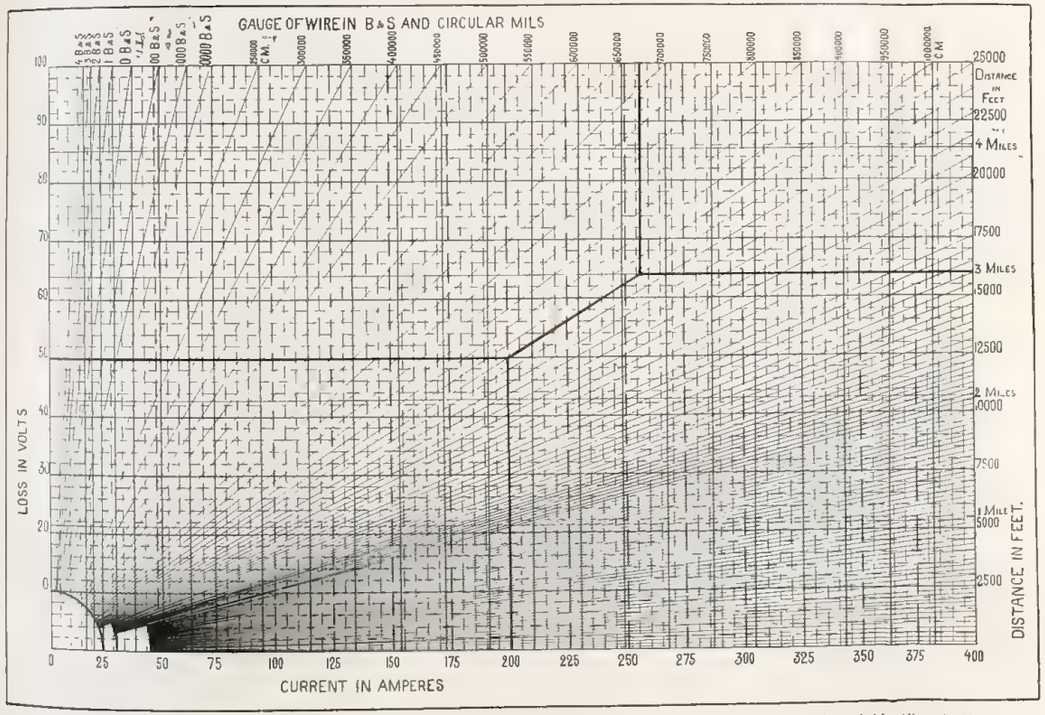
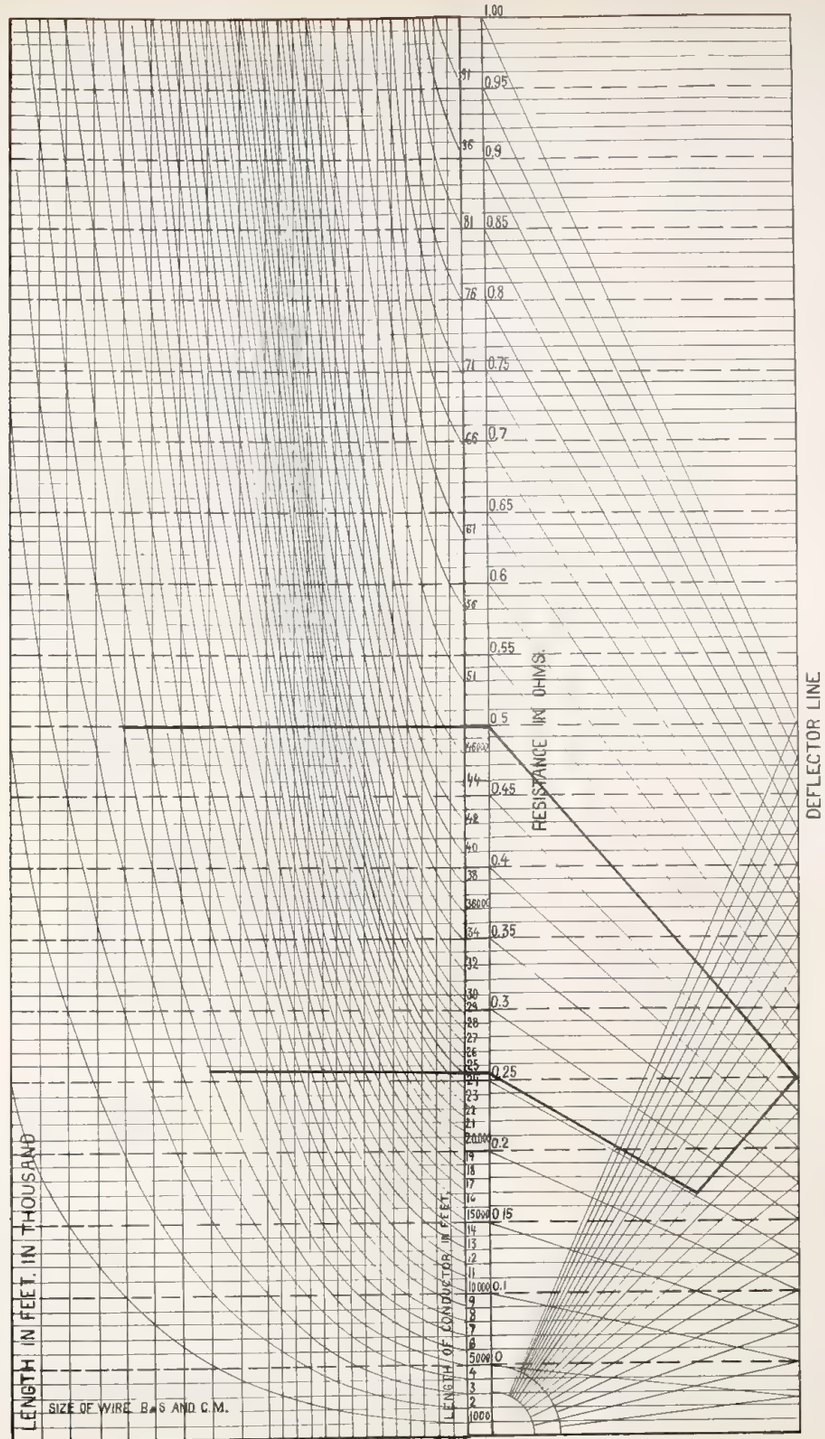


DIAGRAM OF WIRING FOR SIMPLE TRANSMISSION

Compiled by Albert B. Herrick

Any wiring problem within the values given on the above diagram can be solved as follows: Suppose we had 200 amps. to carry three miles with 50 volts drop and wish to know the size of wire. Start at the bottom of the diagram at 200 amps., follow this vertical line up until it intersects the horizontal line from 50 volts on the left hand vertical scale, pass along the radial line from this point until the horizontal line from three miles is met. The vertical line passing through at this point will lead upwards until the scale of wire in circular mils is reached, and this will be 67,500 c.m., the value sought. Any three terms of railroad feeder being known the fourth can be determined graphically by this table. For instance, suppose we had 0000 wire and wished to find out how far this would take 100 amps with 75 volts drop. This problem can be solved by finding the intersection of the 100 amps. and 75 volts lines and passing along the radial line intersecting this point until the vertical line extending from the c m. scale from 0000 wire is reached. Then the horizontal line intersecting at this point from the scale of feet will give the distance in feet that the current can be carried with this wire and with this loss. The problem of finding the current, having given distance, size wire, and drop, can be solved as follows. First, find the intersection of the wire with the distance, and then pass along the radial line intersecting at this point until the volts drop is reached. Then the vertical line also intersecting at this point with the radial line will lead to a horizontal scale in amperes and satisfy the other conditions of this equation. The other required problem to find the volts drop when the size of wire, current and distance are given, can be worked out in the same way. The conductor length is given in feet single distance and the table should not be used for a metallic circuit; for in that case it shows only half the amount of copper necessary.



MULTIPLE FEEDING DIAGRAM

To find the combined resistance of two conductors, the length and size of which are given, follow along the curved line branching from the given length in feet, until it intersects the vertical line indicating the proper size. Then follow the horizontal line at this intersection to the resistance scale. Locate, in the same way, the resistance of the other conductor in multiple with this. Then follow the diagonal line from the highest resistance conductor to the deflector line at the extreme right, then pass along this same line towards the resistance scale until the diagonal line from the lower resistance conductor is reached. Opposite this point of intersection can then be read the resistance of the two conductors in multiple. This multiple resistance can then be used as a single conductor resistance and the resistance of another conductor in multiple with this can be determined by the same method. As an example suppose we had a No. 0 trolley feeding 5000 ft. in multiple with the No. 0000 feeder of the same length. Follow along the 0 line until the curved line from 5000 ft. is reached; the value on the resistance scale will be .5 of an ohm. Then follow along the 0000 feeder until 5000 ft. is reached, and the reading on the resistance scale will be found to be .26 of an ohm. Pass along the diagonal line from the higher of these two resistances, and continue along this line after it has changed its direction until it has intersected the lower diagonal line from the 0000 feeder resistance. From the point of intersection follow back the horizontal line to the resistance scale and the reading there will be the combined resistance of these two conductors, viz. .17 of an ohm.

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in multiple arc. In order to facilitate the calculation of the railway engineer another chart is given at the right of that previously described, which graphically solves these problems of the resistance of conductors in multiple. The heavy vertical line near the centre of the chart is laid out on one side to a scale in feet, and on the other side to resistances. In order to find the combined resistance of two conductors, the length and size of which are given, follow along the curved line branching from the given length in feet, until it intersects the vertical line indicating the proper size. Then follow the horizontal line at this intersection to the resistance scale. Locate, in the same way, the resistance of the other conductor in multiple with this. Then follow the diagonal line from the highest resistance conductor to the deflector line at the extreme right, then pass along this same line towards the resistance scale until the diagonal line from the lower resistance conductor is reached. Opposite this point of intersection can then be read the resistance of the two conductors in multiple. This multiple resistance can then be used as a single conductor resistance and the resistance of another conductor in multiple with this can be determined by the same method.

As an example, suppose we had a No. 0 trolley feeding 5000 ft. in multiple with the No. 0000 feeder of the same length. Follow along the 0 line until the curved line from 5000 ft. is reached; the value on the resistance scale will be .5 of an ohm. Then follow along the 0000 feeder until 5000 ft. is reached, and the reading on the resistance scale will be found to be .26 of an ohm. Pass along the diagonal line from the higher of these two resistances, and continue along this line after it has changed its direction until it has intersected the lower diagonal line from the 0000 feeder resistance. From the point of intersection follow back the horizontal line to the resistance scale and the reading there will be the combined resistance of these two conductors, viz: .17 of an ohm.

Growth of the Electric Railway Industry in Europe

According to a recent monthly bulletin of the Compagnie Francaise pour l'Exploitation des Procédés Thomson-Houston, at Paris, the first electric railway in Europe was built by the Siemens-Halske Company, in 1881, between Lichterfeld, near Berlin, and the Central Military Establishment. In 1889, the first electric railway in France was built with Thury apparatus at Clermont-Ferrand, this tramway being still working. In the same year, 1889, at the Paris Exposition, the French Thomson-Houston Company first showed electric railway apparatus, of which exploitation had already commenced in America, and this exhibit was awarded the grand prize, while at the same time Prof. Elihu Thomson was made an officer of the National Order of the Legion of Honor. The first actual railway of the Thomson-Houston system was built in December, 1893, from Bordeaux-Bouscat to Vigean. To-day there are 11,000 kilometers operating by the Thomson-Houston system in France and 21,000 in the rest of Europe, or 32,000 in all. On these 32,000 km. of track about 7800 cars are run, of which 5800 are motor cars and 2000 trail cars. The current is furnished by 50,000 kilowatts of generator capacity.

After a number of trials of various floor paints and paints mixed especially for the purpose, the conclusion has been reached that there is nothing equal to pure white lead and linseed oil and suitable color for the floors of all cars. From paper at the Boston Convention, 1898.

Comparative Gross Receipts of American Street Railway Companies

In the following table are presented the comparative gross receipts of 222 American street railway companies for financial years ending (at various times) in 1897 and 1898, and the percentage increase or decrease in the two years. Classification is made on the basis of gross receipts in 1898, as the magnitude of operation is, of course, the interesting feature of a comparative presentation of this character. The details may be summarized as follows:

Roads having gross receipts of—	Number	Gross Receipts: 1897	1898	Percentage Inc.
$1,000,000 or more	26	$90,035,454	$93,740,164	4.1
500,000 to $1,000,000	20	13,685,777	14,407,780	5.3
100,000 to $500,000	58	12,634,697	13,389,776	6.0
50,000 to $100,000	62	4,237,941	4,414,039	4.2
25,000 to $50,000	56	2,019,385	2,130,762	5.5

The per cent increase in gross is seen to be uniform in the different classifications, but with wide variation in individual cases. In New York City the Metropolitan system shows an increase of 7.7 per cent, the Manhattan elevated system a decrease of 5.4 per cent, and the Third Avenue system a decrease of 9.6 per cent, while the receipts of the Union Railway Company, above the Harlem, increased 13 per cent. The Brooklyn Rapid Transit Company, both surface and elevated systems, made the very surprising increase of 17.5 per cent for the year ending Dec. 31, 1898, over the year ending June 30, 1897, and along with this came an increase of 23.8 per cent in the gross receipts of the Coney Island & Brooklyn Railroad Company, the only company competing with the Rapid Transit combination.

Seattle, Wash., has had apparently an exceptionally prosperous year, the gross receipts of the Seattle Traction Company having increased 54.9 per cent, while those of the West Street & North End Electric Railway Company, of Seattle, have increased 59.4 per cent.

Many of the suburban roads around Boston show large increases, among them the Norfolk Central Railway Company, 120.8 per cent; the Framingham Union, 52.6 per cent; the Newton & Boston, 48.7 per cent; the Commonwealth Avenue, 34.9 per cent, and the West Roxbury & Roslindale, 32.3 per cent. Several other interurban roads in Eastern Massachusetts, however, show decreases, among them being the Union Street Railway Company, of New Bedford, with its associated company, the Dartmouth & Westport Street Railway Company, the Haverhill & Amesbury, 9.9 per cent; the Taunton, 13.4 per cent; the Dighton, Somerset & Swansea, 12.2 per cent, and others.

Among other companies which show large percentage increases may be mentioned the system of New Castle, Pa., 217.8 per cent; Nashville, Tenn., 47.4 per cent; New Brunswick, N. J., 44 and 54 per cent respectively; Warren, Brookfield & Spencer, 43.2 per cent, and Chicago General Railway Company, 50 per cent.

ROADS HAVING GROSS RECEIPTS FOR 1898 OF $1,000,000 OR OVER

Name of Company	Gross Receipts, 1897	Gross Receipts, 1898	Per Cent Increase
Metropolitan St. Ry. Co., New York City	$11,160,167	$12,020,999	7.7
Union Traction Co., Phila.	11,014,991	11,226,998	1.9
Brooklyn Rapid Transit Co.	*9,214,592	†10,832,642	17.5
Boston Elevated Ry. Co.	8,719,032	9,257,254	6.1
Manhattan Ry. Co., N.Y. City.	9,477,052	8,965,851	d. 5.4
Chicago City Ry. Co.	4,816,516	4,832,806	0.3
United Rys. & Electric Co., Baltimore, Md.	.....	4,062,358	....
West Chicago St. R. R. Co.	3,899,918	4,031,904	3.4
Market St. Ry. Co., San Francisco, Cal.	3,406,606	3,483,445	2.5

*Year ending June 30, 1897. †Year ending December 31, 1898.

Name of Company	Gross Receipts, 1897	Gross Receipts, 1898	Per Cent Increase
North Jersey St. Ry. Co., Jersey City, N. J.	3,303,624	3,472,308	5.1
North Chicago St. R. R. Co.	2,911,552	3,015,323	3.5
Third Av. R R. Co., N.Y. City.	2,653,261	2,397,484	d. 9.6
Consolidated Traction Co., Pittsburgh	2,463,247	2,172,278	d. 11.8
Twin City Rapid Transit Co., Minneapolis, Minn.	2,009,121	2,170,716	8.0
Buffalo Ry. Co.	1,871,840	1,813,180	d. 3.1
United Traction & Electric Co., Providence, R. I.	1,685,775	1,732,424	2.7
Cleveland Electric Ry. Co.	1,632,024	1,718,515	5.3
Lynn & Boston R. R. Co.	1,431,936	1,490,311	4.1
Montreal (Quebec) St. Ry. Co.	1,342,368	1,471,940	9.7
United Trac. Co., Pittsburgh.	1,437,427	1,469,907	2.3
New Orleans (La.) Trac. Co.	1,239,256	1,311,365	5.8
Louisville (Ky.) Ry. Co.	1,238,042	1,297,394	4.8
Toronto (Ont.) Ry. Co.	1,077,612	1,210,618	12.3
Detroit (Mich.) Citizens' St. Ry. Co.	1,102,250	1,196,487	8.6
Coney Island & Brooklyn (N. Y.) R. R. Co.	927,245	1,148,015	23.8
Chicago Consolidated Traction Co.	.....	1,026,781	....
Totals	$90,035,454	$93,740,164	4.1
ROADS HAVING GROSS RECEIPTS FOR 1898 OF $500,000 TO $1,000,000			
Capital Traction Co., Washington, D. C.	908,839	993,177	9.3
South Side Elevated R. R. Co., Chicago (eleven mos. only).	637,346	978,330	....
North Hudson County Ry. Co., Jersey City, N. J.	923,100	966,280	4.7
Toledo (Ohio) Traction Co.	875,692	921,168	5.2
Metropolitan R. R. Co., Washington, D. C.	1,101,937	836,819	d. 24.1
Rochester (N. Y.) Ry. Co.	801,391	824,735	2.9
Los Angeles (Cal.) Ry. Co.	681,325	746,491	9.6
Denver (Col.) Consolidated Tramway Co.	726,106	735,588	1.3
Forty-Second St. & St. Nicholas Ave. Ry. Co., N. Y. City.	724,496	704,809	d. 2.7
Columbus (Ohio) St. Ry. Co.	611,318	689,033	12.7
Cincinnati, Newport & Covington Ry. Co.	638,477	681,672	6.8
Dry Dock, East Broadway & Battery R. R. Co.	698,502	675,467	d. 3.3
The Albany Ry.	596,766	648,746	8.7
Lake St. Elevated R. R. Co., Chicago	579,961	633,404	9.2
Union Ry. Co., N. Y. City.	542,855	613,499	13.0
Central Crosstown R. R. Co., New York City.	576,911	600,082	4.0
Springfield (Mass.) St. Ry. Co.	554,312	583,050	5.2
Worcester (Mass.) Trac. Co.	508,856	537,873	5.7
Troy (N. Y.) City Ry. Co.	506,298	530,810	4.8
Wilkesbarre (Pa.) & Wyoming Valley Traction Co.	491,289	506,747	3.1
Totals	$13,685,777	$14,407,780	5.3
ROADS HAVING GROSS RECEIPTS FOR 1898 OF $100,000 TO $500,000			
Nashville (Tenn.) St. Ry.	350,426	493,185	47.4
Richmond (Va.) Ry. & Electric Co.	475,851	477,541	0.4
Syracuse (N.Y.) Rapid Transit Ry. Co.	446,927	460,612	3.1
Lowell, Lawrence (Mass.) & Haverhill St. Ry. Co.	426,657	455,545	6.7
New York & Queens Co., Long Island City, N. Y.	472,472	437,757	d. 7.3
Pittsburgh (Pa.) & Birmingham Traction Co.	457,622	436,203	d. 4.7
United Traction Co., Reading, Pa.	419,927	430,956	2.9
Detroit (Mich.) Electric Ry.	394,213	401,179	1.8
New Orleans (La.) & Carrollton R. R. Co.	382,106	396,313	3.7
Lowell (Mass.) & Suburban St. Ry. Co.	381,804	389,949	2.1
Scranton (Pa.) Ry. Co.	366,325	383,727	4.8
Paterson (N. J.) Ry. Co.	.....	ETAOINNRDLUI	
Brockton (Mass.) St. Ry. Co.	332,256	337,604	1.6
Globe St. Ry. Co., Fall River, Mass.	322,094	323,604	0.4
Thirty-fourth St. Crosstown Ry. Co., New York City.	339,120	311,805	d. 8.8
Portland (Me.) R. R. Co.	276,858	302,126	9.1
Harrisburg (Pa.) Traction Co.	228,534	301,467	31.9
Camden (N. J.) & Suburban Ry. Co.	269,525	294,246	12.8
Des Moines (Ia.) City Ry. Co.	233,080	254,820	9.3
Trenton (N. J.) St. Ry. Co.	225,075	247,050	9.8
Ottawa (Ont.) Electric Ry. Co.	223,802	231,802	3.1
Atlantic Coast Electric R. R. Co., Asbury Park, N. J.	210,483	230,766	9.6
Holyoke (Mass.) St. Ry. Co.	216,684	229,098	5.7
Allentown (Pa.) & Lehigh Valley Traction Co.	214,845	227,669	6.0
Galveston (Tex.) City R.R. Co.	215,299	220,820	2.6
Chester (Pa.) Traction Co.	210,916	216,215	2.5
Union St. Ry. Co., New Bedford, Mass.	220,626	206,138	d. 6.6
Duluth (Minn.) St. Ry. Co.	202,031	201,840	d. 0.1
Halifax (N. S.) Electric Tramway Co.	196,178	197,829	0.8
Pennsylvania Traction Co., Lancaster, Pa.	* 198,770	† 194,167	d. 2.3
Utica (N. Y.) Belt Line St. R. R. Co.	166,793	193,258	15.7
Columbia Ry. Co., Washington, D. C.	162,497	171,397	5.5
Central Ry. & Electric Co., New Britain, Conn.	‡ 154,017	‡ 164,443	6.8
Binghamton (N. Y.) R. R. Co.	151,105	161,704	7.0
Manchester (N. H.) St. Ry.	146,326	158,885	8.6
Buffalo & Niagara Falls Electric Ry. Co.	136,756	155,497	13.7
Worcester (Mass.) & Suburban St. Ry. Co.	144,758	154,367	6.6
Richmond (Va.) Traction Co.	132,697	147,655	11.3
Seattle (Wash.) Traction Co.	91,453	142,738	54.9
Erie (Pa.) Electric Motor Co.	143,208	141,947	d. 0.9
Quincy (Mass.) & Boston St. Ry. Co.	118,395	135,728	14.6
Interstate Consolidated St. Ry. Co., N. Attleborough, Mass.	127,315	135,563	6.5
Fitchburg (Mass.) & Leominster St. Ry. Co.	133,770	134,315	0.4
Easton (Pa.) Transit Co.	123,812	131,758	6.4
Westchester Electric R. R. Co., New York City.	129,485	127,234	d. 1.7
Springfield (Ill.) Consolidated Ry. Co.	105,123	121,432	15.5
Chicago General Ry. Co.	79,821	119,739	50.0
Camden (N. J.), Gloucester & Woodbury Ry. Co.	123,424	117,404	d. 4.9
Yonkers (N. Y.) R. R. Co.	104,671	116,267	11.1
Southwest Missouri Electric Ry. Co., Webb City, Mo.	117,128	115,050	d. 1.8
London (Ont.) St. Ry. Co.	101,366	113,812	12.3
Lincoln (Neb.) Traction Co.	95,901	113,306	18.2
Johnstown (Pa.) Passenger Ry. Co.	106,350	113,031	6.3
Schuylkill Electric Ry. Co., Pottsville, Pa.	93,993	109,638	16.6
Roxborough, Chestnut Hill & Norristown Ry. Co., Phila.	85,231	109,596	28.6
Meriden (Conn.) Electric R. R. Co.	111,437	106,556	d. 4.4
Cleveland, Painesville & Eastern R. R. Co.	87,533	105,360	20.4
Lehigh Ave. Ry. Co., Phila.	102,803	105,164	2.3
Totals	$12,634,697	$13,389,776	6.0
ROADS HAVING GROSS RECEIPTS FOR 1898 OF $50,000 TO $100,000			
Norfolk Suburban St. Ry. Co., Hyde Park, Mass.	$98,159	$99,390	1.3
Springfield (Ohio) Ry. Co.	79,286	97,137	22.5

*Year ending December 31, 1897. †Year ending June 30, 1898. ‡Including electric light plant.

Name of Company	Gross Receipts, 1897	Gross Receipts, 1898	Per Cent Increase
Lehigh Traction Co., Hazleton, Pa.	109,618	97,025	d. 11.5
Dartmouth (Mass.) & Westport St. Ry. Co., New Bedford, Mass.	102,925	96,914	d. 6.2
Niagara Falls & Suspension Bridge Ry. Co.	89,320	96,399	7.9
Akron, Bedford & Cleveland R. R. Co.	101,321	96,054	d. 5.2
Newton (Mass.) St. Ry. Co.	94,072	95,820	1.9
Holmesburg, Tacony & Frankford Electric Ry. Co., Phila.	105,574	94,696	d. 10.4
Northampton (Mass.) St. Ry. Co.	95,086	92,326	d. 2.9
Jamestown (N. Y.) St. Ry. Co.	86,708	90,902	4.8
Schuylkill Traction Co., Girardville, Pa.	93,444	90,279	d. 3.4
Haverhill (Mass.) & Amesbury St. Ry. Co.	99,485	89,665	d. 9.9
Niagara Falls (N.Y.) & Lewiston R. R. Co.	87,322	85,613	d. 1.9
Poughkeepsie (N. Y.) City & Wappinger's Falls Electric Ry. Co.	85,3000	84,998	d. 0.4
Milford (Mass.), Holliston & Framingham St. Ry. Co.	61,408	83,472	35.9
New Castle (Pa.) Traction Co.	26,257	83,429	217.8
Hoosac Valley St. Ry. Co., North Adams, Mass.	81,328	79,242	d. 2.6
Macon (Ga.) Consolidated St. Ry. Co.	74,722	78,764	5.4
Newton (Mass.) & Boston St. Ry. Co.	52,638	78,309	48.7
Altoona (Pa.) & Logan Valley Electric Ry. Co.	83,051	78,176	d. 5.8
Rockland & Abington St. Ry. Co., North Abington, Mass.	74,787	77,889	4.1
Alton (Ill.) Ry. & Illuminating Co.	73,195	77,587	6.0
Norwich (Conn.) St. Ry. Co.	79,502	76,107	d. 4.2
Ithaca (N. Y.) St. Ry. Co.	70,935	75,141	5.9
Commonwealth Ave. St. Ry. Co., Newton, Mass.	54,552	73,630	34.9
Taunton (Mass.) St. Ry. Co.	81,632	72,083	d. 13.4
Gloucester (Mass.) St. Ry. Co.	66,398	70,571	6.3
Beaver Valley Traction Co., Beaver Falls, Pa.	68,555	69,937	2.0
Williamsport (Pa.) Passenger Ry. Co.	68,146	69,192	1.5
Delaware Co. & Philadelphia Electric Ry. Co., Phila.	63,258	68,477	8.5
Rockland (Maine), Thomaston & Camden St. Ry. Co.	66,782	68,223	2.1
City Passenger Ry. Co. of Altoona, Pa.	58,275	67,813	16.3
West Roxbury (Mass.) & Roslindale St Ry. Co.	50,940	67,438	32.3
Pittsfield (Mass.) Electric St. Ry. Co.	61,168	66,302	8.3
Bangor (Maine) St. Ry. Co.	69,493	65,291	d. 6.0
Glens Falls (N.Y.), Sandy Hill & Ft. Edward St. Ry. Co.	57,692	64,420	11.5
Schuylkill Valley Traction Co., Norristown, Pa.	62,963	63,867	1.4
Bangor (Maine), Orono & Oldtown Ry. Co.	65,659	63,676	d. 3.1
Geneva (N. Y.), Waterloo, Seneca Falls & Cayuga Lake Traction Co.	62,618	62,802	0.3
Auburn (N. Y.) City Ry. Co.	59,849	62,772	4.8
Elmira (N. Y.) & Horseheads Ry. Co.	68,810	62,169	d. 9.6
Wakefield (Mass.) & Stoneham St. Ry. Co.	58,225	62,063	6.5
Dighton (Mass.), Somerset & & Swansea St. Ry. Co.	69,096	61,569	d. 12.2
The Carbondale (Pa.) Traction Co.	60,083	61,186	1.8
Kingston (N.Y.) City R.R. Co.	55,412	60,745	9.6
Nashua (N. H.) St. Ry.	61,104	60,260	d. 1.4
Newburyport (Mass.) & Amesbury Horse Ry. Co.	60,897	59,892	d. 1.7
Fulton St. R. R. Co., New York City	61,840	59,743	d. 3.4
Gloucester (Mass.), Essex & Beverly S. Ry. Co.	58,642	59,036	0.7
Schenectady (N. Y.) Ry. Co.	‡ 51,961	‡ 57,632	10.9
South Middlesex St. Ry. Co., Natick, Mass.	52,074	57,119	9.7
York (Pa.) St. Ry. Co.	52,398	56,637	8.0
Portland (Maine) & Cape Elizabeth Ry. Co.	59,015	55,948	d. 5.2
Brightwood Ry. Co., Washington, D. C.	51,080	55,935	9.5
New London (Conn.) St. Ry. Co.	53,822	55,802	3.7
Woonsocket (R. I.) St. Ry.Co.	51,305	55,547	8.3
Natick (Mass.) & Cochituate St. Ry. Co.	45,739	55,490	21.3
City Electric Ry. Co., Port Huron, Mich.	52,565	55,252	5.1
Plainfield (N. J.) St. Ry. Co.	50,604	53,974	6.7
Concord (N. H.) St. Ry. Co.	49,779	52,440	5.3
West Side St. R. R. Co., Elmira, N. Y.	56,421	51,930	d. 8.0
Brunswick Traction Co., New Brunswick, N. J.	33,656	51,842	54.0
Totals	$4,237,941	$4,414,039	4.2

ROADS HAVING GROSS RECEIPTS FOR 1898 OF $25,000 TO $50,000

Salem (Ore.) Light & Trac. Co.	$45,028	$49,500	9.9
Burlington (Vt.) Traction Co.	53,327	49,369	d. 7.4
Rochester (N. Y.) & Irondequoit R. R. Co.	47,760	49,046	2.7
Hingham (Mass.) St. Ry. Co.	49,322	48,980	d. .7
Stamford (Conn.) St. R.R. Co.	40,426	48,561	20.1
Braintree (Mass.) & Weymouth St. Ry. Co.	46,687	48,558	4.0
Warren (Mass.) Brookfield & Spencer St. Ry. Co.	33,687	48,241	43.2
Newport (R. I.) St. Ry. Co.	37,375	48,031	28.5
Shamokin (Pa.) & Mt. Carmel Electric Ry. Co.	57,747	47,173	d. 18.3
Middletown (N. Y.)—Goshen Traction Co.	47,910	46,620	d. 2.7
Marshalltown (Iowa) Light, Power & Ry. Co.	41,607	45,581	9.6
Greensburg (Pa.), Jeannette & Pittsburgh St. Ry. Co.	41,075	45,485	10.7
Suburban Rapid Transit St. Ry. Co., Pittsburgh.	42,192	45,445	7.7
Amsterdam (N. Y.) St. R. R. Co.	39,408	45,422	15.3
Wilmington (N. C.) St. Ry.Co.	42,769	45,253	5.8
West St. & N. E. Elec. Ry. Co., Seattle, Wash.	28,363	45,225	59.4
Braintree (Mass.) St. Ry. Co.	38,150	45,114	18.3
Leominster (Mass.) & Clinton St. Ry. Co.	40,588	43,626	7.5
Hamilton (Ont.), Grimsby & Beamsville Electric Ry. Co.	43,002	42,736	d. .6
Bergen Co. Traction Co., Undercliff, N. J.	39,288	41,583	5.9
Washington (D. C.) & Gt. Falls Electric Ry. Co.	49,734	40,903	d. 17.7
North Woburn (Mass.) St. R. R. Co.	36,294	40,838	12.5
Augusta (Maine), Hallowell & Gardiner R. R. Co.	40,840	40,620	d. .5
Bridgeton (N. J.) & Millville Traction Co.	35,055	39,180	11.8
Lebanon (Pa.) & Annville St. Ry. Co.	38,167	39,015	2.2
Marlborough (Mass.) St. Ry. Co.	34,766	38,855	11.8
Manistee (Mich.), Filer City & Eastlake Ry. Co.	36,159	38,635	6.8
Herkimer, Mohawk (N. Y.), Ilion & Frankfort Electric Ry. Co.	41,348	38,631	d. 6.5
Scranton (Pa.) & Carbondale Traction Co.	41,435	38,443	d. 7.2

Name of Company.	Gross Receipts, 1897.	Gross Receipts, 1898.	Per Cent Increase.
Buffalo, Bellevue & Lancaster Ry. Co.	39,749	38,365	d. 3.5
Norfolk Central St. Ry. Co., Dedham, Mass.	16,876	38,263	120.8
Atlantic Highlands, Red Bank (N.J.) & Long Branch Electric Ry. Co.	41,160	38,238	d. 7.1
Plymouth (Mass.) & Kingston St. Ry. Co.	37,888	36,834	d. 2.8
Olean (N. Y.) St. Ry. Co.	26,180	34,977	33.6
Greenfield (Mass.) & Turner's Falls St. Ry. Co.	33,252	34,585	4.0
New Brunswick City Ry. Co., New Brunswick, N. J.	23,993	34,561	44.1
Cortland (N. Y.) & Homer Traction Co.	36,885	34,406	d. 6.7
Citizens' St. Ry. Co., Fishkill, N. Y.	34,616	33,934	d. 2.0
Reading (Pa.) & Southwestern St. Ry. Co.	29,302	32,831	12.0
Anacosta & Potomac River Ry. Co., Washington, D. C.	46,834	32,743	d. 30.1
Van Brunt St. & Erie Basin R. R. Co., Brooklyn, N. Y.	31,390	32,101	2.3
Framingham (Mass.) Union St. Ry. Co.	19,936	30,424	52.6
Syracuse (N. Y.) & East Side St. Ry. Co.	34,810	30,291	d. 13.0
Oil City (Pa.) St. Ry. Co.	28,315	30,237	6.8
Athol (Mass.) & Orange St. Ry. Co.	32,550	29,459	d. 9.5
Phillipsburg (N. J.) Horse Car R. R. Co.	29,614	28,979	d. 2.1
Southbridge (Mass.) & Sturbridge St. Ry. Co.	25,149	28,531	13.5
Rockport (Mass.) St. Ry. Co.	28,539	28,433	d. .4
Cohoes (N. Y.) City Ry. Co.	23,322	28,321	21.4
Bradford (Pa.) Electric St. Ry. Co.	28,268	27,841	d. 1.5
Washington (Pa.) Electric St. Ry. Co.	25,099	27,701	10.4
Charlotte (N. C.) Electric Ry., Light & Power Co.	§ 27,338	§ 27,631	1.1
Troy (N. Y.) & New England R. R. Co.	31,278	27,438	d. 12.3
Gt. Falls (Mont.) St. Ry. Co.	24,050	26,479	10.1
Utica (N. Y.) & Mohawk R. R. Co.	27,359	26,422	d. 3.4
Dunkirk & Fredonia (Mass.) R. R. Co.	26,123	26,068	.2
Totals	$2,019,385	$2,130,762	5.5

§Railway plant only. d Decrease.

Convenient Rheostat for Testing

For carrying large currents while testing in a power station or repair shop, a water rheostat made out of an old barrel is a common form of resistance employed. There are some disadvantages in connection with its use, however, especially the difficulty of keeping the ohmic resistance of the rheostat any way constant.

A different form of cheap rheostat is employed by the engineers of the Consolidated Traction Company of Pittsburgh, in the new power station at Twentieth Street and the Allegheny River. It consists of about 300 ft. of No. 12 bare copper wire, wound upon a wooden frame, and then immersed in an ordinary oil barrel filled with water. This wire will carry about 225 amps. (at 550 volts) if cold water is kept running continuously through the barrel. A ½-in. hose will usually supply enough water to keep the rheostat cool. At the Consolidated station there are ten of these rheostats, and they have been found very satisfactory.

Plows for Underground Conduit Electric Cars

Although a considerable item of expense was abolished when the overhead trolley went out of use, the trouble and outlay has probably been at least equalled, if not increased, by the care and expense incident to the use of the underground current.

The plow, although the result of a great deal of engineering talent outlay, is still far from being practically perfect. Even though suspended in a very elastic manner from the truck of a car, it is knocked and battered to pieces frequently. The present method of elastic suspension is from two 2½-in. round iron or steel bars, which in turn are carried by a light, yet stiff angle-steel frame attached to the end of a (double) truck by means of steel plates, which are bolted to both frame and truck. The plow is attached to a pivoted bar, which in turn is swiveled to shoes that slide easily over the round bars the entire width of a car. The shoes slide very easily, so easily in fact that it seems almost impossible that the plow can fail to respond to demands from the slot, yet it often does fail, and the plow which has been in use for several weeks bears many marks of extra hard usage.

The plows used with cable cars of the New York companies take the slot wear on the steel plates or bars which form the vertical supports of the grip and its mechanism. The life of these frame bars or plates averages about six weeks, when they are removed, being found worn nearly half in two, and are replaced by new bars. In the electric plows, the wear does not come directly upon the bars which support the plows. Instead, four soft malleable iron shoes are attached in pairs to opposite sides of the shoe support or frame. These "chafing plates" are held on by slight recesses in either side of the shoe, and by two countersunk units through the frame and each pair of plates which are located at the line of the slot. In practice, a set of these plates is found to last about three days. Then, the rivets must be chipped out by a round-nosed cold chisel, forged round and tapering, and ground on one side only, at an angle of about 60 degs.

At the lower ends the plows have loose spring contacts which are arranged on a wooden support, which in turn is dovetailed to the lower end of the iron portion of the plow. A piece of thin rainbow packing is cemented to each piece of wood, and the pair when fitted together over the plow frame is firmly fastened together by common wood screws.

The leads which run down through the plows are made of a number of wires, about No. 20 or 22, and braided into a flat tape about ⅝ in. wide. Frequently the wooden portion of a plow gets caught in the conduit and is torn off, the leads being broken just below their exit from the iron portion of the plow. The splicing of these leads is done by sandpapering the broken end until clean and bright. The wire ends of another piece of braided lead are then straightened for about 2 ins., and in alternate bunches of half a dozen, are bent back and forth to form a sort of Y into which the broken lead end is placed. The wires of the new piece are then bent down upon the old piece, bound with a narrow strip (¼ in. wide) of thin tinned copper and hammered flat. The joint is then soldered, alcohol and resin being used as a flux, after which the thin copper is stripped off and the splice filed a little and taped.

Testing, for continuity of leads and for grounds in the plows, is done by a couple of contacts rigged on long flexible wires in the usual manner and connected with a 500-volt current through five lamps in series. While it is usual to throw such contacts carelessly aside when not in use, it is the practice by at least one man in the Metropolitan shops to use his bank of test lamps for light. The test

points were thrust under the free ends of a strip of copper, which in turn was fastened by two screws through its middle portion, to a piece of slate. When it is necessary to test, the wires are pulled out from under the copper and applied to the work. There is no danger from fire from these testing points.

A Quick Piece of Electrical Equipment

The State Street line of the Chicago City Railway is now being operated by electric power, and the change was made from cable to electricity in three weeks. The ordinance allowing the temporary change was passed on June 19; permit to work on the streets was secured on the evening of the 23d, when work was immediately begun, and the first car was run on the evening of July 15, between 4 and 5 o'clock. The change embraced 7 miles of street on which poles had to be erected, the trolley and feed wires strung, additional power provided and a large number of extra cars to be electrically equipped. The 600 h.p. motor that was formerly employed at Fifty-second Street for driving the cable drums was moved to the Twentieth Street station, where it is operated as a generator during the hours of heavy traffic. Two feed wires were brought over from the Clark Street line and connected with the switchboard of the Twentieth Street station. The ordinance granting the privilege of operating for the present by electric power is for ninety days only, and does not allow the cars to be electrically operated north of Van Buren Street, but between Van Buren and Madison Streets horse cars are run every two and one-half minutes.

The grant was secured for the purpose of making repairs to the Twentieth Street power station, as some of the engines, and especially foundations, were so weakened by long service that a break-down was imminent. The No. 1 and No. 2 Wheelock engines of this station have been in continuous operation, driving the cable plant since 1882, and of late years have been greatly overloaded. The new equipment has not been fully decided upon, but will probably include new engines for those worn out, and new cylinders for the other four engines. The gripmen are operating the electric cars, having been broken in preparatory to the change. It should be noted in connection with the change that all the material had been secured and was on hand ready for immediate use. The change from cable to electric power is very acceptable to the patrons, as the time for making the entire trip is very much reduced.

A New Power Plant for Atlanta

The Atlanta Railway & Power Company has prepared plans for the construction of a modern power and lighting plant, to cost about $750,000. This plant will furnish all the power for the consolidated street railway lines and for general commercial purposes throughout the city, and a lighting service will also be given in competition with the existing company. Steam heat in winter and cold air in summer will be furnished to the large buildings in the business district. The plant is to be centrally located and will be built on a railroad, so that coal can be brought by cars direct to the storage bins. After the new station is completed the present plant in the outskirts of the city will be used for manufacturing street cars for the company and for other street railway companies in the South.

The Broad Ripple Traction Company, of Indianapolis, has been incorporated, with a capital of $100,000, as successor to the Indianapolis & Broad Ripple Rapid Transit Company.

German Track Specifications

A prominent German track engineer has sent us the following specifications for a tramway track, as used in Germany. As will be seen, they differ somewhat from what would be considered standard American practice.

A.—GENERAL REMARKS

The roadbed of an electric railway should be so substantial that it will carry the heaviest traffic. The cost of preparing rail joints and renewing tracks and rails in the city streets is so expensive that no reasonable precautions should be spared in making the weight of rail, quality of material or joint construction as good as possible. In this particular the maxim will be found true as much or more than in any other branch of tramway work, that it "pays to use the best." The track should be so laid as not to hinder the street traffic or interfere with the proper drainage of the street, and the head and flange of the rail should be so designed that uneven wear from street or vehicle traffic will be avoided. The style of pavement in which the track is laid has a considerable influence upon the most desirable height of the rail and the width of the base. Only in asphalt can considerable liberty be exercised in selecting the rail sections, as with this pavement there is comparatively little objection to projecting bolts, wide base, etc. The length of rail should be as great as possible. At present there is no difficulty in rolling rails 12 m. long, even in the heaviest sections. The section should be designed so as to bring the center of support as nearly as possible under the center of pressure. With the composite rail this condition is obtained in an almost ideal way. The single web rail can never be constructed so as to absolutely accomplish this result, as the vehicular traffic will keep on the flange, although the car wheels may be directly over the web.

The heaviest angle plates should be used, and all shock at the joints should be reduced by laying the ends of the rails close together, and, in general, by using the mitered joint. In asphalt paving the rails can be butted, as the rails are held rigidly by the pavement; but in block paving a space should be left for expansion and contraction, though this space should be less than that on exposed track. The tie rods also need not be so numerous in asphalt construction, and, as a usual thing, only about half as many should be used as when the rails are laid in block pavements.

B.—DETAILS OF RAIL SECTION.

1. Rail Head.—The width of the rail must correspond to that of the wheel tread, and should therefore be at least 50 mm. wide. The shape of its surface must correspond to that of the wheels. Where the mitered joint is used the angle plates must be bolted up tight to get satisfactory results.

2. The Groove.—With single web rails the lip of the rail is integral with the rest of the rail, while composite rails are composed of two girders. The depth of the groove with single web rails is limited by rolling mill considerations, but rail makers can now provide, without any trouble, a groove 40 mm. in depth; with composite rails the groove can be made any depth. It is to the interest of the public to have the groove as narrow as possible, and 30 mm. may be considered standard width.

For heavy traffic (ninety cars per hour) the wear of a 50 mm. wide steel rail head, made of the best material, is supposed to be 1.5 mm. per annum, so that for a ten years' life of rails the depth of the throat should equal 15 mm. plus the depth of the wheel flange, or 13 mm. to 15 mm.; total, 28 mm. to 30 mm.

3. The Shape of the Groove.—This should be angular and considerably wider than the wheel flange, to prevent the crowding of dirt and snow into the groove. The wheel flange should be able to press the dirt upward over the lip. The width of the tram (or flat surface of the lip), the part on which street vehicles will run, should amount to at most one-third of the width of the head of the rail, and generally 15 mm. is sufficient if the rail is elevated slightly above the grade of the street. Here unfortunately track engineers are not given much choice, for the authorities frequently demand a much wider tram; for instance, at Berlin, 25 mm.

4. Thickness of the Web.—While with the composite rail 8 mm. is usually a sufficient width of rail web, with a single web rail the web should have the thickness of 10 mm. With an eccentric web rail the thickness of the web should be 16 mm.

5. Base of Rails.—This should not be less than 100 mm. for horse-car rails and 130 mm. for electric rails. The base should have a thickness at the web of at least 20 mm. This thickness may taper down at the ends to 10 mm.

STREET RAILWAY JOURNAL

AUGUST, 1899.

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, BEARD BUILDING, 120 LIBERTY STREET.

BRANCH OFFICES:

CHICAGO.....Monadnock Block.
PHILADELPHIA.....929 Chestnut Street.
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Long Distance Telephone, "New York, 4044 Cortlandt."
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / 25l / 31 fr

Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

NOTICE.

Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, accounting, finance and invention.

Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

Address all communications to

The Street Railway Publishing Co.,
Beard Building, 120 Liberty Street, New York.

We are pleased to note the incorporation in Great Britain of the Tramways and Light Railways Association, an organization similar in scope and purpose to the American Street Railway Association, and with a function quite as valuable, no doubt, as that which the great American Association has for so many years fulfilled. The new association is fathered by excellent men widely known in the industry, both at home and abroad, the six first members of the council being George Richardson, George F. Fry, Emile Garcke, J. Barber Glenn, W. M. Murphy and Stephen Sellon. The honorary secretary is A. M. Willcox, editor of the "Railway World." We sincerely wish our friends across the water the highest measure of success in their organization.

Graphical methods of solving engineering problems are always convenient and usually a time saver to the engineer or worker in the electrical field. For this reason we call attention to the application of "graphics" to the proportioning of feeders, as contained in an article with inset sheet, published elsewhere in this number, and think that the ingenious methods adopted, based, as they are, upon correct geometrical principles, will commend their use to our readers.

A careful study instituted to determine the cause of flat wheels on the North Jersey Street Railway recently has brought to light the interesting fact that the rear wheels, particularly of double truck cars, are more subject to flattening than the forward wheels. The argument adduced to explain this is that when the brake shoes are applied, the tendency of the truck is to rock forward, bringing greater weight on the forward wheels and less on the rear wheels. As the brake rigging is arranged to produce an equal tension on both wheels, the rear wheel develops a tendency to slide before the forward wheel, and this is thought to produce the flattening. An effort is being made to reduce this by so changing the brake leverage that a difference in pressure is exerted by the two sets of brake shoes, corresponding to the difference in weight carried by each pair of wheels. The outcome of this test will be watched with interest.

The striking difference between European and American track construction is shown in a set of track specifications by a prominent German engineer, which is published elsewhere in this issue. It seems somewhat amusing to American readers to be told that the rolling mills have now no difficulty in producing rails 39 ft. long, and that in asphalt paving the rails can be butted, but that in block paving a space should be left for expansion and contraction. It is also contrary to the best American practice to lay rails in asphalt without a stone setting, while the frequent reference to composite rails, and rails with eccentric web and mitred joints, seems strange to American readers. Undoubtedly several of the differences in practice, such as the eccentric web rail and the composite rail, are due to differences in conditions. While the former rail undoubtedly possesses certain advantages from a structural standpoint, the cost of milling the rail ends will undoubtedly preclude its general use in this country, with present prices of labor, but this expense may not be as great in Europe. The composite rail has been tried to a limited extent only in this country, and perhaps under such unfavorable conditions that its true value has not been determined by American managers, but the sentiment in this country at present is practically unanimous in favor of a single web rail. Certain other conditions must undoubtedly be attributed to differences in the weight of cars, the European cars being, as a rule, much lighter and smaller. The tendency will grow, we think, however, in European countries towards the employment of longer and heavier cars, although the labor charge being lower, there is not the same incentive to the use of long cars in Europe as in America. In other respects we look for a modification of the European practice in track building, tending towards the American grooved rail construction; and while municipal councils abroad seem unalterably opposed to any section of head similar to

the American standard girder rail, we should think that the Metropolitan or Crimmins' rail would admirably suit the conditions existing in European cities.

There is grave danger that the strong hold upon the export trade in a hundred different industries which American manufacturers have obtained during the past five years will be loosened, if not destroyed, this year and next, by lack of foresight or sheer carelessness, either or both. The home demand for manufactured product has suddenly become so almost overwhelming, and profits immediately in sight seem to be so great, that the foreign demand is being in many cases neglected, and foreign agencies, which have been doing such magnificent work, and which are worthy of all support, are being "starved out" through refusal of home manufacturers to fill orders except at practically prohibitive prices. The wisest of our manufacturers are not, it is true, falling into this mistake, but mindful of the possibly temporary character of the home trade, are continuing to help out the foreign agencies in their endeavor to secure the wide and varied world market, which ought to be far more permanent in character than that of any one country, however rich and prosperous. But too many of the smaller manufacturers are "spasmodic" in their effort to enter the foreign field, and will find it extremely hard to take up the lines again and renew old friendships when the necessity for foreign outlets again comes upon them.

The foreign customer in almost all branches of trade is a very different being from the American. The British people, home and colonial, are attracted by age and persistence in business dealings, and despise weak and ill-sustained effort. They are not constantly seeking lower prices, but will often deal for a score of years with long established houses with which they have a *habit* of dealing. With them confidence once lost is never regained. Continental Europe buys in America, not because it wishes to do so—only because it has to. Any excuse which a customer can find for failure to place orders in America will be availed of. The South American trade has always belonged chiefly to Great Britain, though partly to Germany and France. Latterly, pro-American feeling has been largely developed in many of the South American countries, and it needs only a little cultivation to build up an important and constantly increasing market for American goods. Elsewhere in the purchasing countries of the world American goods have come to be highly regarded for their intrinsic value and a new trade is partly worked up. This ought not now to be lost through carelessness or neglect, even when home profits are more tempting.

There is every reason in the world why America should become the great manufacturing nation of the world. With limitless natural resources in coal and ores; with unequaled internal and external transportation facilities, natural and created; with unsurpassed organizing ability for the creation of vast industries and the handling of labor; and with labor itself skilful, intelligent, well fed and well treated for a hundred years past, our manufacturers may safely expand their facilities to meet the present home demand, and a future foreign demand enormously greater than which exists to-day.

In a lengthy argument in favor of the municipal control of street railways, which appeared in one of the New York dailys recently, great stress was laid upon the economic value of the fact that municipalities can borrow money at very low interest, and that consequently they could afford to operate street railways at much lower rates than could a private corporation. This is an old and favorite argument which seems, from a superficial view, to be sound, but a little further consideration will show that it is not such a good argument in favor of municipal control as would first appear. The people who lend money to municipalities do not accept low rates in interest from sentimental grounds, but because the security is better than that which a private corporation can give. The municipality is practically an unlimited corporation, made up by the different taxpayers, and the security given or pledged to make good the loan is their property. Now if, with private ownership, a railway should be uneconomically administered, or if, even with excellent management and the best human foresight, the line should prove unprofitable and the company fail, the loss does not come upon the residents of the city. On the other hand, however, if under municipal operation a similar trouble should be encountered, the citizens have to make up the deficiency. That is, the real property of all kinds belonging to the taxpayers is pledged as security for the wisdom and ability of municipal officers as railway managers. The taxpayers pay the bill if anything goes wrong. Moreover, any possible saving in interest account will be far more than counterbalanced by the large increase in cost of labor sure to come with municipal ownership, since one thing which the advocates of municipal ownership always promise to do is to increase the wages of labor or reduce the hours of work, which amounts to the same thing. In fact, one of the laughable features of municipal ownership arguments as usually advanced is that "you can eat your cake, and have it, too," i. e., you can reduce fares, increase wages of labor and make more money for the city's treasury—all at the same time.

We believe that Mr. Duffy and Mr. Ham were, on the whole, justified in yielding to the unanimous wish of the committees representing the Associations of Railroad Commissioners and of Railroad Accountants that "taxes" should be included in "deductions from income," instead of made a part of "operating expenses," though the latter classification was decided upon by the committee on standardization of accounts of the Street Railway Accountants' Association of America. It is best that railroad accounting practice should first be made uniform, and then should be corrected "from the inside," as it were, wherever corrections are right and necessary. We believe that taxes belong in operating expenses, in spite of the almost universal accounting practice to the contrary, and we have no doubt that in the course of time the reasons in favor of this will appeal to the different associations with sufficient force to cause a change to be made. The original argument in favor of the present ruling, which is a reversal of early practice, is that taxes are not within the control of the manager, and that his administration, therefore, should not be held responsible for a non-flexible item of this kind. The real truth of the matter is, however, that taxes are affected as much as any other item in operating expenses by the wisdom or unwisdom of the manager in his dealings

with the public. If he is popular, fair minded and meets the public half way in any propositions for the public good, his company is not nearly so likely to be "struck" by cruel and unusual tax burdens. If, on the contrary, he is too generous, too yielding, too ready to establish dangerous precedents, a load may be fastened upon the company which it can never shake off. Taking either point of view, it can be held as an absolute certainty that management has an influence on taxation as important as that on "wages of conductors and motormen," or any other pure "operating expense," where all that a manager can do is to increase or diminish an average volume of expenditure, which cannot be abolished in its entirety. If, therefore, the test of managerial ability is to be expressed in the percentage of operating expenses to gross receipts, taxes should be logically included, as the Street Railway Accountants' Association decided. The most important thing, however, is uniformity, and, as before stated, we believe that the Street Railway Accountants' Association should accept for the present the practice of the Interstate Commerce Association and other railroad accounting practice.

Should Strikes be Permitted

"If I should allow my men to strike, I should not be worthy of the position which I hold."

These pregnant words uttered by President Vreeland of the Metropolitan Street Railway Company contain a truth well worthy of interpretation, and a secret of successful management.

The employees of a modern electric railway—particularly those in the transportation department—are not unreasoning or unreasonable beings, eager to give ear to the counsel of demagogues or the ravings of the disaffected. On the contrary, they are usually intelligent, frequently ambitious, and always appreciative of the genuine efforts of their employers to improve their condition. It would probably be impossible to-day to induce the employees of the Metropolitan Street Railway Company of New York, for example, to leave its service in a body, because they see in President Vreeland and his department heads chiefs who are sincere and honest in their friendship for the men whom they employ, who are fair and just at all times in dealing with them, and who are ready to aid their employees in the lower ranks of the service to rise to the higher in every practicable way, recognizing merit and ambition wherever it occurs. As Mr. Vreeland frequently says to his men: "There is just as much reason for any one of you to hope that he may become president of this company as there was for me to expect a position of high responsibility twenty years ago, when I was a flagman on the Long Island Railroad." The secret of the hold which a manager can thus obtain upon his men is found in his treatment of them as reasonable fellow citizens, recognizing that each is doing a work as dignified in its way as is that of the department chief or the company's president.

When, therefore, a strike of any magnitude occurs upon a street railway system, it is not safe to assume that the fault is wholly with the men, however unreasonable their demands may seem at first sight to be. There is rarely heavy smoke without some fire, and it is more than probable that men who claim to have grievances are not wholly without the elements of them, particularly as no body of men can afford to ask public sympathy on too flimsy pretexts. If, now, the manager arbitrarily refuses to discuss such grievances frankly and freely, or even if he lets the disaffection grow to serious proportions without quieting it by prompt investigation and correction of abuses, he runs a grave risk of being found unworthy of the responsibilities placed upon him as a "master of industry." His most important business is to make sure that his men have no excuse for striking—nothing which they can urge as a sufficient reason.

It does not follow by any means, however, that strikes can always be avoided. It is often the case that the incoming of a new manager or superintendent, whose intentions, however good, are wholly unknown, is made the occasion of a strike, or of strike talk, which is really an effort to "find the master." Under such circumstances the mischief may have gone too far for correction and the gage of battle must be accepted. Again, a body of employees may be taken into a larger body through railway consolidations, as in Brooklyn, and before it can become assimilated and get used to the new management, disaffection may creep in and be fomented by unworthy labor leaders to the point of rupture. How much blame can attach to a management under these circumstances is not self evident, but depends upon the underlying facts in the case. Other exceptional causes may also lead to strikes without the possibility of putting blame upon the managers. Broadly speaking, however, it is true that the ablest street railway managers of to-day are men who are not troubled by strikes nor the fear of them; they do not hold themselves aloof from their employees, but mingle with them constantly, though without loss of dignity, commanding respect for the position rather than for the man. And they are *honest* in their friendship for the workers in every branch of the service, not simply superficially desirous of being regarded as friendly.

But when a strike is actually declared, it must be fought to a finish, assuming, of course, that the company has deliberately decided beforehand that it can go so far and no further, even if a strike be the consequence. The results of yielding to force what is denied to reason are so utterly disastrous to discipline and success in management, and involve such dangers of renewed attempts to obtain further concessions that almost any loss of money or property is preferable to allowing strikers to succeed in their strike. Arbitration even is usually unwise or impossible in contests of this kind, partly because the results of arbitration, particularly where the matter of wages is to be considered, may mean bankruptcy to a company, and partly because if the decision of arbitrators is unsatisfactory to strikers they rarely, or never, consider themselves bound by it, but often decide to continue the strike until some satisfactory conclusion is reached.

The best guarantee that the public can have that a street railway company will treat its employees with fairness, and that, in the case of strikes actually declared, the burden of proof as to its justification rests upon the strikers and not upon the company, is that "labor troubles" are so costly in their continuance and so disastrous in their effects, that a management will never permit them to be brought about if it is possible to satisfy the demands of the men.

High Speed Electric Railway Between Dusseldorf and Krefeld

The electric railway between Düsseldorf and Krefeld, Germany, which was put in operation a few months ago, is of special interest, as it is the first installation in Europe of a high-speed electric railway. For this reason new methods and apparatus of a kind untried in European countries, had to be installed. An interesting paper on this road was read at a recent meeting of the Verband Deutscher Electrotechniker, in Hamburg, by Gustav Braun, from which the facts given below have been largely taken.

The necessity for a direct connection between the two cities, Düsseldorf and Krefeld, was discussed as early as 1830, and it may be said that the plan has been agitated ever since. Düsseldorf, which is situated on the right bank of the Rhine, and is famous for its enormous industries and as an important railway center and river harbor, has long felt the lack of opportunity to extend more than in one direction on account of the broad river; while Krefeld, situated 6 km. to the left of the Rhine, and the center of the German silk and velvet industry, has felt the necessity of being connected with the neighboring city on account of railroad facilities.

In 1891 the State Minister of Railroads announced that the Government was not willing to grant the subsidy necessary for the building of the bridge across the Rhine required for the projected line, but if the city of Düsseldorf, or a stock company, would build the bridge at its own expense, it could obtain permission for the collection of a reasonable bridge toll. Finally all difficulties were overcome, and the Rheinische Bahngesellchaft was formed in March, 1896, for the purpose of constructing the required bridge at Düsseldorf and an electric railroad from that city to Krefeld.

The bridge itself is a handsome structure. The main portion consists of two large spans of 183 meters (600 ft.) each, framed by immense sandstone portals. At either side are a number of smaller spans. For the railroad two tracks have been laid, and two vehicles can pass outside of them at one time with ease. At each side of this roadway are two conveniently wide passenger walks.

As the electric road parallels a steam railway for the greater part of its length it was necessary to adopt a speed of 40 km. (25 miles) per hour on open stretches, and here the highway was avoided as much as possible. For this reason also the road does not pass through the intervening towns, but only touches them on the outskirts.

The route is shown in the map on page 527. The total length of the road from the Haroldstrasse in Düsseldorf to the Rheinstrasse in Krefeld, is 22 km. (13.6 miles). The length of the open stretch between the stopping places, Oberkassel and the Krefeld depot, is 16.7 km. (10.4 miles). The steepest grade is that of the bridge approaches, and is



MOTOR CAR AND TWO TRAIL CARS ON S CURVE IN KREFELD

2½ per cent. Between the starting point in the city of Düsseldorf and the stopping place, Oberkassel, which may be considered the end of the Düsseldorf local traffic, double tracks have been laid, while there is but a single track along the open stretch up to Krefeld, excepting at the stopping places, where double tracks serve as turnouts.

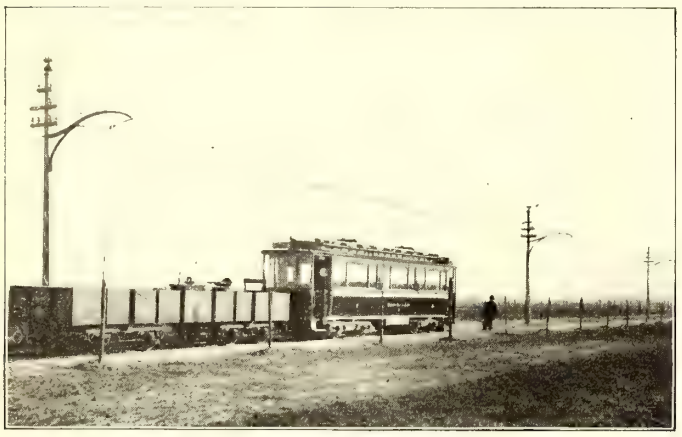
In Krefeld only a small portion is provided with two tracks. The entire road bed, however, has been laid out with sufficient width so that two tracks, on a road bed 9.2 m. wide, can be laid at any time without any difficulty.

As it is the intention to eventually run State railway cars over the open stretch between Oberkassel and Krefeld for private use as well as the needs of the company, the gage and distance between tracks had to be chosen to conform to the needs of these larger cars, which are considerably greater than that required by street cars. On the stretches intended for the latter the distance between tracks is only 2.75 m. (9 ft.) from center to center.

For the portion between the bridge and Krefeld tie con-

struction with Vignol T-rail sections, 11 A of the Prussian railways, were chosen. The rails have a weight of 27.5 kg. per meter (54 lbs. per yard), which is sufficient for the support of the large railway cars, as the lines are not to be used by the locomotives. The rails are laid in 12 m. (39 ft. 4 ins.) lengths, and in this distance fifteen tie rods are used.

The switches are of the tongue type, with a radius of



TRAIN ON HIGH SPEED SECTION BETWEEN OBER-KASSEL AND HEERDT-LÖRRICK

curvature of 150 m. (492 ft.), which permits the use of the railway cars. For the flange rails in the city streets, Phoenix, type 25 A, with a weight of 42 kg. per meter (84 lbs. per yard) were selected.

The construction of the road was started in the beginning of July, 1897. The ground and stone work for the completion of the roadbed was begun first and pushed so quickly that before winter set in the roadbed on the entire open portion, consisting of several cuts, road and railway crossings at Osterath, were finished, and the greater part of the rails laid. In the fall of the same year the building of the central station was started, and roofed before winter, so that during the winter months the machine and boiler foundations could be built. As soon as the warmer weather in year 1898 commenced, the outside work was resumed, and the several depots, which are very handsome, the car barns and workshops, as well as six dwelling houses for officers and workmen, were erected. In April the tracks were laid, in May the poles were placed in position and soon after the trolley line was strung.

Bids for supplying the electrical equipment for the line were requested by the Rheinische Bahngesellschaft in 1896 of a limited number of well-known electrical firms, the results of which gave the company plenty of material for comparison. Though the proposition of the firm Siemens & Halske was found to be the most acceptable, another competition with definite instructions was opened, and again the Siemens & Halske proposition proved the best. On account of the excellent general and special apparatus which this firm proposed to furnish, as well as the splendid operation of all electric lines executed by it, it received the contract for the electrical equipment of the road, that is the construction of the line and car equipment, while the well-known firm, Elektricitäts-Aktien-Gesellschaft, formerly W. Lahmeyer & Co., received the contract for the furnishing of the electrical machinery in the generating station, which had to conform, however, to the plans of the Siemens & Halske Company.

In view of an expected large demand for power by factories, the power house was located at Oberkassel, near one end of the line. In order, however, profitably to feed the other end at Krefeld, an accumulator plant was installed at Fischeln, and housed in the beautiful depot at that place.

The power house is a large, single-story building, containing the boiler, engine and generator rooms, as well as a repair workshop for cars. In the engine room are two horizontal tandem compound condensing steam engines of 270 normal effective h.p. each, and 330 h.p. effective maximum, at a speed of 90 r.p.m. The engines were built by the Hohenzollern Machine Company of Düsseldorf. Directly coupled to them are two shunt-wound continuous current generators, of 330 amps. capacity at 600 volts. Only one of these units is in use at any one time, the other being held in reserve. Besides the above, for the charging of the batteries, at Fischeln two sets of rotary converters have been installed, one for service and one for reserve, which furnish an additional 45 volts.

For the lighting of the station there is another continuous current rotary converter which runs at a speed of 900 rev. 4 amps. at 600 volts, and delivers current at 110 volts pressure. All the electrical machines were furnished by the Elektricitäts-Aktien-Gesellshaft, formerly W. Lahmeyer & Co., of Frankfort-on-Main. All machines in the engine and dynamo room can be reached by a 12,500 kg. (27,500 lb.) crane. Three arc lights illuminate the room.

In the boiler room are two water-tube boilers of 220 sq. m. (2370 sq. ft.) heating surface each, and a pressure of 10 atm. They were also built by the Hohenzollern company.

A voltage of 600 volts was chosen as being best suited in this instance, so as to reduce the cost of the line to a minimum. A higher pressure was not advisable, as this would exclude any possibility of connecting the road with the electric roads of Düsseldorf and Krefeld in the future.



CURVE CONSTRUCTION IN LUEG-ALLEE IN OBER-KASSEL

The overhead line, carried by iron poles, consists of two hard-drawn copper wires 9 mm. in diameter (No. 00),

which are strung 15 cm. (6 ins.) apart, along the single track portions, but are strung on both sides of the roads along the two-track portions and at the turnouts, and doubly insulated from the ground.

In order to prevent interruption of service in case of a break in the trolley wire, a special power wire, 100 sq. mm. in section (No. 0000) is stretched along the entire route, and is connected to the trolley wire at definite distances so that in case the latter should break the current can be interrupted for a length only corresponding to the distance between two successive poles.

The distance between any two points of support is about 30 m. (96 ft.) on the straight open sections and 35 m. (103 ft.) within the city limits. At curves and turnouts the distance is considerably less. The advantage of supporting the trolley wire when the bow-sliding trolley is used over that required by the wheel trolley is especially evidenced by the sharp curves in Krefeld, particularly in the S curves shown in one of the illustrations. The number of points of support of the trolley at this curve is remarkably small.

All wires are arranged so that they can be tightened if they stretch, and every 300 m. (984 ft.) the poles are made specially strong, so that a break in the trolley wire does not cripple the entire line.

Along the open stretch, from Oberkassel to Dissem, bracket poles are used; at the turnouts and on double track span construction is employed. At the land pillars of the new Rhine bridge the trolley poles also support the arc lamps.

Three feeders lead from the power and accumulator stations to the feeding points at the stopping places. The entire system is therefore divided into six independent sections, which can be separately controlled, and are again subdivided into 1 km. (0.62-mile) lengths. Each one of these is separated from the adjoining one by a line insulator with switch and is protected by a lightning arrester.

The feeders are supported by glass insulators on wooden crossarms, fastened to the upper part of the poles. In order to be able to report the cars along the open stretch the several stations are connected by telephone.

The car equipments, which were also furnished by the Siemens & Halske A. G., and conform to the requirements of this road, possess some departures from usual methods. The motors are mounted direct on the axles without springs. Double trucks are used, and each truck carries on its inner axle a 35-40 h.p. motor. A pair of wheels with armature and magnet frame weighs about 2.9 tons. The field consists of four poles, of which two are consequent. The diameter of the wheels is 800 mm. (31.5 ins.), the wheel base is 1600 mm. (5ft. 2 ins.), and the distance between



CAR FOR LOCAL TRAFFIC



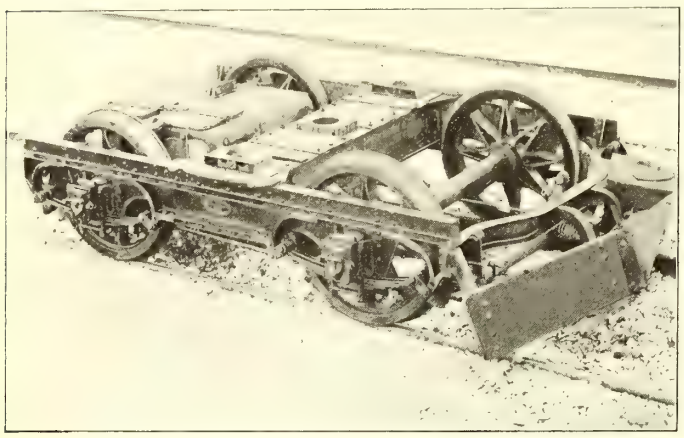
STATION AT FORSTHAUS-ALEER AND TRAIN OF CARS

axles 5.9 m. (19 ft. 4 ins.). The over-all length between buffers is 12.4 m. (43 ft.).

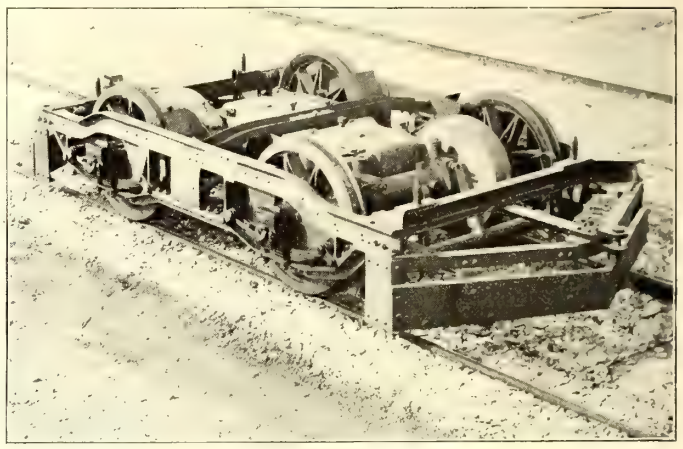
The passenger cars have a seating capacity of thirty-four, and standing room for sixteen, and are divided into II. class (12 seats) and III. class (22 seats), while the trailers in the III. class have cross seats, and those in the II. class have parlor car arrangement. The platforms are provided with glass storm doors; the illumination consists of eighteen 16 c.p. incandescent lamps. There are two lamps in the headlight, of which only one burns, while the other one is held in reserve in case something should happen to the first. The cars are heated with briquettes, by means of a stove under the car frame, to which pipes are attached, running along under the seats. The interior and exterior finish of the cars is extremely elegant compared with other German roads, and care has been taken to make them as comfortable as possible.

The cars can be braked in three different ways, i.e., usually by an air or hand brake, and in case of necessity by an electrical short-circuit brake. The air brake is of the Standard Air Brake Company's type. Its compression pump is coupled direct to a small electric motor, which is wound for 600 volts and uses 3-4 amps. in order to compress the air to 3-6 atmospheres. The two-cylinder, single-acting compressor of 76 mm. (3 in.) piston diameter, and a stroke of 51 mm. (2 ins.) delivers 140 to 200 liters (5 to 7 cu. ft.) of free air per minute, at an average speed of 600 r.p.m. The weight of a four-axle motor car is 18,750 kg. (41,250 lbs.).

To insure the certainty of the current collection the



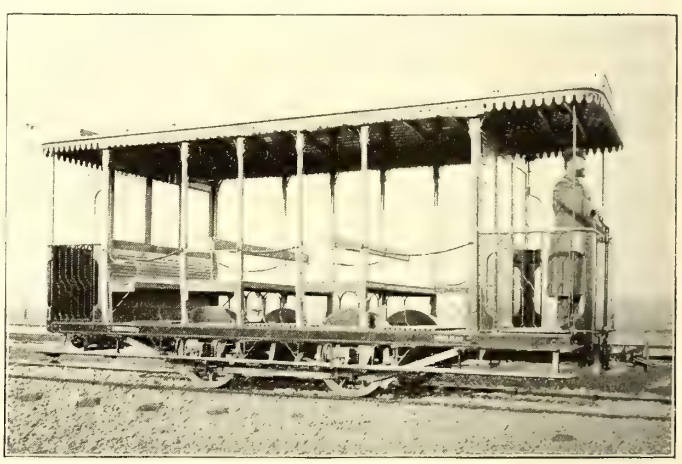
DOUBLE TRUCK FOR 8-WHEEL CARS



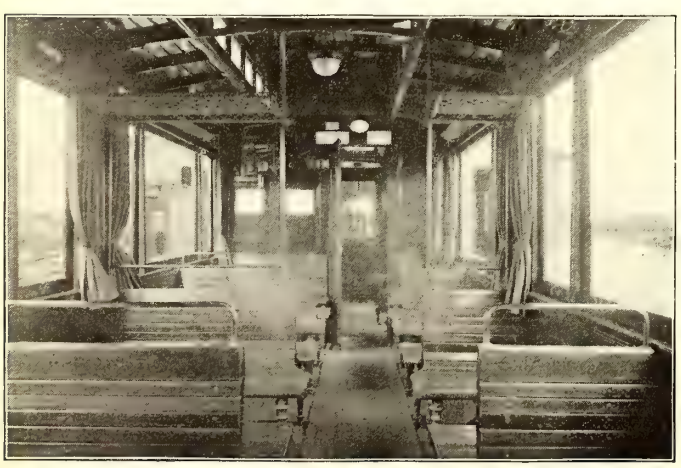
TRUCK FOR 4-WHEEL CARS



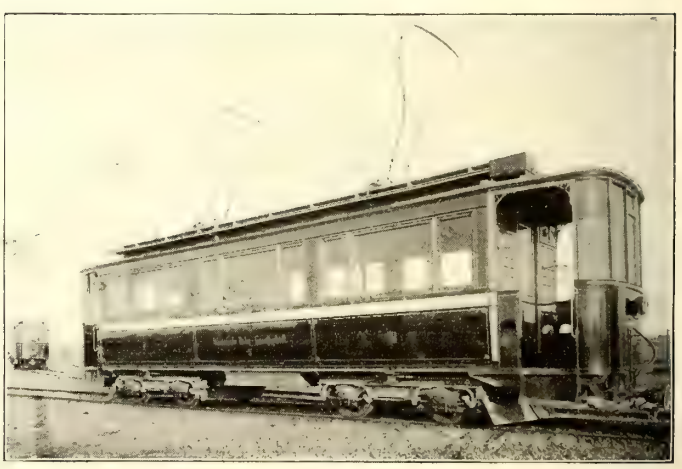
DOUBLE TRUCK CLOSED FREIGHT CAR



SINGLE TRUCK TRAIL CAR



INTERIOR OF OPEN TRAIL CAR



DOUBLE TRUCK MOTOR CAR

motor cars are supplied with two trolley poles of the well-known Siemens & Halske sliding contact type. This has proved satisfactory with the high speed of 60 km. per hour.

The passenger trailers, open and closed freight cars are also supplied with air and hand brakes. The four-axle passenger trailers weigh, empty, 12,100 kg. (26,620 lbs.). For the local service in Düsseldorf and Krefeld two-axle open and closed small cars are used. These closed two-axle passenger cars have a seating capacity of sixteen, and standing room for fourteen, and are elegantly furnished. The open trailers have a seating capacity of twenty-four, and standing room for twelve. Each axle of the motor car is driven by a 20 h.p. electric motor. The current is collected by only one sliding trolley. The local cars are equipped with a hand brake, but here also the electrical brake can be used. The freight cars also have four axles, a wheel base of 1.4 m. (4 ft. 7 ins.), distance between axles 5.2 m. (17 ft.), weigh, empty, 7750 kg. (17,050 lbs.), and can carry a load of 6300 kg. (13,860 lbs.). Trial trips were made at the close of 1898, and speeds of 60 km. (37.2 miles) per hour were obtained, showing that the electrical equipment was suited for even this speed, far in excess of the prescribed speed of 40 km. per hour.

At an early date the building of a 1.2 km. extension of the Düsseldorf portion of the road will be begun, .8 km. of which will be of the underground conduit system of Budapest.

Electric Transportation Systems at the Paris Exposition

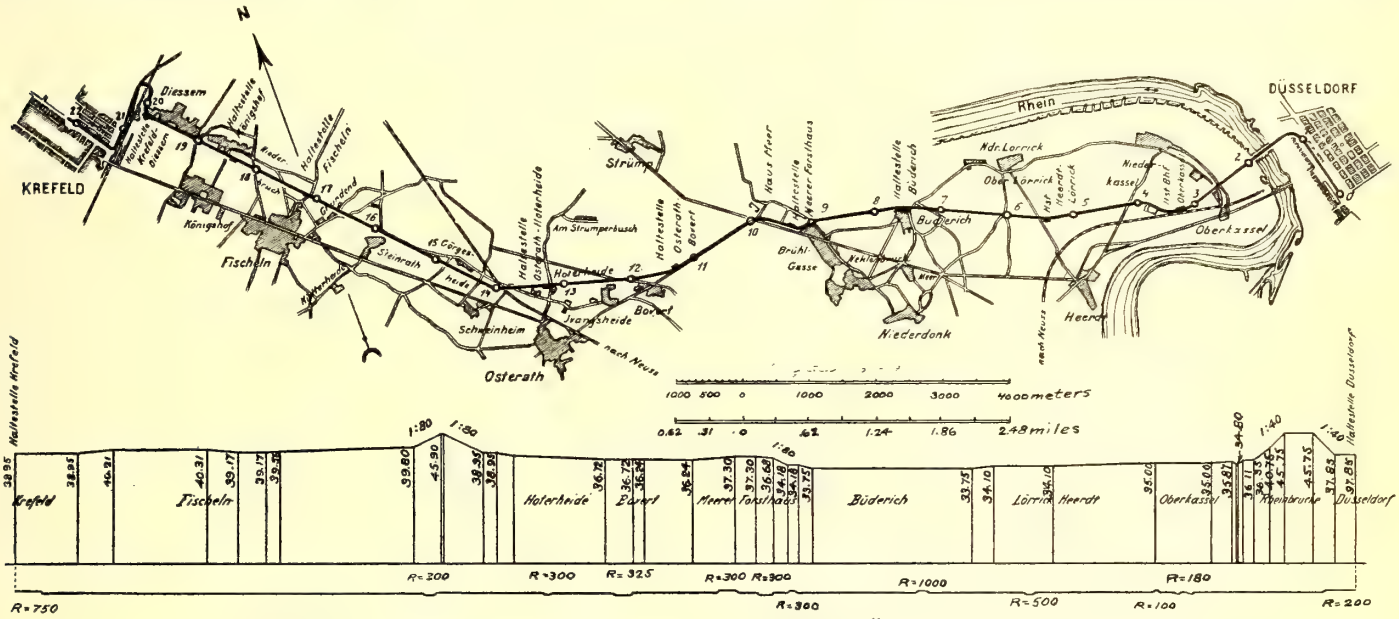
Arrangements are being made for the extensive introduction of transportation systems at the forthcoming exposition in Paris in order to accommodate the large number of strangers which, it is expected, will attend. Without counting the Metropolitan road, the Orleans Railroad Company and the Compagnie des Chemins de Fer de l'Ouest will extend their tracks to the entrance of the exposition. Both of these lines will be operated by powerful electric locomotives, so that while the city of Paris will not be able to show any extensive application of electricity to tramway service, visitors will be able to see electric transportation on a large scale, with the employment of heavy electric locomotives.

The plans adopted by the Orleans Railroad Company for the use of 45-ton electric locomotives, with a capacity of 700 h.p., have already been described in the STREET RAILWAY JOURNAL. These locomotives, mounted on four axles, each carrying one 25-h.p. motor, are able to draw a train of 250 tons at a speed of 50 km. per hour. The power station will have a capacity of 2000 kw., and will distribute current on the three-phase system at 5500 volts, with two substations, at which this current will be transformed to 550 volts for traction and 450 volts for lighting the trains.

The Compagnie de l'Ouest has already commenced the construction of a power station, from which it will generate current for, (1) electric traction on its Invalides-Exposition-Versailles line; (2) for the compression of air for its compressed air locomotives; (3) for pumping purposes in its Invalides station; (4) for the electric lighting of its Invalides station; (5) for the electric lighting of its Champs de Mars station; (6) for the operation of elevators.

This power station will contain a number of groups of 1200-h.p. engines, operating 800-kw. three-phase alternators, running at 5500 volts, at which the power will be distributed. There will be three substations at 2.4 km., 6.7 km., and 3.4 km. distance.

The company will also install a number of electric locomotives capable of drawing trains of 120 tons at a speed of 50 km. per hour on a maximum grade of 1 per cent.



MAP AND PROFILE OF HIGH SPEED RAILWAY BETWEEN DÜSSELDORF AND KREFELD

The road was opened to the public on Dec. 15, 1898, and the service was under the control of the Siemens & Halske A. G., by contract for three months, and it was found that all requirements were met.

For passenger service a through train leaves each terminal station every half hour; for local service between Düsseldorf and Oberkassel the small two-axle cars are used, which have a headway of from 6 to 8 minutes, while the small cars for the local service of Krefeld have a headway of 10 minutes.

The freight and farm service is regular, and the trains have but a small headway. The results of service are as follows:

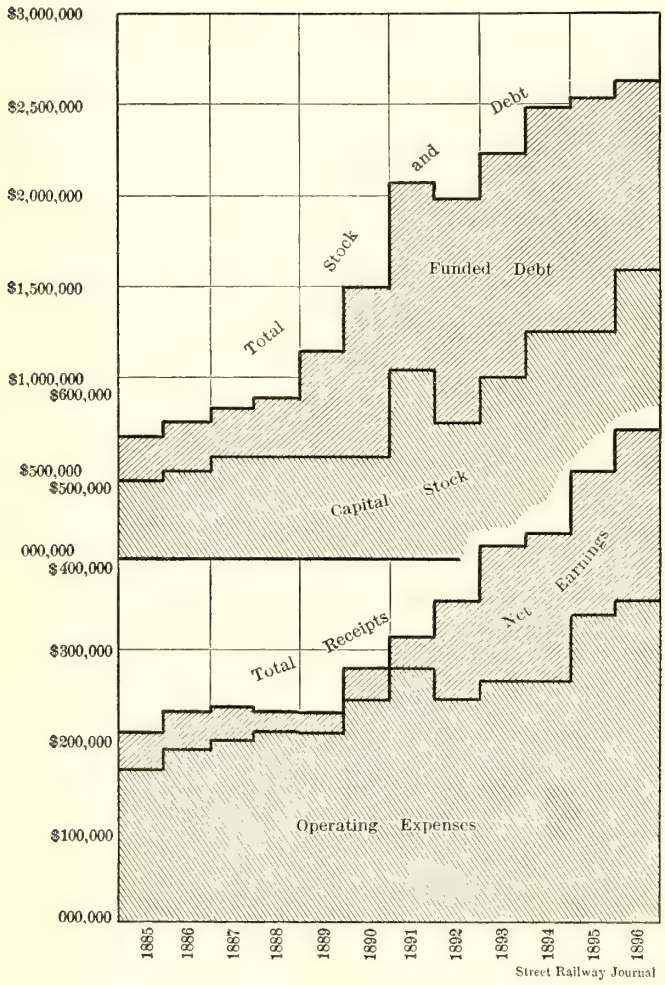
	January	February	March	April
Kilometers traveled by				
4 axle motor cars	43577.8	38242.9	43864.2	44354.0
" trailers	7298.0	9223.6	10253 0	13141.1
" freight cars	.....	4144.3	4843.3	5202.7
2 axle motor cars	15992.1	14994.1	12869.1	12777.7
" trailers	.....	.....	36.8	453.4
Number of long distance passengers carried	50,763	44,673	45,726	53,576
Number of local passengers carried	43,036	25,643	27,886	30,974

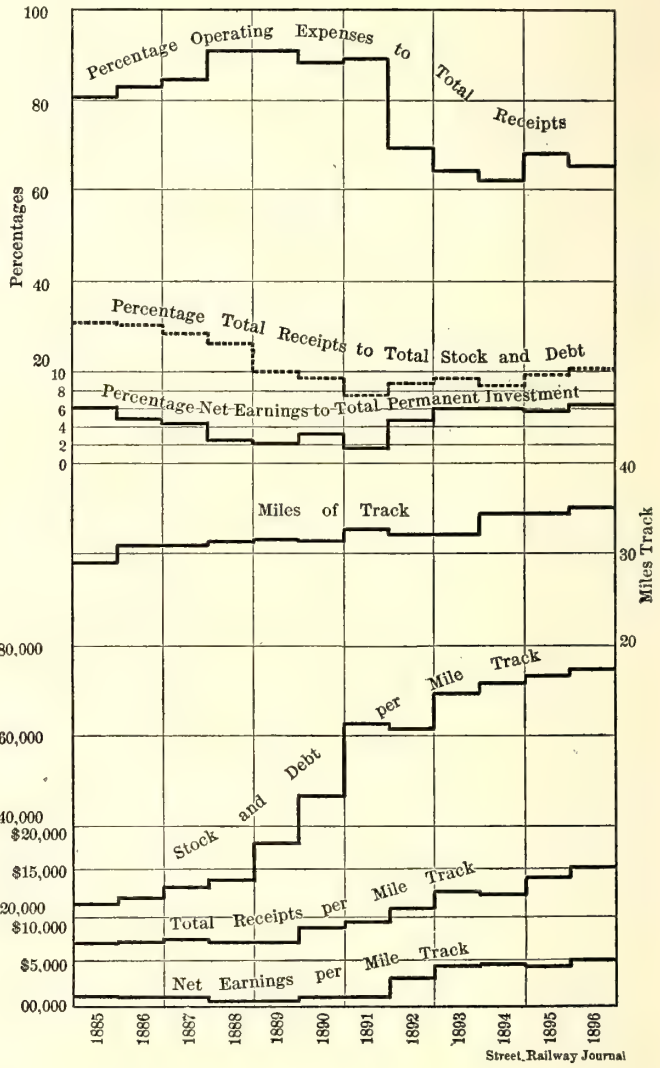
Financial and Operating Reports in Diagrammatic Form for Use of General Managers

During the past two or three years the Street Railway Journal has several times called attention to the value to the street railway manager of diagrams, or "curves," in interpreting the financial results and details of operation of his system. In no other way can five and ten year reports be so well examined and compared. The usual system of comparing "this year" with "last year" by figures is oftentimes unsatisfactory, in that one or both of the two years may be exceptional in certain respects, and it is often, if not always, desirable to have before one on the same sheet the results of several years' operation.

In Figs. 1 and 2* may be seen one form in which the general results from the operation of a street railway for many years can be compared. A diagram in this same form can be made for months, as well as years, so that nineteen diagrams would reflect comparative monthly, quarterly, semi-annual and annual reports covering any desired period—ten, fifteen, or twenty years.

Mr. H. C. Mackay, auditor of the Milwaukee Electric Railway & Light Company, about a year ago presented to General Manager John I. Beggs a pocketbook, in which appeared in diagrammatic form, but on a system somewhat different from that just illustrated, practically all the details of operation, information concerning which would be desired. Illustrations of two or three of the typical pages of this book are given herewith. Each year is traced through the different months by a line of a given color of ink. On completing the year another line commences with January, and is traced through the following year in another color. Five colors, red, black, purple, green and blue are provided for in the general scheme, and the result is, perhaps, more distinct than appears in the accompanying illustrations, where black lines only are used. Every detail of gross receipts and operating expenses, in both railway and lamp departments, is represented by these diagrams in Mr. Beggs' pocketbook, and from the index in front the desired page can be quickly found.





FIGS. 1 AND 2.—MILWAUKEE NOTE BOOK

The general manager of the Maple Leaf line, a large steam railroad of the West, employs a clerk whose sole business it is to translate into diagrams of this form all the figures submitted by the auditing department. In this way Mr. Stickney can rapidly go over the reports of each month, seeing at a glance whether or not pay rolls are being increased or diminished, and to what extent, and where leakages occur, and can get a much better comparative bird's eye view of the entire system in its operating and financial phases than could possibly be obtained in any other way except by the expenditure of far greater time.

*From Street Railway Journal, July, 1897, pp. 410-11.

Electric Railways at Florence, Italy

One of the first of the modern electric railways in Europe was built in Florence, in 1891, and connected that city with Fiesole, a mountain suburb of the city. During the last year, however, the principal tramway company of the city, la Société des Florentins, has completed the equipment of its lines, comprising about 60 km. of track,

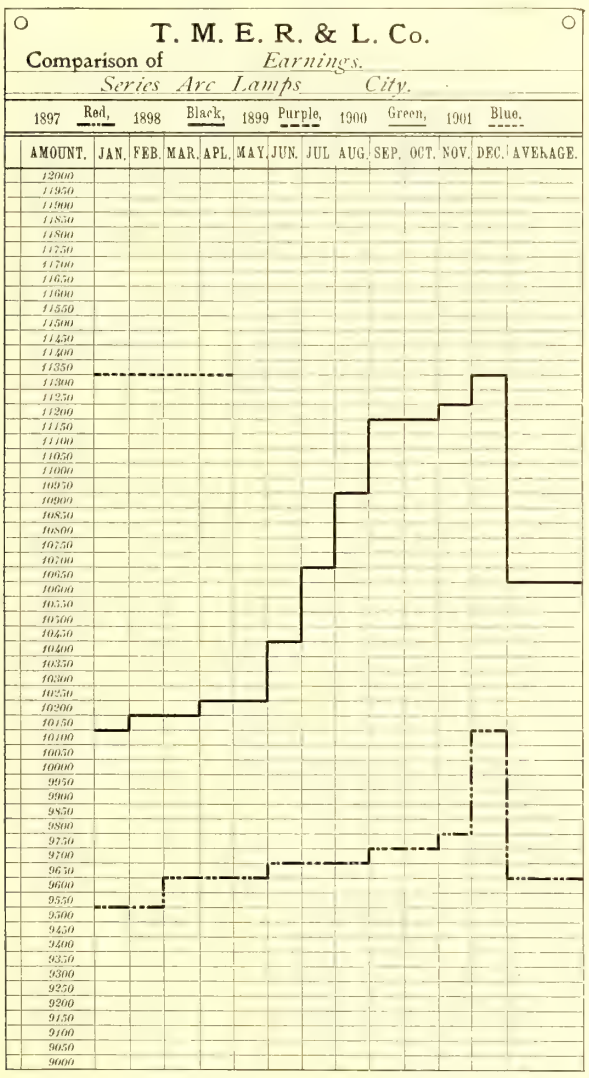
and the famous city of Savanarola, Dante and Galileo now possesses an electric railway complete in modern equipment. The installation was made by the French Thomson-Houston Company, and was put in operation Dec. 5, 1898.

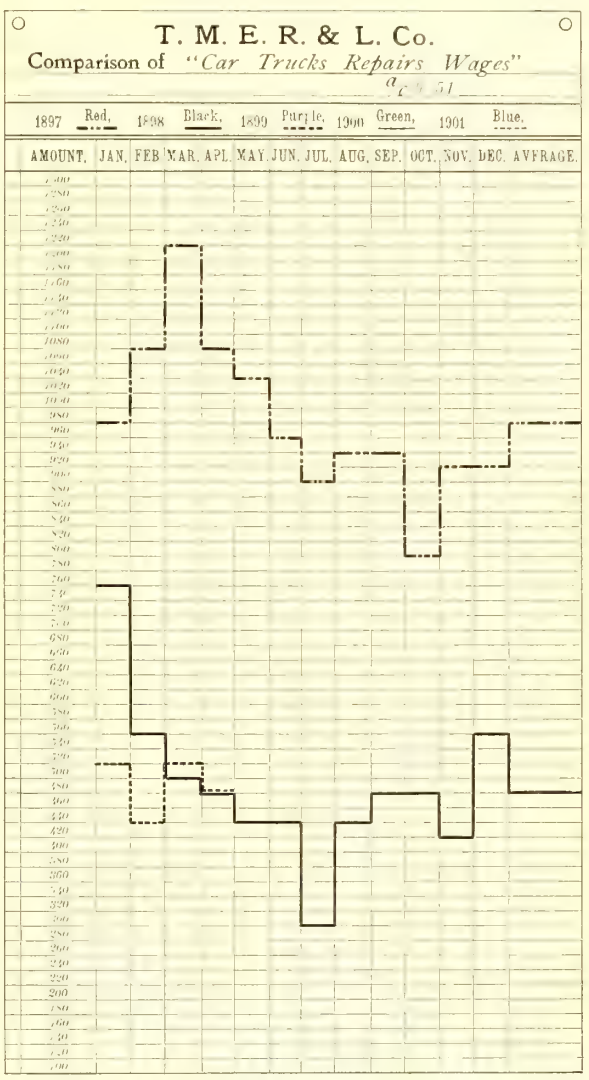
The track construction within the city is made up of the standard Broca rails, weighing 34 kg. per m., and mounted on metal ties weighing 18.75 kg. each, and spaced seven to every ten meters. In the suburbs the Vignole rail is used, weighing 24 kg. per m., laid on oak ties. These rails have a length of 9 meters and each rests on ten ties. The rails are bonded with the Chicago rail bond, 9 mm. in diameter, and are cross connected every 50 meters. The return feeders are made up of old rails weighing 30 kg. per m., connected electrically and buried a distance of 700 mm. in the ground. The outgoing feeders are also carried underground in the center of the city, and are of 250 mm². and 500 mm². section. The suburban feeders are entirely overhead and are composed of bare copper wires of 250 mm². and 125 mm². section.

The overhead system is standard, with a trolley wire 8.25 mm. diameter and is divided into sections of about 50 meters in length, each equipped with a lightning arrester.

The power station is a handsome building, the front of which is finished in the characteristic Italian style with alternating horizontal stripes of dark and light material, and is located about the center of the system. The boiler room contains four Weinlig boilers, each with a heating surface of 155 m². and capable of furnishing 2500 to 3000 kg. of dry steam per hour under a pressure of 9 atmospheres. Green economizers are used, and the chimney is 55 meters in height. The engine room contains three Escher Wyss & Company's tandem, compound condensing engines, two of 700 i.h.p. each and the third of 350 h.p., all running at 120 r.p.m. The air pumps are operated directly from the engine shaft, but the condenser pumps are driven by a 25-h.p. electric motor. A traveling crane of 15 tons capacity completes the mechanical equipment of the engine room.

The generators are of the Thomson-Houston M. P. type. Two are of 425 kw. capacity, and one of 225 kw. capacity. The switchboard is made up of eight panels, of which three are for the generators, two for the feeders, one a totalizer panel, one for the distribution of electric power and one a lighting panel for station and car house use.



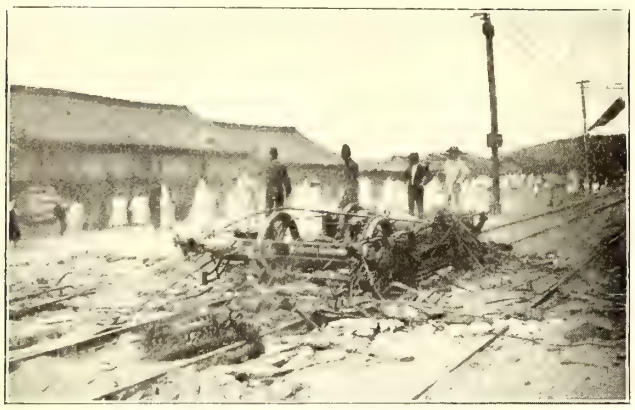


FIGS. 3 AND 4.—PAGES FROM MILWAUKEE HAND BOOK

There are seventy-five cars, of which sixty are closed cars, each equipped with two G. E. 800 motors; ten are open cars with the same equipment and five are closed cars equipped with two G. E. 57 motors. The latter cars are intended to act as locomotives in driving ordinary freight cars within the city, where steam locomotives are not permitted. The cars carry thirty-eight passengers each, and are equipped with electric brakes and are mounted on Brill trucks. The company also possesses a number of trail cars which are used on days of special traffic, but are not employed under ordinary operating conditions. These cars are also equipped with electric brakes.

Electric Railroading in Corea

Some of the difficulties of operating electric railroads in oriental countries are almost as great as those experienced in this country, and occasionally a mob will take offense at the management of the railroad and destroy nearly as much property in the same length of time as a more civilized mob provided with improved instruments of destruction can accomplish in the same length of time in this part of the globe.



RUINS OF CAR IN COREA

An incident of this kind occurred on May 26 at Seoul, Corea, where an electric railway has been in operation for a few months. It was the first road of its kind in the country, and at the start the natives took kindly to it, the opening celebration continuing practically for a week. Unfortunately for the railway company, however, soon after the opening of the line a drought occurred, which threatened the failure of the rice crop. As the most likely cause, the natives imagined that rain was cut off by the electric wires, and to them the most obvious way to obtain the needed showers was to remove the objectionable cause. This they proceeded to do by tearing down the trolley wires and burning the cars. The result of a few hours of this pastime is shown in the accompanying engraving, where the only thing left of the cars was the J. G. Brill trucks on which they were mounted, and which do not seem to have been injured by the conflagration above them. It is interesting to note that order was very quickly restored after this example of the mob's violence, as the method adopted by the government was a simple one, and consisted in cutting off the heads of some of the rioters.



CLEANING AWAY THE DEBRIS

The simple minds of the natives soon comprehended that droughts and trolley cars are less serious calamities than the loss of one's head, and are likely to leave the cars alone in the future.

According to the press dispatches of the riot the disturbance was largely quelled by two officers of the company, H. R. Bostwick, formerly of San Francisco, manager of the Seoul Electric Railway Company, and H. Raymond Krumm of Columbus, Ohio, chief of the Imperial Engineering Department, who, alone and unarmed, by their coolness and nerve dispersed a howling mob of from 3000 to 4000 Orientials and saved their own lives, the power house and electric plant.

New Road in Massachusetts

Westminster and Gardner, Mass., are two towns respectively 7 and 12 miles west of Fitchburg, Mass., on the line of the Fitchburg Railroad. The village of Westminster is about a mile and a half distant from the railroad station of that name, and between it and Fitchburg no adequate accommodation for local traffic can be obtained through the steam road. The Gardner, Westminster & Fitchburg Street Railway is an electric line, of which all but three miles have been completed, connecting the three places named. Frederick S. Coolidge, of Fitchburg, is president, and the general management of the road is to be in the hands of M. A. Coolidge, who has the contract for construction, and will do all buying for the work.

A power house and car barn are now being erected at Westminster. H. G. Howard, of Ashburnham, has the contract for the former, which is of brick, 82 ft. x 85 ft. The car barn is being built by M. C. Ryan, of Gardner, and is of wood, with brick underpinning. It will be heated by steam from the power station.

The boilers are three in number, of the horizontal tubular type, 72 ins. in diameter by 21 ft. 6 ins. long, built by D. M. Dillon, of Fitchburg. They are to rest on ordinary brick settings with rough stone foundations and are to have firebrick linings throughout. The engines are two Slater cross compounds, 14 ins. x 28 ins. x 36 ins., of 300 h.p. each. They will be erected on brick foundations over a concrete bed 2 ft. deep, the outside dimensions of the foundations being 25 ft. 4 ins. x 20 ft. 11 ins. The stack is of brick, 10 ft. 8 ins. square outside, with a circular core 5 ft. in diameter and 85 ft. high. The piping contract, including the heaters, pumps, etc., has been placed with the Walworth Construction & Supply Company, of Boston. Warren pumps and condensers, Cochrane separators, Wheeler heaters, Crane valves, Metropolitan injectors and Johns' asbestos fire felt covering will be used throughout. The generators are two 225 kw. General Electric 550-volt machines. The car equipments, also furnished by the General Electric Company, include motors for eight double truck cars. Hodges & Harrington, of Boston, are the engineers for the power plant.

The individuals controlling the road form also a majority interest in the Gardner Street Railway, a road covering some 5 miles of streets in the town of Gardner. This road is at present supplied with power by the Gardner Electric Light Company, but will be operated from the Westminster plant when the latter is completed.

I realize that it is a hard matter for the Government to make a flat rate to cover all roads and the local condition pertaining to each road; but as they have attempted to do this, I claim that they should have made the rate flattering enough to the electric railroads to make them at least interested in the subject, and that three cents per mile for pouch service and sixteen cents per mile for 16-ft. cars, which are fast becoming obsolete and replaced by cars from one-third to twice as large, is not enough. From paper at the Boston Convention, 1898.

The Recent Street Railway Strikes

The Brooklyn strike of July was due to dissatisfaction among the men of the Nassau Electric Railway system, which has recently been taken into the great combination which now controls nearly all the surface and elevated railways of Brooklyn. The Nassau men are said to be made up largely of former strikers who were "locked out" in the last great Brooklyn strike, and who remained out of work until the Nassau system was built by the Johnsons, by whom they were largely re-engaged. Rightly or wrongly, these Nassau men seem to have felt that their past record was being brought against them by the management of the Brooklyn Rapid Transit system, and that sooner or later practically all would be discharged upon one pretext or another. It was also claimed by them that the provisions of the ten-hour law were being evaded and that the men, particularly in the Nassau system, were obliged to run their cars at high speeds under serious nervous strain for more than the legal limit of a day. All other grievances than these two were merely perfunctory or non-existent.

There appears to be little doubt that strike feeling was secretly fostered by Wall Street speculators for the fall, and at a critical moment Albert L. Johnson, formerly president of the Nassau system, came out in open championship of the cause of his old employees, and as a contributor to their funds. Almost immediately after this the strike was declared.

There was never from the first the slightest hope of success. The disaffection was not general, but highly localized, and in spite of the most urgent effort on the part of the strikers, but few of the employees of the Rapid Transit system, outside of the Nassau lines, could be induced to "go out." The strike was short lived, and ended in a lock-out of most of the Nassau men and a few of the remainder. There was some violence, including one serious case where dynamite was used to blow up a portion of the elevated structure, but the prompt and stern determination of the police to preserve order at all costs was largely effective in preventing serious riots or bloodshed.

The strike on the Metropolitan Street Railway system was a roaring farce. The absurd Parsons, Grand Master Workman of the Knights of Labor, pretended at first to represent a powerful organization among the Metropolitan employees, although nearly 90 per cent of the latter had signed a statement which they sent to President Vreeland to the effect that they were entirely satisfied with their treatment, and had appointed no representatives to present grievances. Later on, certain over-enthusiastic followers of Parsons, who were chiefly ex-employees of the Metropolitan Company, demanded that he declare a strike, and although he used his best efforts to prevent this, fearing, no doubt, that the weakness of his alleged organization would thereby become known, he was carried away and practically forced to declare the strike. As a result hardly one hundred men out of the 3500 Metropolitan employees responded to his call. The cars ran almost as usual throughout the city, and the great body of employees remained loyal to the management which has done so much to improve their condition during the past six or eight years. Statement after statement was issued by Parsons to the effect that the tie-up was complete, and the remainder of the men would go out immediately, but the employees themselves laughed him to scorn and went about their business. There was practically no violence on any line except the Second Avenue, where, in fact, the disaffection was chiefly localized, this having been one of the last properties to be brought into the Metropolitan system.

The Cleveland strike in its revived form belongs to a wholly different and far more dangerous class than the New York strike. As Mayor Farley of Cleveland says, "Our people seem to have gone crazy." The strikers have actually come out with a public statement justifying violence as necessary—a very rare thing in strike annals, where the labor leaders generally disclaim all attempts at violence, and frequently allege that it is practiced by the friends of the railway company in order that the men may lose sympathy in their struggle. Never before have high explosives been so freely used as in the Cleveland strike to date. Cars have been blown up, bombs have been thrown into car houses, shots have been fired at cars, passengers and non-union motormen, and the latter have been maltreated at every opportunity. To quell the insurrection, for it is little less than that, the local troops have all been ordered out, and the State troops called for, and Mayor Farley states that no effort will be spared to stop the reign of terror which now exists in Cleveland. It is much to be feared that a large part of the trouble has been due to lack of firmness of the city government in dealing with the strikers at the beginning of the difficulty, but the authorities now seem fully aroused to the occasion, and the result cannot be in question.

New Railway in Ohio

The new line being built at Galion, Ohio, by the Ohio Central Traction Company is nearly completed, and the company will commence operations soon. The company owns 12 miles of track, laid with 60-lb. T rails, and about eight cars. Four of these cars will be 36-ft. double-truck combination cars, and four ten-bench open cars. The cars will be mounted on the Brill maximum traction and No. 21 trucks, and the cars will be built by the American Car Company. The power station will contain two 250-h.p. Slater engines, two 150-kw. General Electric generators, and two 250 water tube boilers built by the Turner Engineering Company, of Bucyrus, Ohio. Located on the route of the road will be a park, known as Secaium Park. It comprises 58 acres, and is being fitted up with a summer theater, which will seat from 800 to 1000 persons, also with a large pavilion, seats, tables, etc. The president of the company is I. A. Kelsey, of West Haven, Conn., and the general manager, W. E. Haycox.

Chartered Car Rates in Rochester

The Rochester Railway Company, of Rochester, N. Y., publishes the following as the rates for chartered cars during the coming season:

CITY LINES

One motor car to any point	$4.00
One motor car and return	6.00
One motor car and trailer to any point	5.00
One motor car and trailer and return	9.00

CHARLOTTE AND WINDSOR BEACH

One motor car one way	$6.00
One motor car one way and return	10.00
One motor car one way with trailer	9.00
One motor car one way with trailer and return	14.00

CHARTERED CARS (BY THE HOUR)

First hour	$4.00
Each hour after	2.00

PRIVATE CAR

First hour	$5.00
Each hour after	2.00

One motor car and trailer will carry 100 passengers comfortably

LEGAL NOTES AND COMMENTS*

Edited by J. Aspinwall Hodge, Jr., of the New York Bar

The Constitutionality of the Ford Amendment to the New York Tax Law

In the June number of the Journal we commented upon the taxation of franchises, and especially upon the tax proposed by what was known as the Ford Franchise bill, which has since become an act of the New York Legislature, after having been amended in two important particulars.

The constitutionality of that act, owing chiefly, if not wholly, to the amendments which were made to it at the instance of the Governor in the extra session of the Legislature, is being seriously questioned and upon two grounds.

First, it is contended that the act is unconstitutional in that it provides for the appointment by the Governor of officers who shall make local assessments for the purpose of taxation; while the constitution provides, in section 2, of article 10, that all State, town and village officers whose election or appointment is not otherwise provided for by the constitution, shall be elected by the electors of such city, town or village or appointed by such authorities thereof as the Legislature shall designate for that purpose.

The supporters of this contention cite the case of the People vs. Raymond, 37 N. Y., 428. Chapter 410 of the Laws of 1867, provided for the appointment, by the Governor, of an officer to be known as the Commissioner of Taxes and Assessment of the City and County of New York, and the constitutionality of the act was attacked in that case.

In answer to the argument made by the counsel of the opponents of the act that additional powers and duties were conferred upon the office created by the act, and that the office was a new one, and so was not within the prohibition of the constitution, the court observed:

"If offices can thus be made new, the section of the constitution above quoted may readily be made a nullity. I am far from conceding that it would be competent for the Legislature to take from the city all control over the assessment of the property of the city for purposes of taxation, and vest this power in the central authority, by conferring powers upon the officers or boards, upon which they conferred it over other subjects, and imposing duties upon them entirely foreign to those of making the assessment."

But it is to be noted that the powers and duties of the commissioner under that act were limited to the territory of the city and county of New York.

We are not able to subscribe to the proposition that this case establishes the proposition for which those who cite it contend, especially in view of other decisions of the Court of Appeals, beginning with the case of the People vs. Draper, 15 N. Y., 532, the doctrine of which was reaffirmed in the People vs. Shepard, 36 N. Y., 285.

The Draper case involved the constitutionality of the act creating the Metropolitan Police District. There the Court of Appeals held that an act was constitutional which created the office of Police Commissioners (who were admittedly local officers when appointed for a single city) to act in a territory to be known as the Metropolitan District, including the city of New York and some contiguous territory. And this, notwithstanding that it was admitted that had they been appointed for a single city, the prohibition of the constitution would apply and notwithstanding that it was contended with reason that the act created a new political division of the State.

It will be noticed that the Ford bill appoints officers who would be local were they appointed for any particular city, but gives to them powers and duties over the entire State. The act, therefore, is not as open to constitutional objections as the act passed upon in the Draper case, for no new political division of the State is created by the Legislature fiat, and the State officers who are appointed have duties in every city alike.

It is quite true that the Draper case was very severely criticised in the Court of Appeals in the case of the People vs. Albertson, 55 N. Y., pp. 50, 64, but the criticism there made by Judge Allen, writing for the Court, is rather directed to the creation of the Metropolitan District than to the proposition which is involved in the appointment of a general State officer to perform duties throughout the State, and distinguishes between an office created for a particular locality and one which covers a larger legitimate political division.

The principle of the Draper case that the officer who performs duties beyond, as well as within, the limits of a particular locality is not a local officer of that locality, whatever his duties may be in it, has never been overruled by the Court of Appeals.

The second, and it seems to us more serious objection, to the constitutionality of the act, is that the tax levied is unequal.

By the amendment to the bill, it is provided that if it shall appear that the person or corporation owning a franchise has paid during the preceding year to the city, town or village any sum of money on account of the franchise, all such amounts, except such as is paid for paving or repaving the streets, shall be deducted from the tax levied and the remainder shall be the tax that is payable by the holder of the franchise.

We have in a preceding article referred to the inequality which distinguishes between a payment on account of paving and payments made for other purposes. But the objection on the ground of inequality is broader and goes deeper.

It would readily be admitted that a system of taxation is unconstitutional, because unequal if it provides that a real estate owner who could show that he paid a larger sum for his property, which he had purchased from the State, than his next door neighbor, should have a deduction made from the tax levied upon him. Yet this is what the amended Ford act does.

An individual or a corporation (for the act applies to both) who owns a franchise is to be granted a deduction if he is, by some previous agreement, paying a part or the whole of the purchase price in instalments. As between a corporation which has paid a lump sum for a franchise and one which has bargained for an annual payment, however computed, the discrimination is seemingly unjust and the tax unequal.

The only answer to this serious objection is that the State might have remitted the annual payment; in other words, forgiven its debtor, and then levied a tax on all alike. Thus in two acts, neither of which would have been unconstitutional, the Legislature would have accomplished the same result as has been attempted in the Ford act. The supporters of the constitutionality of the act are entitled to any comfort they may derive from that consideration.

H.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

CONNECTICUT.—Franchise—Location—Terminus—Description.

A street railroad charter described the location and terminus of the road as "over and through Main street in the town of S. to

* Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

a convenient point in said town, where connections can be made with the 'S. & P.' Electric Railroad," and authorized it to connect with any other street railroad. Held, that the terminus was sufficiently described, and the right to build the road was not affected by the fact that the "S. & P." road was abandoned, and connection could not be made with it.—(Central Ry. & Elec. Co. vs. N. Y., N. H. & H. R. R. Co., 43 Atl. Rep., 490.)

NEW YORK.—Nuisance—Implied Powers—Injunction—Appeal.

1. Where the trial court does not fully state the facts found, but decides that defendant's conduct amounts to a nuisance, the Court of Appeals, after an affirmance by the Appellate Division, must assume the existence of the nuisance.

2. Where a statute authorizes a company to construct and operate a railroad, the implied authority to operate a turntable in connection therewith does not justify its operation, so as to constitute a private nuisance.

3. Where a continuing trespass is shown, which must necessarily result in substantial damages to plaintiff's property, which are in no way offset by benefits, a permanent injunction may be issued, although the amount of the damages is not fixed.—(Garvey vs. Long Island R. R. Co., 54 N. E. Rep., 58.)

LIABILITY FOR NEGLIGENCE.

ALABAMA.—Injuries to Passenger Alighting—Argument of Counsel—Instructions—Negligence—Discharge of Passenger—Sudden Starting—Contributory Negligence.

1. In an action for death of a passenger, caused by a sudden jerk of a street car while he was attempting to alight therefrom, the evidence tended to show that, through negligence of the conductor, the car was carried beyond the passenger's destination. The conductor testified that the passenger was drunk, used profane language, and made faces at some women on the car. There was evidence to contradict these statements. Held, that a statement of plaintiff's counsel, in argument, that, not satisfied with taking the passenger's life, the conductor attempted to rob him of his good name, was not improper.

2. In an action for death of a passenger, claimed to have been caused by a sudden jerk of a street car while he was alighting, a passenger testified for the company that, to the best of his recollection, the car stopped at the crossing. All of the company's testimony was not introduced to show that the car so stopped. Held, that a charge that some of the testimony offered by the company tended to show that the car stopped at the crossing was not erroneous.

3. In an action for death of a passenger, claimed to have been caused by a sudden jerk of the car while he was alighting therefrom, a witness testified that the car slowed up almost to a standstill, it being hard to tell whether it was going or standing still. The court charged that some witness testified that the car so nearly stopped that its motion was almost imperceptible, but subsequently withdrew the statement, saying merely that some of the testimony tended to show that the car slowed up. Held, not error.

4. Where a street car, having failed to stop at a crossing in compliance with a passenger's request, slows up beyond such crossing to such an extent as to imply an invitation to him to alight, it is the duty of the operatives not to cause the car to jerk suddenly so as to endanger his safety.

5. Where a street car slows up to allow a passenger to alight, and he is injured by a sudden jerk thereof, his attempting to alight before the car actually stops cannot be held contributory negligence, as matter of law, but it is for the jury to determine, though the passenger carried a small bundle under one arm (which, however, was not shown to have incumbered him), whether he was negligent or not.

6. In an action for injuries to a passenger, some witnesses testified that, when the street car had slowed up nearly to a standstill, the passenger attempted to alight, and by a sudden jerk of the car was thrown down. Other witnesses testified that the passenger was thrown from the platform after the car had started, and while it was going six or eight miles an hour. It was admitted that the passenger was negligently riding on the steps or platform in violation of the rules. Held, that a charge that such negligence alone would not defeat a recovery, unless it proximately contributed to the injury, was proper.

7. In an action for injuries to a passenger, claimed to have been caused by a sudden jerk of the car, throwing him off, a charge that, if the injury resulted from the passenger's riding on the platform, he could not recover, was properly refused, as it did not hypothesize such riding as the proximate cause.

8. Ordinarily it is not, as a matter of law, contributory negligence for a passenger, when the street car is slowing up to allow him to alight, to go upon the platform or steps before the car has actually stopped.—(Birmingham Ry. & Elec. Co. vs. James, 25 So. Rep., 847.)

CONNECTICUT.—Crossing Track—Negligence—Evidence—Default—Appeal—Review.

1. In a negligence case, in which the question of legal liability is purely that of prudent conduct under circumstances peculiar to the case, and no violation of law by the trial court is apparent from the record, its conclusion as to negligence or legal liability, including the measure of duty and the extent of its performance, is final.

2. Deceased passed a street car standing at its termius ready to start in the direction in which he was traveling with a wagon. After traveling alongside of the track for some time he turned to cross the track, and was struck by the car and killed. He did not stop before turning across the track, and it did not appear whether he looked back or listened before attempting to cross. He was slightly deaf. When he started to cross the car was at least 70 ft. from him, and he had time, at the speed at which he was driving, to have crossed the track ahead of the car had it been going at its ordinary and proper rate of speed. Held, in an action to recover for deceased's death, that he was not guilty of contributory negligence as a matter of law.

3. On the hearing in damages after a default in an action against a street railway company to recover for death of a person run over by its cars, it appeared that deceased was driving alongside of the track, and turned to drive across the track, when he was struck by a car from behind and killed. The car was coasting down a heavy grade at a speed greater than its ordinary, proper rate, and after seeing deceased on the track not less than 70 ft. ahead of him, the motorman was unable to stop the car until after it had gone 200 ft. further, though it could be stopped within 70 ft. when going at its usual rate of speed. In trying to stop the car the motorman failed to sand the track, which was slippery in places. Held, that a finding that the street railway company had not shown its freedom from negligence was warranted, as after the default the burden of proof was on it.—(Lawler vs. Hartford St. Ry. Co., 43 Atl. Rep., 545.)

ILLINOIS.—Injury to Persons Near Track—Questions for Jury—Instructions—Motion in Arrest of Judgment.

1. Plaintiff was on a crossing near a sidewalk, beside a policeman, waiting to cross a street crowded with vehicles, when defendant's cars came around a curve at a speed of about six miles an hour, and the gripman, not seeing or not heeding the policeman's signal to stop, ran against a vehicle, throwing it against plaintiff, causing her injury. Held, that whether plaintiff was exercising ordinary care for her own safety, and whether defendant was negligent, were questions for the jury.

2. The refusal of an instruction limiting the damages alleged to have been sustained by plaintiff to a just compensation for the injury is not erroneous, where the court had instructed that no exemplary damages were allowable.

3. A motion in arrest of judgment, because of a defect in the record, in that the declaration was not filed ten days before the second term of the court at which the suit was begun, is properly overruled, where the declaration was filed before the date on which defendant was served with summons.—(Chicago City Ry. Co. vs. Roach, 54 N. E. Rep., 212.)

ILLINOIS.—Personal Injuries—Evidence—Instructions.

1. Where, in an action for personal injuries caused by plaintiff's wagon being struck by defendant's car, there was evidence that after the wagon was struck it was carried 70 to 80 ft. before the car could be stopped, and there was conflicting evidence as to the rate of speed at which the car was moving, the question whether the car was moving at a negligent rate of speed was properly left to the jury.

2. Where there is no evidence that defendant was negligent in any manner other than that charged in the declaration, and the jury were charged that the evidence must show that defendant was negligent as charged in the declaration, a charge to find for plaintiff if they found defendant negligent is not error, although it does not limit the negligence to that alleged in the declaration.—(West Chicago St. Ry. Co. vs. Musa, 54 N. E. Rep., 168.)

INDIANA.—Receivers of United States Courts—Action for Death of Husband—Damages—Instructions—Instantaneous Death—Survival of Cause of Action.

1. Under 25 Stat., 436, providing that every receiver of any property, appointed by any United States court, may be sued in respect to any act or transaction of his in carrying on the business connected with such property, without previous leave of the court in which he was appointed, but such suit shall be subject to the general equity jurisdiction of the court in which he was appointed so far as necessary to the ends of justice, an action can be maintained in the State courts against a receiver operating a railroad for negligence, without first obtaining leave from the United States Court appointing him.

2. Five thousand dollars is not an excessive verdict in favor of a widow for the wrongful death of her husband where he was in good health; fifty years of age; was at at the time of his death earning $1,150 per annum as United States postal clerk, which position he had held for seventeen years; left a wife and two children dependent upon him, nineteen and fourteen years old, and his expectancy of life was about twenty-one years.

3. In an action for wrongful death, it is not necessary to show that deceased would have been able to continue to earn what he was receiving at the time of his death, or what part of his earnings he expended for the benefit of his family, or what part of his time he spent with his family, or what part he took in raising and educating his sons, in order to entitle his widow to more than nominal damages.

4. In an action by a wife for the wrongful death of her husband, an instruction that she is entitled to recover for the pecuniary loss sustained by her is not erroneous, as being vague, in defining the damages to which she was entitled, in the absence of a request for more explicit instructions.

5. In an action under the statute, which provides that whenever the death of a person shall be caused by the wrongful act of another, and it is such as would, if death had not ensued, entitled the party injured to maintain an action and recover damages therefor, then the person who would have been liable if death had not ensued shall be liable to an action by the personal representative of deceased for the exclusive benefit of the widow and the next of kin, an instruction that plaintiff cannot recover if her intestate's death was instantaneous is erroneous, as the statute does not contemplate the survival of a cause of action which would otherwise abate with death, but creates a cause of action.—(Malott vs. Shimer, 54 N. E. Rep., 101.)

INDIANA.—Actions for Death of Child—Who May Sue.

Under Horner's Rev. St., 1897, Sec. 266, providing that a father (or, in case of his death, the mother) may sue for damages for injury or death of a child, a woman who is neither the mother of a child nor has legally adopted it cannot maintain an action for damages for its death, although she has raised it from infancy, and maintained and supported it as her child.—(Citizens' St. Ry. Co. vs. Cooper, 53 N. E. Rep., 1092.)

KANSAS.—Degree of Care—Injury to Passenger—Acts of Intermeddler—Negligence of Employee—Objections to Evidence.

1. A street railway company is bound to the highest possible caution and prudence in letting off its passengers at its stopping places, and its employees must not merely wait a reasonable time to enable the passengers to alight, without looking to see whether such has been done, but they must see and know that the passengers are safely off before starting the car in motion again.

2. When a street railway car is negligently started in motion before a passenger endeavoring to leave it has safely alighted from it, and while it is so in motion the passenger is seized with an attack of dizziness, which prevents him from holding on, and, in consequence, he falls off and is injured, the company is liable.

3. A street railway company is not responsible for injuries resulting from the act of an intermeddler in the running of its cars, which its employees could not foresee and guard against; but when such act of intermeddling consists in giving the signal to start the car in motion, and the conductor in charge, without seeing and knowing that a passenger has safely alighted before the car started, does not stop it as soon as can be, but allows it to continue in motion in obedience to the unauthorized signal, he will be held to have ratified and adopted the act of the intermeddler, and the company will be liable for the consequent injury as caused by an act of its employee's negligence.

4. If, by custom among street railway employees, known and assented to by the company, those who are on duty are in the habit of calling for and receiving assistance from those who are not at the time on duty, and an employee off duty, thus called upon, undertakes to render the assistance asked, he will be regarded as in the employ of the company for such service; and, if he negligently abandons the work before completing it, whereby injuries to a passenger occur, the company will be liable.

5. If, however, such custom does not exist, or, existing, is not known and assented to by the company, but an employee on duty deputes the one off duty to assist him, and he undertakes to do so, but negligently fails to fully perform it, whereby injury to a passenger occurs, the company is likewise liable, because of the negligent abandonment of duty by the employee directly chargeable with its performance.

6. When additional bodily injuries and damages resulting therefrom were not alleged in the plaintiff's petition, but evidence of them was received upon the trial without objection by the defendant, and upon which evidence the defendant cross-examined the witnesses giving it, an objection to it cannot be made for the first time by a request to instruct the jury to disregard it in making up their verdict.—(Leavenworth Elec. Ry. Co. vs. Cusick, 57 Pac. Rep., 519.)

MICHIGAN.—Crossing Street Car Tracks—Duty to Look—Contributory Negligence.

A woman, twenty-six years old, who has crossed street car tracks at the place where she is injured for about a year, and is familiar with the running of cars thereon, will be guilty of contributory negligence when she stands about six feet from the track to permit a car to pass her, and then passes behind the car and in front of a car on the other track, going in the opposite direction, by which she is injured, and there is a space of 5 ft. between the tracks, and no physical obstacle to prevent her seeing the approaching car if she looks after the first car passes.—(McCarthy vs. Detroit Citizens' St. Ry. Co., 79 N. W. Rep., 631.)

MINNESOTA.—Injury to Passenger—Evidence—New Trial.

1. On the evidence, held, that the St. Paul City Railway Company and the Minneapolis Street Railway Company were jointly operating the Interurban Line, partly owned by each, and connecting the two cities, and each one is liable for the acts and omissions of the other in operating the same.

2. Held, the uncorroborated evidence of the plaintiff on the vital and essential point in the case is so inherently unreasonable and improbable that the trial court abused its discretion in failing to grant a new trial.—(Messenger vs. St. Paul City Ry. Co., 79 N. W. Rep., 583.)

MISSOURI.—Harmless Error—Speed of Car—Ringing Bell—Negligence of Parents—Instructions.

1. Failure of a street car company to equip its car with a fender, which would have prevented the injury complained of, is not, in the absence of an ordinance or statute requiring it, negligence.

2. Where, on cross-examination, a witness for defendant says that he testified in a certain way before the coroner, and his testimony on the trial is substantially the same, it is harmless error to allow counsel for defendant to read his testimony before the coroner (Rev. St. 1889, Sec. 2303), providing that the Supreme or Appellate Court shall not revise a judgment unless it believes that the alleged error materially affected the merits.

3. In an action to recover for injuries alleged to have been caused by the negligence of defendant's motorman and conductor, it is competent for the motorman (who has been shown to be experienced), after testifying to what was done, to testify that there was nothing else that he could have done, under the circumstances, to prevent the injury, as such testimony does not preclude the jury from finding from the other testimony that he could have done something which he failed to do.

4. In an action to recover for personal injuries, plaintiff alleged that defendant was negligent in running its cars at a greater rate of speed than was permitted by an ordinance. The evidence disproved this allegation. Held, that the court properly took the question of negligence on account of the speed of the car from the jury, as plaintiff was not entitled to rely on common-law negligence as to its speed.

5. A complaint alleged that defendant was guilty of negligence in failing to ring the bell on its gripcar as it approached the crossing where the injury occurred. Plaintiffs witnesses testified that they did not hear the bell, but admitted they were not paying attention, while defendant's witnesses testified that the bell was rung twice, which was the usual signal at a crossing. Held, that an instruction, at defendant's request (plaintiff making none), that, if the jury found from the evidence that the gripman rang the bell as the train approached the crossing, it must find for defendant on that issue, is not erroneous.

6. It is not error to refuse to give an instruction, though it states the law correctly, where there is no evidence in the case on which to predicate it.

7. An instruction that defendant is liable, even though the parents of the child killed were negligent in permitting it to be on the street unattended, if the person operating defendant's car which killed it was negligent, and his negligence was the immediate cause of the injury, and by the exercise of ordinary care and precaution the injury might have been avoided, is properly refused because it excludes the principle that defendant would be liable if, after the discovery of the danger in which the child was, the exercise of ordinary care would have averted the injury, and it failed to exercise such care, or if it failed to discover the danger through its own recklessness, when by the exercise of ordinary care it could have discovered the danger and averted it, and because it makes defendant liable, if negligent, though the negligence of plaintiff contributed to the injury.—(Hogan et al. vs. Citizens' Ry. Co., 51 S. W. Rep., 473.)

MISSOURI.—Injuries to Passengers—Negligence—Riding on Footboard—Contributory Negligence—Instructions—Trial—Witnesses—Contradiction.

1. In an action against a street railway company for the death of a passenger, caused by collision between the car on which he was riding and a broken-down wagon on the track, there was evidence that the gripman was engaged in conversation with a passenger, and was not looking at the track ahead of him. Passengers on the train testified that they saw the wagon on the track when within 50 to 125 ft. from it, and the driver of the wagon and another testified that the driver had gone up the track about 60 ft. to warn the approaching car, but that the gripman paid no attention to him; the evidence being conflicting whether the car could have been stopped within 40 ft. or in not less than 75 ft. Held, that the question of the gripman's negligence was for the jury.

2. A passenger on a cable car notified the gripman of his intention to get off at a crossing, and preparatory to doing so stepped on a footboard running alongside the car on which persons getting off the car were obliged to step. The motorman failed to stop at the crossing, and stated he would let the passenger off at the next crossing, and thereupon the passenger remained standing on the footboard, though there were empty seats in the car, and, before reaching the next street he was killed by the car colliding with a wagon on the track. Held, that the passenger was not guilty of contributory negligence in remaining on the footboard while the car was going to the next crossing, the position not having been voluntarily assumed by him.

3. Nor was he guilty of contributory negligence in that he saw the obstruction which caused the injury on the track ahead of the car in time to have stepped back into his seat, and failed to do so, as he had a right to assume that he would be carried safely, and that the gripman would see the obstruction in time to prevent a collision.

4. A passenger confronted with sudden danger while on a car is not guilty of contributory negligence merely because he fails to exercise what might have seemed to others the best judgment in trying to avoid the danger.

5. In an action against a street railway company for the death of a passenger from injuries received while riding on a running board used to step on in getting on and off the car, an instruction that if the passenger voluntarily left his seat in the car to ride on the running board, and that he would not have been injured had he not been standing thereon, and if the position on the running board was an unsafe one for passengers, no recovery can be had, is properly refused, since it prohibits a recovery notwithstanding the carrier's failure to exercise the greatest care to carry him safely, though he had voluntarily assumed an unsafe position.

6. In an action for the death of a passenger from injuries received while riding on a car, an instruction that if the passenger voluntarily left his seat, and took up the position in which he was injured, and that he would not have been injured had he remained in his seat, no recovery can be had unless the person in charge of the car saw him in his position of danger in time to have prevented the injury, is properly refused, as it assumes that the position which the passenger took was dangerous as a matter of law, and that no recovery could be had, though the injury was caused by the negligent management of the train.

7. A witness cannot be contradicted by proof that on a prior occasion he expressed an opinion at variance with the facts testified to by him.

8. In an action for the death of a street car passenger from injuries caused by the car in which he was riding colliding with an obstruction on the track while the passenger was riding on the footboard of the car preparatory to getting off, the charge being negligence, in that the collision could have been avoided with ordinary care, an instruction that the carrier is liable if the injury was the result of even slight negligence in the management of the train, is not erroneous as enlarging the issues.

9. A street railway company is bound to exercise towards its passengers the utmost care and diligence of a very cautious person, and an instruction that it will be liable if its servants are guilty of even slight negligence is proper.

10. In a negligence case the court need not, in its charge, define the word "negligence."

11. In an action for the death of a street car passenger, caused by the car in which he was riding colliding with a wagon, an instruction using the term, "a broken-down wagon and obstruction which was at said time upon and in close proximity to the tracks," is not erroneous as assuming that there was a broken-down wagon on the track, where the evidence shows that part of the wagon extended over one of the rails for a distance of one foot.

12. Nor is such an instruction erroneous where the carrier has requested an instruction, assuming that there was an obstruction on the track, thereby conceding the fact.

13. In an action for the death of a passenger caused by the car in which he was riding colliding with an obstruction on the track, an instruction that the carrier is liable if its servants in charge of the car saw the obstruction in time to stop the car and avoid the danger, or could, by the exercise of the care required of them, have seen it in time to stop the car, followed by an instruction as to the degree of care required of a carrier, is not erroneous as requiring the carrier's servant to stop the car when he saw the obstruction, though too late to avoid the injury.—(Sweeney vs. Kansas City Cable Ry. Co., 51 S. W. Rep., 682.)

NEW YORK.—Appeal—Review—Questions Considered.

1. In an action by a husband for the loss of his wife's services through injuries received by her, the husband cannot for the first time on appeal raise the question that the joint negligence of the wife and defendant cannot defeat his rights.

Crossing Accidents—Contributory Negligence.

2. The question whether a person run over by a street car at a crossing was guilty of contributory negligence is for the jury, where it appears that, before stepping into the road, she looked in both directions for approaching cars, and then walked fast towards the other side of the street, and stepped on the track on which she was struck, without again looking.—(Hickman vs. Nassau Elec. R. R. Co., 58 N. Y. Suppl., 858.)

NEW YORK.—Injury to Passengers—Defects in Roadbed—Notice.

1. A passenger was injured in alighting from a street car by the giving way of the roadbed, which was elevated, the street having been cut down to a lower level. The proof did not show by whose agency the street was lowered, but similar accidents had happened to passengers alighting from defendant's cars in that vicinity. Held, that, even if defendant was not responsible for the lowering of the street, it was bound, knowing the defective condition of its roadbed, to inform passengers about to alight thereon that they could not safely do so.

Same—Exercise of Due Care.

2. While a street railway company may not be obliged to furnish a passenger a safe place to alight from its cars, where they are stopped not at a regular stopping place at his instance, yet, if it has provided any portion of its roadbed as a place for passengers to alight, it must exercise reasonable care to keep that particular place safe for the purpose.—(Flack vs. Nassau Elec. R. Co., 58 N. Y. Suppl., 839.)

NEW YORK.—Master and Servant—Personal Injury—Negligence of Co-Employee.

1. Two bobtail horse cars, each in charge of a driver, met on the same track. At the request of one of the drivers, a boy about twelve years of age got on the rear platform of his car, which was a safe place, to drive the horse back to a switch, while the driver took charge of the brake at the other end. It was necessary for the driver to get some one to assist him, as there were no other employees of the company in the vicinity. Other boys boarded the car, and the driver pretended he was coming through it to catch them, whereupon they scrambled off, and pushing the boy who was driving off the the platform, he fell under the car and was injured. Held, that, assuming that the boy was an emergency employee, and that his injury was due to the negligence of the driver, he and the driver were co-employees, and the railway company was not liable.

Trespasser on Street Car—Personal Injury—Company's Liability.

2. A boy boarded a bobtail car, at the request of the driver, to drive the horse attached to the hind platform back to a switch, while the driver attended to the brake at the other end. Other boys boarded the car, and, on the driver pretending he was coming through to catch them, they scrambled off, and, pushing the boy driving off the platform, he fell under the car and was injured. Held, that, assuming that he was a trespasser, the company was not liable, since the driver could not have foreseen that the injury would result from his act, and hence it was not the proximate cause thereof.

Passenger for Hire.

3. A boy about twelve years old, at the request of the driver in charge of a bobtail street car, which met on a single track, got on the rear platform, to which the horse was hitched, and drove back to a switch, while the driver attended to the brake. Held, that he was not a passenger for hire, and that the railway company was not liable for an injury caused by the negligence of the driver.—(Marks vs. Rochester Ry. Co., 58 N. Y. Suppl., 210.)

NEW YORK.—Injuries to Passengers—Negligence—Evidence.

In an action for injuries received in alighting from a street car, plaintiff testified that the car suddenly started as she was attempting to take hold of a brass rail on the car to aid her in getting off, thereby throwing her to the ground. The conductor and two disinterested witnesses testified that, while the car was still in motion, plaintiff, though told by the conductor to wait until it stopped, got off, and was thrown to the ground. Held, that a finding that plaintiff's injuries were caused by starting the car too

soon, was against the weight of the evidence.—(Ormond vs. Metropolitan St. Ry. Co., 58 N. Y. Suppl., 335.)

NEW YORK.—Injury to Passenger.

A verdict for plaintiff in an action against a street car company for injuries alleged to have been received by the car starting while she was alighting at a street crossing is not conclusive, but will be set aside, as against the weight of the evidence, where the uncorroborated evidence of plaintiff that the car started while she was alighting was contradicted by the conductor, gripman and two disinterested witnesses, who testified that the accident happened north of the crossing, and that plaintiff alighted from the car before it came to a stop.—(Connor vs. Metropolitan St. Ry. Co., 58 N. Y. Suppl., 340.)

NEW YORK.—Injuries to Passengers—Evidence.

Plaintiff testified that a street car was started after it had stopped, and after he had a foot on a step, and he was thrown into an excavation and injured. A person on the opposite side of the street partially corroborated and partially contradicted plaintiff's testimony. Six other persons who were near the place of the accident, two of whom were disinterested passengers, testified that the car did not stop at all, and that plaintiff fell into the excavation before he touched the car. Held, that a judgment for plaintiff was not sustained.—(Hansen vs. Third Ave. R. Co., 58 N. Y. Suppl., 282.)

NEW YORK.—Railroads—Turnouts—Right to Construct.

1. A city deeded a strip of land in a street to a railroad company and its lessees, successors and assigns, with the right to use it for the purposes of tracks and turnouts in the same manner as on land ceded by it to the city. A successor of such company leased such strip to another, whose charter authorized it to maintain a railroad with necessary appendages. Held, that the lessee company could construct a necessary turnout from its tracks on such strip to a freight yard situated near it.

Same.—Right to Connect—Intersection.

2. Under laws 1890, chap. 565, sec. 4, subd. 5 (laws 1875, chap. 606, sec. 26, subd. 3), authorizing any corporation formed thereunder to join or unite its railroad with any other railroad before constructed at any point on its route, the two roads need not actually intersect in order that a connection be authorized.

Street Railroads—Elevated Railroad—Right to Connect.

3. Laws 1839, chap 218, re-enacted in laws 1890, chap. 565, sec. 78, makes it lawful for any railroad corporation to contract with any other railroad corporation for the use of their respective roads, or any part thereof. Laws 1875, chap. 606, sec. 26, subd. 3 (laws 1890, chap. 565, sec. 4, subd. 5), which contemplated the construction of elevated street railroads, provides that any corporation formed thereunder may join or unite its railroad with any other railroad before constructed at any point on its route, and upon the grounds of such other road; and sec. 26, subd. 5, prohibits any elevated railway company formed under the act from using or occupying any streets except those designated for its route. Laws 1890, chap. 565, sec. 129, prohibits any such company from constructing a street surface railroad. Held, that an elevated railroad company could connect with a surface railroad company, and that they could agree for the use of each other's tracks, the connection being entirely on the latter company's land.

Railroads—Viaduct—Right to Connect.

4. Where a city deeds a railroad company a strip of land in a street for the purpose of railroad tracks and turnouts, to be used and traveled over by cars and locomotives and otherwise, in the same manner as the tracks on land ceded by the company to the city, the company may construct a viaduct on such land to connect with an elevated railroad.

Same.—Connecting with Freight Yards.

5. Such company may also, by another viaduct, connect such viaduct with its freight yards, situated near such land.

New York City—Connection of Railroads—Consent of Assembly.

6. The granting of permits by the Highway Commissioner of New York City to an elevated and a surface railroad to connect their tracks by a viaduct so as to enable each to operate its cars on the tracks of the other, does not create a new franchise, so as to require the consent thereto of the Municipal Assembly, under sections 72-74 of the charter.

Same.—Authority of Highway Commissioners.

7. Under New York charter, secs. 524 and 525, giving the Commissioner of Highways cognizance and control of the laying or relaying of railroad tracks in the streets, and providing that there shall be no disturbance of the street except with his permission, he has authority to permit an elevated railroad to connect with a surface road under an agreement for the use by each of the other's tracks.—(Gallagher vs. Keating et al., 58 N. Y. Suppl., 366; affirmed on appeal, 57 N. Y. Suppl., 632, 1123.)

Further Progress Towards Standardizing Street Railway Reports

The following is a copy of the report made by C. N. Duffy, chairman of the Committee on a Standard System of Street Railway Accounting of the Street Railway Accountants' Association of America, to President Calderwood covering the action taken at a meeting of the representatives of several railway accounting associations, held in New York City, July 11:

St. Louis, July 21, 1899.

John F. Calderwood, Esq., president of the Street Railway Accountants' Association of America, Minneapolis, Minn.:

Dear Sir.—In response to the invitation of Wm. O. Seymour, of the Board of Railroad Commissioners of the State of Connecticut, to attend a meeting at the Manhattan Hotel, New York City, on July 11, 1899, to confer with the committee representing the National Association of State Railroad Commissioners, and a committee representing the Association of American Railway Accounting Officers, for general discussion upon the subject of a classification of construction and operating expenses of street railways, I beg leave to report that Wm. F. Ham and myself attended this meeting, representing the Street Railway Accountants' Association of America.

The following gentlemen were present at the meeting: Wm. O. Seymour, member of Board of Railroad Commissioners of the State of Connecticut, and chairman of committee on classification of construction and operating expenses for street railways; Ashley W. Cole, chairman Board of Railroad Commissioners of State of New York, and a member of Mr. Seymour's committee; H. M. Kochersperger, Comptroller, New York, New Haven & Hartford Railroad Company, and a member of committee representing American Railway Accounting Officers Association; J. D. Greene, Auditor of Disbursements, Pennsylvania Railroad Company, and a member of committee representing American Railway Accounting Officers Association; Wm. F. Ham and C. N. Duffy, representing Street Railway Accountants' Association of America, and H. T. Billings, clerk, Board of Railroad Commissioners, State of Connecticut.

After a morning and afternoon session, in which was discussed the report of our committee made to the Street Railway Accountants' Association of America, at its second annual convention in Boston, the following modifications and changes were uanimously agreed to by all the gentlemen present:

1st. The sub-heading "Car Service" under "Transportation," which includes operating expense accounts numbers 16 to 24, was changed to "Operation of Cars."

2d. Account No. 8, "Maintenance of Miscellaneous Equipment." In the second paragraph the phrase: "Repairs and renewals of all harness should be charged to this account," should be followed by: "The cost of replacing horses lost by death or worn out in service, and the depreciation in the value of horses should be charged to this account."

3d. Account No. 30, "Stable Expenses," which now reads: "Charge to this account the cost of feed, keep and shoeing of horses, replacing horses lost by death or worn out in service, depreciation in value of horses, and all other stable expenses," should be changed to read: "Charge to this account the cost of feed, keep and shoeing of horses, and all other stable expenses." A fourth paragraph should be inserted, to read: "The cost of replacing horses lost by death or worn out in service, and the depreciation in the value of horses, should be charged to account No. 8." This will necessitate a change in the printed report as it appears on page 35.

4th. The number of operating expense accounts is to be thirty-eight, Nos. 1 to 38 inclusive, account No. 39, "Taxes," is to be eliminated from operating expense accounts and classified as a "Deduction from Income."

This will necessitate a number of changes in phraseology, punctuation, etc.

5th. In the monthly and annual reports, under "Deductions from Income," the first item is to be "Taxes."

After the modifications and changes referred to above were unanimously agreed to by all of the gentlemen present, Mr. Seymour announced that at the annual meeting of the National Association of Railroad Commissioners, to be held in Denver, Aug. 11, 1899, his committee would report to the convention, recommending the adoption and use of the standard system of street railway accounting adopted by the Street Railway Accountants' Association of America, with the modifications and changes as agreed upon, which he would have embodied in his report, and that he was confident that his association would unanimously

adopt the report as presented. Mr. Seymour stated that he would have at least 200 copies of the system printed, containing the modifications and changes as agreed upon, together with blank reports printed to conform thereto, and that he would have the street railways of the State of Connecticut make their annual reports for the fiscal year beginning in 1900, on these new forms.

Mr. Kochersperger and Mr. Greene, representing the American Railway Accounting Officers' Association, stated that they would report to their association at its next annual convention, to be held in May, 1900, the result of this conference, and they would recommend the adoption and use of the street railway accounting system, with modifications and changes as agreed upon.

Mr. Ham and myself, on behalf of the committee representing the Street Railway Accountants' Association of America, agreed to all the modifications and changes that were made, and stated to the gentlemen representing the other two associations that we would present a report at the next annual convention of our association, to be held in Chicago in October, 1899, embodying what was agreed upon, and assured the gentlemen that we were confident that our association would sustain us in what we had done.

Through the co-operation of the various associations represented at the New York conference Mr. Ham and myself are satisfied that the standard system will be used by all of the street railway companies of the United States, and that a uniformity of methods and results, which has been so much desired, and for which we have so earnestly labored, will now be attained.

In explanation of the modifications and changes that were agreed to I beg leave to submit the following:

1st. As to changing the title of the sub-heading "Car Service" from "Car Service" to "Operation of Cars," Mr. Kochersperger and Mr. Greene stated that the title "Car Service" would conflict with a technical term used in the operation of steam railroads, and with an account that steam railroads carried on their books, which represents a car mileage account, as I understand it. In addition, it was suggested by the gentlemen that the title of the sub-heading "Operation of Cars" was preferable to "Car Service," and was in uniformity with the title of the first sub-heading under "Transportation," "Operation of Power Plants." Mr. Ham and myself readily agreed to this suggestion, and we both considered not only the objection to the other title well founded, but the name of the new title an improvement over the old.

2d. As to transferring from account No. 30, "Stable Expenses," to account No. 8, "Maintenance of Miscellaneous Equipment," the cost of replacing horses lost by death or worn out in service, and the depreciation in the value of horses, Mr. Kochersperger and Mr. Greene criticised the action of our committee in classifying this item as a "General Expense" account, for the reason that they thought that the cost of maintaining horses was a maintenance charge, and should be classified under the same account that carried the cost of maintaining the wagons and horses. They pointed out that the wagons, harness and horses were one, in the sense that the wagons and harness were useless without the horses, and that, in their opinion, account No. 8 should carry the cost of maintaining wagons, harness and horses, in order to have the classification consistent. In this, Mr. Ham and myself thought that unquestionably they were correct.

3d. As to eliminating account No. 39, "Taxes," from "Operating Expense" account, and classifying same as a "Deduction from Income," in view of the fact that under the Inter-State Commerce Classification of Accounts, the universal standard followed by steam railroads, and the position taken by all of the boards of railroad commissioners throughout the United States that exercise any supervision over the books and accounts of street railways, to consider "Taxes" as a "Deduction from Income," and not as an "Operating Expense Account," and, for the sake of bringing about a uniformity of methods and secure the co-operation of the National Association of State Railroad Commissioners and the Association of American Railway Accounting Officers, all of the gentlemen representing these two associations being firmly fixed in their opinion that "Taxes" should not be a part of the operating expenses of railroads, Mr. Ham and myself agreed to change our classification of operating expense accounts to conform with theirs.

A copy of this report will be sent to each of the gentlemen who attended the meeting at the Manhattan Hotel, New York City, July 11, 1899; to the two members of the committee of the Street Railway Accountants' Association, besides yourself, who were not present at the meeting; to the secretary of our association, and also to the two honorary members of our association, H. H. Windsor, of the "Street Railway Review," Chicago, and E. E. Higgins, of the STREET RAILWAY JOURNAL, New York, as both of these gentlemen are deeply interested in the subject, and will no doubt give our association the benefit of the columns of their papers to further the work of our committee.

I trust that what was accomplished at the meeting and the action taken by Mr. Ham and myself will be endorsed and approved by the other members of our committee, as well as ratified and confirmed by our association at the next annual convention.

Very respectfully,

C. N. DUFFY,

Chairman of Committee on Standard System.

Proposed Solution of Municipal Franchise Problems

The following extract from Allen Ripley Foote's new work upon "Municipal Public Service Industries" is worthy the attention of street railway managers as a proposed equitable solution of the way in which to carry on public service industries with private capital in the interests of the municipality:

Franchises should be granted to municipalities by a general State law, uniform in its provisions for every town and municipality. This law should constitute every incorporated town and city a legal corporation for the purpose of rendering industrial public services, and clothe them with power to own and operate in the name of and for the benefit of the municipality and of its inhabitants, one or all public service industries, when ever such a policy is determined upon by a majority vote of all registered municipal voters.

This law should require:

1. That every public service industry owned by a municipality shall be owned and operated as a monopoly in order to secure for the people all benefits derivable from natural monopolies.

2. That municipalities deciding to transfer a public service industry from private to public ownership shall take possession of all existing property, by whomever owned, then being used for the purpose of rendering such service, under proceedings for the exercise of the right of eminent domain, or by arbitration, if so mutually agreed upon with the owners of said property.

3. Municipal authorities to dedicate public possessions to and to take private property for the special use required for the effective rendering of the service, and to adjust the distribution of special burdens or benefits created thereby, by an assessment of damages or benefits on the private property affected, as for other public improvements.

4. The taxation of all private and public users of the service on the basis of the cost of service used plus such profit, if any, as the Municipal Council may determine; and that no service shall be furnished to a public or private user free of charge, or at a price less than the full and entire costs of ownership and operation.

5. Every municipality to include in all statements of cost made to determine the price to be charged to public and private users for service rendered:

(a) Interest on the entire investment at the rate paid by the municipality on its bonded debt.

(b) The cost of insurance against loss by accidents of all kinds.

(c) The value of municipal taxes relinquished by reason of municipal ownership.

(d) The amount of State taxes paid.

(e) The cost of insurance against the impairment of investments by reasons of depreciation from use and improvements in mechanical arts.

(f) The cost of all material consumed.

(g) The cost of all salaries and wages paid for administration and operation.

(h) The cost of all sundry expenses not otherwise classified and included.

6. An addition to cost, for the purpose of determining selling price, of a sufficient annual provision for a sinking fund to fully pay at their maturity all bonds issued on account of the industry.

7. All municipalities to keep books for each public service industry owned and operated by them, in the form prescribed by the State, and to subject the same to an audit whenever required by the duly authorized officer of the State.

8. The creation of a competent *Board of Municipal Regulation*, which shall have immediate supervision of and be responsible to the Municipal Council for details of administration and operation. Said board shall determine all qustions of engineering, mechanical and operating details, and shall report to the Municipal Council at stated periods all information necessary for its guidance in deciding questions of public policy pertaining to the service.

9. All employees shall be protected in their right to employment by civil service regulations, which shall provide that no employee shall be discharged without cause, set forth in a written statement signed by the officer ordering the discharge, and after a proper opportunity to be heard in his own defence.

10. The Municipal Council shall determine the rates to be charged public and private users for services rendered to them, for periods of five years, and shall provide that all services rendered to any municipal department, or to the municipality in any way, shall be estimated and paid for at a fixed price, out of appropriations for such department, or for the general expense of the municipality.

11. The Municipal Council, on the recommendation of the Board of Municipal Regulation, may lease to a private person, partnership or corporation the municipal franchise and property then used for the purpose of a public service industry owned by the municipality on terms that will secure to the municipality all the benefits of municipal regulation provided for in the act, and the additional advantages of employing private capital, for which interest on the entire investment shall be paid at the same rate per cent as the municipality is at that time paying on its bonded debt, and all responsibility and risks of management to be assumed by the lessee, in consideration of the determination of rates for periods of five years, to be charged by said lessee for services to be rendered to public and private users, on the basis of cost as herein provided, plus a profit calculated at twice the rate per cent of interest then paid by the municipality on its bonded debt, such lease to terminate at the expiration of any period of five years, at the option of the municipality.

12. To reimburse the State for the loss of taxes relinquished by municipal ownership and for the expense of supervision and auditing municipal public service accounts, and for the publication in an annual volume by the State, which is hereby required, in form to facilitate reliable comparisons, of the reports of all municipal public service industries, each municipality shall pay to the State an annual tax of 1 per cent on its gross receipts from the sale of service to public and private users.

These requirements are designed to develop the highest attainable degree of efficiency for municipal governments, the agent to which the people must intrust the administration of their public service industries when they adopt the policy of municipal ownership and operation.

It is only through expert and honest management, the just individual distribution of the burdens of providing the required investment, and of the costs, responsibility and risks of ownership and operation, and by the just distribution of benefits collectively earned, that the people can hope to realize from municipal ownership and operation the full measure of the advantages they seek.

NEWS OF THE MONTH

The Manhattan Railway Company, of New York, has purchased about 120 lots just north of its present terminus at 177th Street and the East Side. It is not known whether this foreshadows the extension of the elevated system to Fordham or the establishment of new storage and repair yards and shops.

Recent newspaper reports to the effect that the General Electric Company was to engage in the automobile business and move a large portion of its Schenectady plant to Lynn are authoritatively denied, and the report that large steel works are to be established at Lynn for the manufacture of castings is pronounced premature.

The organization of the National Tube Company, a consolidation of the wrought iron, steel tube and pipe industry of the United States, was completed on July 12. The required capital was furnished by J. P. Morgan & Company and their friends. Twenty-one companies operating in New York, Pennsylvania, West Virginia and Ohio are included in the combination, and their combined output at present is about 1,100,000 tons of all classes of tubular goods per annum. The capital stock is $80,000,000, of which half is to be 7 per cent preferred stock, and half in common stock. The officers are: President, Edmund C. Converse; chairman of the board, Joshua Rhodes; first vice-president (in charge of manufacturing), F. J. Hearne; second vice-president (in charge of mercantile affairs), Horace Crosby; third vice-president (financial), Francis L. Potts; general manager (manufacturing department), A. S. Matheson; treasurer, Arthur F. Luke; assistant treasurer (at Pittsburgh), William H. Latshaw; general counsel, Sullivan & Cromwell.

The second annual meeting of the Pacific Coast Electric Transmission Association was held at San Francisco, Cal., on June 20 and 21, 1899. Prominent electrical transmission engineers were present from all parts of the Pacific Coast, and a valuable discussion of this subject took place. Papers were read as follows: "Tests and Calculations for a Forty-Mile Aluminum Wire Transmission Line," by F. A. C. Perrine, of Stanford University; "Electric Lighting vs. Gas," by John Martin, president of the Yuba County Power Company; "Regulation of Alternating Current Generators," by C. L. Corey, of the University of California; "Electrically Driven Centrifugal Pumps," by L. A. Hicks, of the Bakersfield Gas & Electric Company, and "Prices for Current Supply," by C. W. Hutton. Officers for the ensuing year were elected as follows: President, Prince A. Poniatowski, of the Standard Electric Company, of California, with headquarters at Stockton, Cal.; vice-president, A. G. Lamson, of Salt Lake City, Utah; secretary, George P. Low, of the Journal of Electricity; treasurer, William Angus.

The New York & Long Island Terminal Railway Company, which has asked for franchises to construct a tunnel railway to be operated by electricity, under the East River, has elected the following officers: President, W. H. Baldwin, Jr.; vice-president, C. M. Pratt; treasurer, A. C. Bedford, secretary, George D. Pratt. All of these gentlemen are connected with the Long Island Railroad.

The new contract between the Twin City Rapid Transit Company, of Minneapolis, and the United States Government for carrying the mails gives the company $1,666.35 per year, which is at the rate of three cents a car mile for the 53,545 miles traveled by the mail carrying cars between Minneapolis and St. Paul, in the course of a year. The company is also to receive $975.02 for carrying mail in Minneapolis. The new agreement is for four years.

At a recent meeting of the Massachusetts Electric Companies the following officers were chosen: President, Amos F. Breed; vice-president, Charles E. Cotting; secretary, Everett W. Burdett; treasurer, J. H. Goodspeed. Executive committee will consist of Gordon Abbott, Charles Francis Adams, 2d; E. N. Foss, Percy Parker and Philip L. Saltonstall. P. F. Sullivan will be general manager.

President Gould, of the Manhattan Railway Company, has authorized the statement that his company has secured a location for its power house at Seventy-fourth and Seventy-fifth Streets and the East River. The plot has a frontage of 204 ft. on the river and 570 ft. on the side streets. It is also announced that the contract for 9000 tons of rail to be used as the third rail conductor, and weighing 100 lbs. per yard, had been given to the Lackawanna Steel Company, the material to be delivered in September. Bids have also been asked for and received from the leading engine and boiler manufacturing companies in the country for the necessary power station equipment. No decision has been reached as to the electrical equipment. W. E. Baker, the electrical engineer of the company, is at work upon the various problems connected with the change of motive power on the system.

What is probably the largest order for steel rails ever given at one time has been placed with the Carnegie Steel Company by the Russian government. The order is for 180,000 tons of steel rails, to be delivered within twenty-six months, and it is said the price is the highest quoted this year, and was not less than $25 per ton at the mill.

As announced first in these columns some time ago, Jesse Spalding has been elected president of the Chicago Union Traction Company. The new general manager will be John M. Roach, for many years vice-president and general manager of the North and West Chicago systems. Louis Owsley, formerly secretary and treasurer of the West Chicago Street Railroad Company, has been elected treasurer of the consolidated properties, and J. Charles Moore, formerly secretary and treasurer of the North Chicago system, has been elected secretary. F. E. Smith, until now with the Lynn & Boston Railroad system, has, as previously announced, become general auditor of the consolidated properties.

The Electric Vehicle Company has placed an order for 4200 electric automobiles with the Columbia & Electric Vehicle Company. The contract amounts to over $8,000,000.

A regular service from the New York end of the Brooklyn Bridge to Coney Island has been instituted on the Fifth Avenue branch of the Brooklyn Union Elevated Railroad Company. From the bridge to Twenty-fifth Street the trains are run by the Sprague multiple unit third-rail system. Each train consists of a motor car and two trailers. The trail cars are equipped with motors and an overhead trolley pole. On reaching Twenty-fifth Street the trains are broken up, and the trail cars proceed to Coney Island as independent motors, taking their current from an overhead wire.

The property of the King's County Elevated Railway Company, of Brooklyn, was sold on July 7, as originally advertised, although on July 6 it was announced the sale would be postponed for twenty days, owing to a restraining order secured by the New York Bank Note Company. At the last moment, however, an agreement with the Bank Note Company was effected, and the sale proceeded. The property was purchased by the reorganization committee. Immediately after the transaction a new company was incorporated at Albany under the name of the King's County Elevated Railroad Company, to take over the road. The capital stock of the new company is $8,800,0000, of which $2,800,000 is 5 per cent preferred and $6,000,000 common stock. The incorporators are E. Mora Davison, Wilton C. Percy, Charles H. Werner, George S. Bonner, Walter F. Wood, Adolph Frank and William J. Cahill, of New York city, and John L. Wells and Benedict Hamburger, of Brooklyn. It is stated that two-thirds of the stock of the King's County Elevated Railway Company will be exchanged for securities of the Brooklyn Rapid Transit Company at once. As soon as this is done, the electrical equipment of the road with the third-rail system will be completed as rapidly as possible.

Owing apparently to worn or defective feeder cables on the section of the Union Loop, of Chicago, the positive side of the circuit became grounded a few days ago, and traffic was stopped for more than an hour, while brilliant displays of electric fireworks were made on the structure. It took some time to locate the defective cable. Meanwhile, the South Side trains were switched back at their old terminus at Congress Street, and the Lake Street and Metropolitan roads were gradually put into service about half an hour apart. No serious damage was done.

The Rochester Railway Company has built a new mail car, modeled after somewhat different lines from the mail cars formerly in operation on that road. The old style cars had the doors at the ends, but in the new type the doors have been placed in the center of each aisle, this being done to prevent the motorman or conductor from gaining admission to the sorting department.

In a recent interview Charles T. Yerkes, of Chicago, stated that his plan is not to desert Chicago, but to give his active attention to the development of suburban and elevated transportation business, the former through the Chicago Consolidated Street Railway Company, and the latter through the interests which he still holds in the Lake Street and Northwestern Elevated Railways.

The Corporation Counsel of Illinois announces that he has discovered that the statutes of Illinois contain a franchise tax law as sweeping in many particulars as the provisions of the new Ford law of New York State.

At the weekly meeting of the Manhattan Railway Company, held on July 11, it was decided to place a contract with the E. P. Allis Company, of Milwaukee, for eight 8000-h.p. engines capable in the aggregate of developing 100,000 h.p. It is stated that the price paid is above $1,000,000. The contract will be drawn and executed as soon as possible.

The Montreal Street Railway Company was recently fined $2 and costs for permitting two of its cars to become overcrowded in violation of a city ordinance.

The Coney Island & Brooklyn Railroad Company has renewed the existing contract and agreement between itself and its employees for another year, or until July 1, 1900. The employees express themselves as satisfied with the treatment they have received and the best of feeling evidently exists.

The Ashtabula Rapid Transit Company has reduced the working hours per day of all its men from sixteen to eleven hours. The employees will receive the same pay as before.

It is probable that within a short time a stable trolley car will be put in operation in Detroit, for the purpose of moving valuable race horses from the railroad stations to the training stables at the race track in the suburbs of the city. The inside of the car will be padded, and each end will be divided into three stalls, making accommodations for six horses. The doors will be at the side, and it is probable the upper parts of the sides of the car will be formed of slats, so as to give good light and ventilation.

The new office building of the Philadelphia & Westchester Traction Company, at Llanarch, is now completed and ready for occupancy. The building is 32 ft. x 45 ft., built of brick with slate roof, and is very artistic in appearance. It contains, in addition to the superintendent's office, a spacious waiting room for patrons of the road, and a room for the use of the motormen and conductors, the latter being provided with lockers, in which the men can keep their uniforms, etc., if they so desire. This room also contains a table with magazines and periodicals. The basement of the building will be used as a storage room for electrical supplies.

The general offices of the Chattanooga Electric Railway Company have been moved from the Market Street car shed to the new transfer station between Fourth and Fifth Streets, on Market Street. The company is engaged in making extensive improvements in its system, and is adding a number of handsome cars.

The Fort Wayne Street Railway Company maintains a swimming pool at Robinson's Park, which is controlled by the company. Hans Reitdard, while swimming with other boys, dove against a stump concealed in the pool, and was so severely stunned as to cause him to drown. His mother brought suit for $10,000 against the company, alleging carelessness in not removing the obstruction, and that by reason of such negligence her son's death occured. The case was tried at Auburn, and the jury, after being out two days, awarded her $500 damages.

The Marion County Tax Board has fixed the assessment of the reorganized Indianapolis Street Railway Company at $3,000,000. General Manager McGowen claimed that in view of the heavy drain on the company by the cost of improvement, together with the direct tax of $30,000 a year to the city, the assessment was too large. He says he will go before the State Board of Tax Review and ask for a reduction. The county board fixed the company's assessment last year at $2,200,000, and the State board raised it to $3,000,000.

The Boston Elevated Railway Company has placed a contract with the Westinghouse Electric & Manufacturing Company for a 4000-h.p. generator, to be installed at Lincoln's wharf.

The Massachusetts Electric Companies have leased the eight-story building at 14 Kilby Street, Boston, and will occupy the premises at once as a general office.

The cars of the New York & Queens County Railway Company, of Long Island City, carry large colored placards showing the right and wrong way to alight from the car. At one side of the card is pictured a young lady in the act of stepping easily to the ground with her face toward the motorman; at the other is a stout dame in the act of turning a somersault on the pavement, with her packages flying in all directions. The lettering accompanying the pictures reads simply: "How to Get Off and How Not to Get Off a Trolley Car." It is thought these signs have prevented numerous accidents.

A car belonging to the Brooklyn Rapid Transit Company was nearly destroyed by fire on July 15. A short circuit caused the flames.

A short circuit burned out one of the transformers in the big electrical power houses in Buffalo Avenue on July 15. The flame communicated to a small tank on the subway floor that supplies oil to the machinery. It took the firemen an hour to extinguish the blaze. The transformer that was burned supplied power to the Buffalo & Niagara Falls Railway, the Gorge Road and the Niagara Falls & Suspension Bridge Road. Cars on these lines were stalled for two hours. The loss, it is stated, will be large.

The State Railroad Commissioners of New York have authorized the Long Island Railroad to discontinue eleven stations in Brooklyn, where the traffic has been nearly all taken away by electric and elevated cars running in the streets. A new station will be established to take the place of three others that are to be discontinued.

The Columbus (Ohio) Street Railway Company has decided on a profit sharing distribution to employees in the same proportion that stockholders receive. The only stipulation is that employees must have been in continuous service for six months. The company has just declared a quarterly dividend of 1 per cent.

The wages of the laborers employed by the Columbus Street Railway Company in relaying its tracks have been increased twenty-five cents per day.

The Cincinnati Street Railway Company will divide among its motormen and conductors about $10,000 as a 5 per cent dividend, thus enabling the employees to share in the profits of the past year.

In order to prevent accidents due to persons putting their heads out of car windows and coming in contact with poles and other obstructions near the track, the Twin City Rapid Transit Company is putting netting in all the windows of its closed cars, along the side nearest the centre of the street.

To encourage pleasure riding the Janesville Street Railway Company, after seven o'clock every evening during the warm weather, will carry passengers around the entire system for five cents, provided they do not leave the car. The same ride usually costs ten cents.

The Columbus Street Railway Company has published a very artistic guide to the city of Columbus. This contains a number of splendid engravings, and tells how to reach all points of interest.

Hambleton & Co., of Baltimore, and New York capitalists are about to complete plans for a purchase and consolidation of the street railways of Chattanooga and the two incline roads to the summit of Lookout Mountain. It is estimated that the deal will involve about $800,000.

The "Leader," of Marion, gives the following list of proposed electric railways to be built in Indiana this season: Indianapolis Street Railway Company will build a line from that city to Greenfield; an electric line from Hartford City to Indianapolis, passing through Noblesville. This road is to be built the coming summer. It will be 46 miles long, and estimated to cost between $300,000 and $400,000; an electric line from Evansville to Rockport, Tell City and Cannelton; an electric line between New Castle and Indianapolis; an electric line between Richmond and Eaton, Ohio; an electric line between Richmond and Muncie; an electric line between Columbus and Terre Haute; an electric line between Ft. Wayne and Indianapolis; an electric line between Aurora and Rising Sun; extension of the Monon from Greencastle to the Indiana coal fields; an electric line to connect Garret, Auburn, Waterloo, Ashley, Hudson, Pleasant Lake, Angola and Ft. Wayne.

The Mayor of Minneapolis has vetoed the ordinance passed recently by the City Council authorizing the Twin City Rapid Transit Company to run through fast cars between Minneapolis and St. Paul. It was the intention to build side tracks along the line and place in service a number of special cars that would make the trip without stops and reduce the running time twenty-four minutes. The fare was to have been fifteen cents on these fast cars instead of ten cents, the regular fare. The Mayor in his veto message said: "There is little doubt that such a fast service as is here proposed would be a convenience, and were the interests of all the citizens properly guarded, there could be no objection to it. In its present form, however, the ordinance is open to the objection that it contemplates a backward step in the relation of public service corporations and municipalities. This is especially apparent when the municipality volunteers an advance in fares in the absence of a showing of loss, or even a failure of reasonable profit on present rates.

Merger of Electrical Manufacturing Companies

Although not officially announced, there seems to be little doubt that the Sprague Electric Company and the Stanley Electric Manufacturing Company will shortly be brought together in a close union of interests amounting to a consolidation. It is practically certain that a director in the Sprague Company is as an individual the purchaser of the Stanley Company, and Henry Hine, of the Stanley Company, has assumed the management of both companies. The control of the Stanley Company will put the Sprague Company in an exceedingly strong position for a general electrical business, inasmuch as it will now be able to manufacture alternating current apparatus for transmission of power under the Stanley patents, direct current generators and motors of the largest types, designed by Mr. Sprague and Mr. Lundell, and apparatus required for the Sprague multiple unit system of train equipment.

The complete list of officers of the Sprague Electric Company is as follows: President, A. B. Chandler, president of the Postal Telegraph Company; first vice-president, John E. Searles; second vice-president and technical director, Frank J. Sprague; general manager, Henry Hine.

The Chicago Convention of 1899

John M. Roach, general manager of the Union Traction Company, of Chicago, who will doubtless be made chairman of the local committee of arrangements in place of the late M. K. Bowen last week authorized a representative of the Street Railway Journal to state emphatically that the local street railway companies were working in great harmony. That the plans for entertaining the members of the American Street Railway Association had been outlined, and that the work from now on would be pushed with great vigor. He stated that the street railway companies of the country and the representatives of manufacturing and supply houses could rest assured that they would receive as cordial a welcome, and find as ample and satisfactory accommodations for entertainment and exhibits as had ever been accorded them at any previous convention.

The secretary of the association also states that all the space in the exhibition hall has already been applied for and assigned, but that additional space will, if necessary, be provided or the original allotments be cut down to provide for later applicants.

The Detroit Situation

The Michigan Supreme Court, on July 5, decided that the McLeod law, authorizing the appointment of the Detroit Street Railway Commission was unconstitutional, that there is no such office as the Detroit Street Railway Commission, and that Governor Pingree and the other commissioners have no title thereto.

The court based its opinion almost wholly on the proposition that the law is in contravention of a section of the State Constitution which provides that "the State shall not be a party to or interested in any work of internal improvement, nor engaged in carrying on any such work, except in the expenditure of grants to the State of lands or other property."

In spite of this decision Governor Pingree and Mr. Johnson endeavored to force through the Detroit Common Council the "Security Franchise," the principal features of which were described in the last issue of the Street Railway Journal. The bill was passed by a small majority, but was promptly vetoed by the Mayor. This action was followed by a determined effort on the part of Mr. Pingree and Mr. Johnson to pass the bill again through the Council over the veto. Charges of bribery were freely made, and the people were greatly aroused. Near the end of the struggle the Detroit companies announced an "object lesson" in 3-cent-fare opera-

tion by putting all the lines in the city on this basis. The bill was finally defeated, and a communication was sent by Mr. Johnson to the Street Railway Commission reading as follows:

"We are satisfied that it is not feasible to consummate, under existing conditions, the plan of transferring the street railway property to your company. We must face squarely the proposition which the opponents of the plan put forward, that our franchises are running out, and that when they do expire we shall have an expensive plant on our hands which the opponents of the plan say they can compel us to sell at a ruinous sacrifice unless we are willing to accept a new franchise on their terms. We must so manage the railways in the meantime as, if possible, to prevent the loss so threatened. Low fares and short franchises are incompatible if railways are to be run for profit as a private enterprise."

This communication is held to indicate an intention on the part of the Detroit companies to return to a straight five-cent fare, abolish tickets and transfers, and endeavor to make the most money possible out of the property during the remainder of the franchise term.

"The Other Side"

Allen Ripley Foote is editor of a new weekly paper entitled "The Other Side," which is published at 126 Market Street, Chicago, and in which will appear arguments and statistics upon questions of municipal ownership of public service industries, in general supporting private ownership. The publication will be found extremely useful and valuable to all who wish to get a clear idea of municipal ownership problems which are coming up for consideration in many cities, and Mr. Foote's well-known ability and long study of public questions of this character are a sufficient guarantee that the reading columns of "The Other Side" will be carefully and well edited.

Street Railway Complications in Atlanta, Ga.

The recent consolidation of the Atlanta Consolidated Street Railway Company and the Atlanta Railway Company under the title of the Atlanta Railway & Power Company has resulted in a complicated fight over franchises between that company and the Collins Park & Belt Railroad Company, which was not included in the consolidation. This, the only opposition railway in Atlanta, at present a suburban road 10 miles long, has been purchased by a syndicate, at whose head is H. M. Atkinson, president of the Georgia Electric Light Company, which corporation has the exclusive contract for street lighting, and until recently has furnished the power for operating the Atlanta Railway Company's lines. The Collins Park & Belt Railroad Company has elected the following officers: J. Simmons, president; H. M. Atkinson, vice-president, and F. M. Zimmerman, superintendent. Mr. Zimmerman has been, during the past year, superintendent of the Atlanta Railway Company, until the formation of the Atlanta Railway & Power Company.

The Collins Park Line has made application to the City Council for franchises over a large number of the most important streets, and consulting engineers who have recently been in Atlanta have laid out a system of 27 miles of track, which will enter into nearly all of the territory now served by the Atlanta Railway & Power Company, and, in fact, crosses that company's lines in about thirty places. Suburban lines have also been surveyed, which parallel the Railway & Power Company in many places.

In the meantime, a fierce newspaper controversy is being waged between H. M. Atkinson, of the Collins Park Company, and Joel Hurt, ex-president and chief stockholder of the Atlanta Railway & Power Company. Mr. Atkinson claims that there is a good opportunity for profitable investment in the new proposed lines, which he expects to operate in connection with his present power plant.

Mr. Hurt, on behalf of the Railway & Power Company, has made the announcement that the latter will begin shortly the construction of a power house to cost $750,000, so as to enter actively into competition for municipal and building lighting, and states that they will be prepared to furnish electricity to the city for streets, manufactories and buildings, and in addition will furnish steam, heat and cold air. They also state that the buildings now occupied by their present power house will be converted into a car manufactory, and active competition will be made for the Southern street car and truck trade.

The latest development in the struggle is the application through the courts for an injunction against the Atlanta Railway & Power Company to restrain them from connecting with or operating the lines formerly controlled by the Atlanta Railway Company, to dissolve the consolidation with that company and to prevent them from abandoning certain portions of lines that formerly competed in the same territory. A temporary injunction has been granted. The courts are also requested to place the properties under a receiver and prevent the transfer of stock.

Storage Batteries in Washington

The new Washington Traction & Electric Company has just placed contracts for ten storage battery cars to be run on the Anacostia & Potomac River Division. These cars are to be practically duplicates of the cars now running in Chicago. Old trolley cars of the system will be changed over to provide for the batteries, and Westinghouse motors and the chloride batteries of the Electric Storage Battery Company will be used. There are several practical reasons for putting storage batteries upon this line. The Pennsylvania Railroad is going to elevate its tracks in that section, and the territory is such that it is not at present safe to go to the expense of putting in an underground electric system. Moreover, it is desired to make a practical experiment of storage battery cars under Washington conditions, with the hope of using them on other lines as feeders. The batteries will be charged from terminals carried in a vault in the streets. Two of these cars may possibly be used on the P Street loop.

Patent Office Report

The report of the United States Patent Office Commissioner for the year ending June 30, 1899, advance copy of which has just been received, shows this department of the government to be in better condition than ever before in its history. A summary of the different tables contained in the report is as follows:

There were received in the last fiscal year 35,352 applications for mechanical patents, 2292 applications for designs, 91 applications for reissues, 1610 caveats, 1861 applications for trade-marks, 612 applications for labels and 112 applications for prints; a total of 41,930 applications. There were 23,550 patents granted, including reissues and designs; 1406 trade-marks, 372 labels and 76 prints were registered. The number of patents that expired was 16,670. The number of allowed applications which were by operation of law forfeited for non-payment of the final fees was 4021. The total receipts of the office were $1,209,554.88; the total expenditures were $1,148,663.48, and the surplus of receipts over expenditures, being the amount turned into the treasury, was $60,-891.40.

Steam Railroad Statistics

The Interstate Commerce Commission at Washington reports the following statistics concerning the steam railroads of the United States, for the year ending June 30, 1898: On June 30, 1898, the total single-track mileage was 186,397 miles, this being an increase of 1968 miles for the year. The total mileage, including single tracks, second, third and fourth track, yard track, sidings, etc., was 247,533 miles, an increase of 4088 miles. The total number of railroad corporations was 2047. On the above date there were 36,234 locomotives, of which 9956 were passenger, 20,627 were freight and the rest switching, etc.; 1,326,174 cars, of which 33,595 were passenger, 1,248,826 were freight and the rest special cars for officials, etc. This does not include cars owned by private individuals or companies. There were 874,558 employees, an increase of 51,082.

The amount of capital outstanding on June 30, 1898, not including current liabilities in the term, was $10,818,554,031. This amount equals $60,343 per mile of line. The amount of capital which existed in the form of stocks was $5,388,268,321, of which $4,269,271,714 was common stock, and $1,118,996,607 was preferred stock. The amount which existed in the form of funded debt was $5,430,285,710, comprising mortgage bonds, $4,640,762,632; miscellaneous obligations, $486,977,279; income bonds, $262,194,688, and equipment trust obligations, $40,351,111. The aggregate number of passengers carried during the year was 501,066,681, an increase of 11,621,483.

The gross earnings of 184,648 miles of steam roads for the year were $1,247,325,621, an increase of $125,235,848; operating expenses were $817,973,276, an increase of $65,448,512; earnings from operation were $429,352,345, an increase of $59,787,336; deductions from earnings were $427,235,703. The total dividends declared were $96,240,864.

Organization of a New Manufacturing Company in Great Britain

A prospectus of the British Westinghouse Electric & Manufacturing Company, Limited, was issued in London under date of July 10. The capital is to be £1,500,000, of which £1,000,000 are in 6 per cent £5 preference shares, and £500,000 in £10 ordinary shares. Preference shares have priority in distribution of assets and are entitled to a non-cumulative preferential dividend at the rate of 6 per cent per annum on the amounts paid up, together with one-quarter of the surplus profits of each year available for dividend after payment of 6 per cent on the ordinary shares, the remaining three-quarters to go as additional dividend on the latter.

The Westinghouse Electric & Manufacturing Company, of Pittsburgh, receives the entire issue of ordinary shares in consideration of certain contracts and agreements referred to below; £500,000 of the preference shares are offered to the public, of which £150,000 have been subscribed by the vendors and their friends and allotted in full.

The directors are J. Annan Bryce, late director of the National Construction & Armaments Company, Ltd.; C. W. Benson, Joseph Lawrence, chairman of the Linotype Company, Ltd., and chairman of the Machinery Trust, Ltd.; Hon. R. Clere Parsons, M. I. C. E., A. I. E. E., late partner in the firm of Kitson & Co., Leeds; George Westinghouse, president of the Westinghouse Electric & Manufacturing Company, and Lemuel Bannister. As technical adviser, the company will have the invaluable services of Lord Kelvin, F. R. S. The secretary is Arthur E. Scanes, and the company's temporary offices are at Cornhill Chambers, 63 Cornhill, E. C.

The prospectus states that the company has been formed for the purpose of establishing works for the production of every description of electrical machinery and appliances on a larger scale than any now existing in Great Britain, and thus meeting a demand that has hitherto been largely supplied from foreign sources. With this object an agreement has been made with the Westinghouse Electric & Manufacturing Company, whereby valuable rights for the United Kingdom, its colonies, possessions, protectorates and dependencies (except those in North America) are secured to the British company.

The American Company agrees to transfer to the British company its patents for the territory above mentioned, and further, for a period of ten years, to communicate all improvements it may make, and supply all plans, specifications and information necessary to conduct its manufacturing operations to the best advantage. The British company, by availing itself of the accumulated experience and technical assistance of the American company, will thus avoid heavy experimental expenditure in establishing its business.

The orders for plant and appliances for the British company's territory for the year ended June, 1898, are certified by the vendors to the board at £130,613, and for the year ended June, 1899, at £266,528. Recent orders and inquiries indicate a progressive increase. The American company returns the output of its Pittsburgh factory for the year ending March 31, 1899, at £1,428,474, and its net profit thereon at above £255,000, these figures being subject to final audit. In view of the constant increase of orders and the profitable nature of the business, the Pittsburgh works are in course of being approximately doubled.

The agreement contains provisions for mutual support and protection between the companies, for the immediate turning over to the British company of the existing business relating to the above-mentioned territory, including the orders on hand, which will at once form a source of revenue, and for the supplying by the Pittsburgh factory at wholesale prices, less agreed discounts, of all apparatus, appliances and accessories which the British company may require until the factory in England is in working order. The British Company will thus start as a going concern. The American company guarantees that the profits resulting from the business for the first two years shall amount to a sum not less than sufficient to pay the dividend upon the amounts called up on the preference shares during that period, so that pending the completion of the factory, which is estimated to take eighteen months at the outside, the 6 per cent to the preference shareholders is assured.

A site, covering about forty acres for the proposed works, has been agreed for at Trafford Park, Manchester, where water and railway communications are excellent. The situation is about the center of the manufacturing districts, where skilled labor is plentiful and where the demand for electric apparatus will be great.

Mr. Westinghouse and Mr. Bannister, who have been for many years associated with the business, have joined the Board of the British company.

The present issue of capital will suffice for the construction and equipment of the works as now proposed, but if the contemplated success is achieved, the land acquired will accommodate larger premises, and further capital will have to be from time to time provided.

The consideration payable has been fixed by the American company, and consists of the 50,000 ordinary shares issued credited as fully paid. It will pay all costs, excepting only government and stamp duties, in connection with the formation and registration of the British company down to the allotment of the preference shares now offered. The entire proceeds of such preference shares will therefore be available for the business.

Opening of a New Niagara Bridge

On Friday, July 21, the new suspension bridge of the International Traction Company, connecting the United States and Canada, over the Niagara River was formally opened with appropriate ceremonies. The new bridge forms a link in the international belt line which it is proposed to establish around the Niagara Gorge and Whirlpool. The most important factor in the belt is the Niagra Gorge Railroad, which starts at Prospect Park, Niagara Falls, and runs through the gorge at the water level, furnishing the only means of access to the immediate vicinity of the Whirlpool and rapids. At Lewiston a switch leads to the new bridge, which crosses to Queenston, Ont. The cable span of the new bridge, now the only suspension bridge across the Niagara, is 1040 ft.

At the Canadian end the Niagara Falls Park & River Railway, controlled by the International Traction Company, ascends a heavy grade to Queenston Heights and runs thence along the bluff on the Canadian side of the upper steel arch bridge, across which cars have been run for the last year. This brings the car back to within less than 1000 ft. of the starting point, and the Niagara Reservation Commission has been asked to grant permission, under a recent act of the Legislature, for the laying of tracks along the riverway, connecting the upper bridge and the Gorge Road tracks in Falls Street. It is understood that this permission will be granted early in August, allowing the completion of the international belt line. A traffic agreement has been made between the Niagara Gorge Railroad and the Niagara Falls Park & River Railway for the sale of round trip tickets good for the complete circuit. This will benefit both roads, but the Gorge Road has less to gain than its Canadian rival, which is now able to add to the inducements to travel on it the possibility of returning via the Gorge.

Organization of the Tramway and Light Railways Association in Great Britain

There has just been organized and registered under the Companies' Acts the "Tramway and Light Railways Association," for the promotion of tramway interests in Great Britain, along lines similar to those of the American Street Railway Association. The articles provide that the governing body of the association shall be a president, a vice-president, a council of not more than eighteen members, the first members to be appointed by the signatories to the articles of the association. In accordance with this provision the following gentlemen have been nominated as the first members of the council: George Richardson, Esq., chairman of the North Metropolitan Tramways Company, Belfast Street Tramways Company, Blackpool and Fleetwood Tramroad Company, etc.; George F. Fry, Esq., member of the Tramways Committee of the Dover Corporation, chairman of the London Street Tramways Company, director of the Belfast Street Tramways Company, etc.; Emile Garcke, Esq., managing director of the British Electric Traction Company, chairman of the Potteries Electric Traction Company, chairman of the Swansea Improvements & Tramway Company, etc.; J. Barber Glenn, Esq., director of the London Street Tramways Company, managing director of Provincial Tramways Company, secretary of the Belfast Street Tramways Company, Isle of Thanet Light Railway Electric Company, etc.; W. M. Murphy, Esq., chairman of the Dublin United Tramways Company, director of the Belfast Street Tramways Company, London Southern Tramways Company, etc.; Stephen Sellon, Esq., Parliamentary engineer of the British Electric Traction Company, director of the Potteries Electric Traction Company, etc.

A. M. Wilcox, editor of the "Railway World," has been appointed honorary secretary, and William Morris, Jr., of the firm of Ashurst, Morris, Crisp & Co., has consented to act as honorary solicitor. The membership will consist of companies of the tramways departments of municipal corporations, and of individuals. Each individual member will have one vote, and every corporation or company will have five votes.

Solid Wrought Forged Axle Box Frames vs. Riveted Patchwork Truck Frames

BY JOHN A. BRILL

In the June and July issues of the STREET RAILWAY JOURNAL are two articles on the fundamental principles of an electric truck, signed by Edgar Peckham. These articles are essentially an attempt to reply to an article by me published in the May issue of the STREET RAILWAY JOURNAL. Mr. Peckham very adroitly begs the question, and at the same time entirely avoids the points which I made in the discussion of the "Parallel in the Development of the Locomotive and the Electric Truck." In that article I did not mention any "make" of truck, but my effort was entirely directed towards showing the fallacy of a patchwork truck frame, which he, very naturally, thinks it is necessary to defend. His statements relating to plate frames in locomotives, as compared to bar frames, are wholly misleading. The bar frame is essentially American locomotive engine practice, and was found necessary because of the formerly inferior roadbed construction. The plate frame is a European type of construction, and the plates are cut out of a single piece of metal; this is the case also of the pivoted or bogie trucks used on European railways. There could be no question about some value of Mr. Peckham's truck if, instead of a patchwork made up of a multitude of rods, bars, castings and rivets, he would follow the English and Continental locomotive practice, as recited above, and cut the side frames of his truck from a single plate of metal.

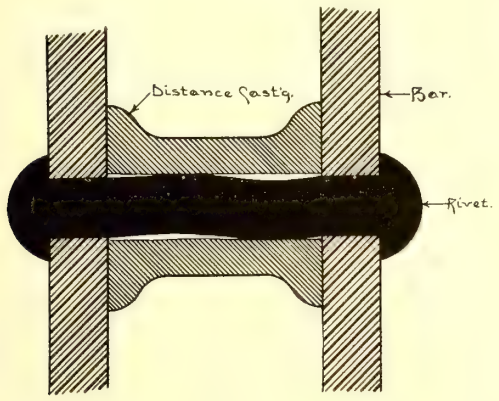


FIG. 1.



FIG. 2.

It is rather surprising to be told that locomotive frames have no weight to carry, and that engines weighing from 120,000 lbs. to 140,000 lbs. "put no strains upon their frame beyond those produced by the propelling mechanism." In English and American locomotive frames, whether of the plate or bar pattern, rivets are conspicuous by their absence. Riveted joints are nowhere able to stand such straining and pounding as trolley car trucks or locomotives give their frames. Then, too, the reference to bridges and riveted structures is not to the point. Riveted bridges, he seems to think, are strong and in every respect analogous to a locomotive or an electric truck. This indicates a radical failure to comprehend the mechanical principles involved. A bridge, it is true, has heavy loads to sustain for a few minutes; it is subjected to a certain amount of vibration in a vertical direction only; but there is no comparison between its work and the hammering which a truck or locomotive frame receives during all the time of service. Whereas a bridge is subjected to a violent strain vertically for a few moments during the passage of a train, and then remains at rest for a very much longer interval of time, a truck frame is subjected to stresses in every possible direction, and the pounding which it receives is almost unparalleled in mechanics. Riveted bridges are not considered as fine structures as the type known as the "pin" connected, and the repairs upon them and upon such structures as elevated roads are sufficient demonstrations of this. The weakness of riveted structures made up of a multitude of parts, combining cast iron, cast steel, bar iron and rivets, is shown in every direction, particularly in trucks over bridge work, because in the trucks the spacing blocks are cored out, whereas the holes in the bars are either punched or drilled. When the parts are riveted the rivets buckle to a large extent, if the hole in the spacing block is large, as shown in Fig. 1 herewith, and under heavy strains allows the rivet to stretch or bend. In this particular riveted truck work differs essentially from that of riveted bridges, especially plate girder bridges, because the plate girders have no spacing blocks, and the plates are placed together, drilled and riveted, under which process the rivets, fitting snugly in all holes, have no chance to buckle.

The difference between bridge work and truck work is illustrated in the accompanying sketches. A rivet driven in two bars separated by a distance piece does not fill the hole, and presents in section the appearance shown in Fig. 1. In bridge or boiler work plates with drilled holes come solidly together, and the rivet is capable of filling the hole, as shown in Fig. 2. The distinction is a radical one. Manufacturers of trucks with this type of side frames have always been obliged to concentrate their attention upon holding up the load, as they have been obliged to use the truss under most unfavorable conditions as to support and submit it to strains for which it is in no wise suited. The inevitable result is the sagging of the car ends. With solid forged frames or a plate bar frame of sufficient size of section the ends of the cars would more likely have stayed in place.

Mr. Peckham entitles the article which he is writing in defence of the composite frame truck "The Functions of the Electric Truck." In his two instalments he makes no mention of these functions. In his writing he as completely ignores them as he does in his construction. The pith and point of his article seems to be that "I can build a fine truss that will hold up the ends of a car." The reply to this is that there is no difficulty whatever in holding up the ends of a car, or there ought not to be, although Mr. Peckham seems to have encountered no end of trouble in this line. The truss of which he speaks and of which he appears to be so proud is one that he has but recently introduced, and is not a part of the frame of his truck, but is a direct copy of a truss the J. G. Brill Company has used for years, and was employed by it on its open horse cars; it is also the same class of truss which the company put on the first motor truck which was ever built.

Mr. Peckham distinctly says that the solid frame trucks are being replaced by those of his own manufacture. I wish to say in reply to this surprising statement that I have yet to learn of a place where such a thing is happening. So far as I know, it has not happened in the past except in one case five years ago, and there the Peckham trucks were not a success, while the discarded ones were purchased by other lines, and are in good condition and operation to-day.

It should be understood that when I undertook to discuss the developments of the electric truck or its frame I was not attempting to consider the matter of building a separate and independent truss for sustaining the ends of long cars. In holding up the ends of cars Mr. Peckham has been as peculiarly unfortunate as he was in the choice of a design for his truck frame. The truck side which he is now making is the same old style that he built in 1892, and is of a type which the Brill Company at that time discarded because of its inherent weakness. Because of this weakness and inability to hold up the ends of a car, he has been obliged to devise what he terms the "new truss," and several thousands of his trucks are now in operation without this truss upon which he lays so much stress. The composite truck side which the J. G. Brill Company built in 1892, and the side which Mr. Peckham builds at present contain all the inherent weak points of the composite locomotive frame of 1832. The J. G. Brill Company thought then, as Mr. Peckham thinks now, that the horizontal stresses were comparatively insignificant. These horizontal stresses are so great that the truss and riveted truck sides shake to pieces and allow the end of the truck to drop, taking the end of the car with it. With the best riveting machines possible, and the most careful attention to every detail of workmanship, the riveted structure is unable to stand the strains of street railroad work. Even after seven years of experience and constant failure, this fact does not seem to have impressed itself upon Mr. Peckham. The "trusses" are simply names to conjure with. They are mere selling points, and are of no value except as such, and as means to cover up weaknesses which are a part of the bad original designs.

The quotation which Mr. Peckham makes from an article by Henry E. P. Cottrell is merely an effort to draw attention away from the main question. I am very glad that Mr. Peckham has called my attention to this article, as I propose to answer it, and set the public straight in regard to this matter. A long car body and a truss for holding its ends up are questions entirely outside of the truck. One truss can be just as easily applied to a car as another. It is the truck side which is defective, and no matter how well the ends of a car may be trussed, the truck side, by reason of the multitude of parts, soon gives out under the stresses and hammering, its ends drop, it ceases to hold the axles in line, and it then becomes an expensive failure. My article was written for the purpose of bringing clearly before the minds of street railway men the fundamental principles of good truck construction. It seems unfortunate to attempt a discussion of principles which are not important, and to undertake to defend one maker's trucks by the application of an outside element which has nothing to do

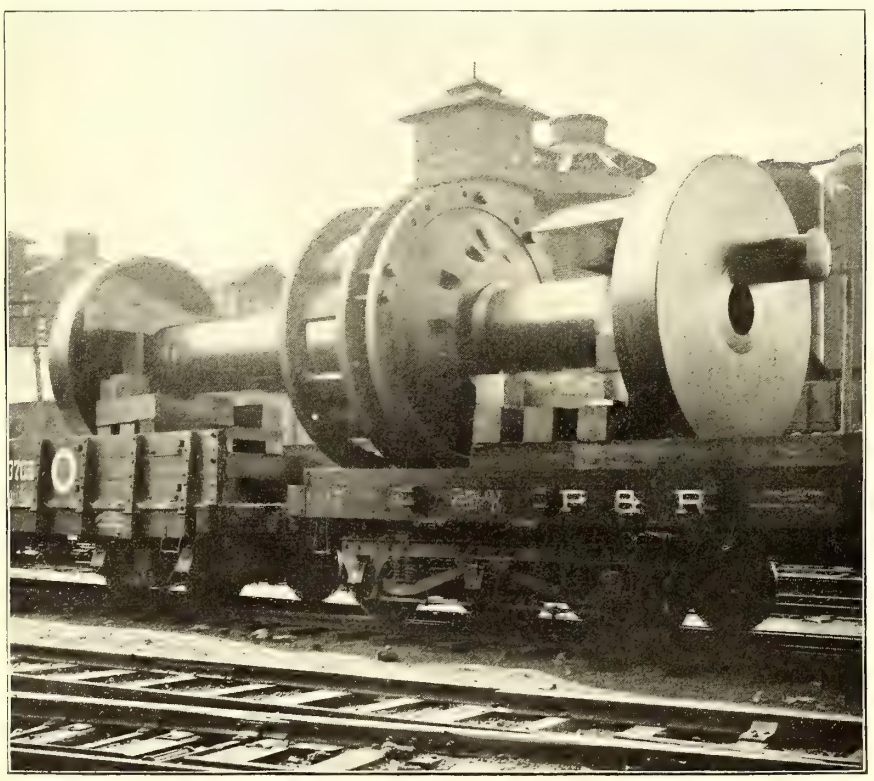
with truck building, because the long truss does not effect the riding qualities of the truck. It does not decrease the pitching nor steady the body in any way, nor strengthen a weak truck side, yet these ideas are persistently advanced in Mr. Peckham's article.

Sale of an Ohio Road

The entire assets and property of the Newark & Granville Electric Street Railway Company, of Newark, Ohio, will be sold at receiver's sale on Aug. 26, 1899. This system consists of about 8 miles of road in the city of Newark, which has a population of over 22,000 and about 7 miles of road, extending from Newark to Granville, a college town of about 3000 population, with one of the finest parks in the country along the road near the city of Newark. It is equipped with first-class machinery and cars.

Large Engine Shaft for Boston

On June 9 there was made from the works of the Bethlehem Steel Company, at South Bethlehem, Pa., what is thought to be the second largest shipment ever made in this country, the largest having been the Krupp gun, which was transported by the Pennsylvania Railroad Company, between Sparrow's Point, Md., and the World's Fair, Chicago. The illustration shows the shipment referred to. It is a shaft with crank discs and generator fly-wheel hub assembled on it, all finished complete. This shaft was made for an engine built by the Corliss Steam Engine Company, of Providence, R. I., for the Boston Elevated Railway. The total



LARGE ENGINE SHAFT FOR BOSTON

weight of the shipment was 170,400 lbs., and in order to transport it from South Bethlehem to the site at Boston, Mass., the Philadelphia & Reading Railway Company furnished two cars of 100,000 and 80,000 lbs. capacity respectively and blocked the shaft so that 60 per cent of the weight was supported on the stronger car and 40 per cent on the other. The shipment was made over the New Jersey Central, the Delaware & Hudson Canal Company and Boston & Albany Railroad Company.

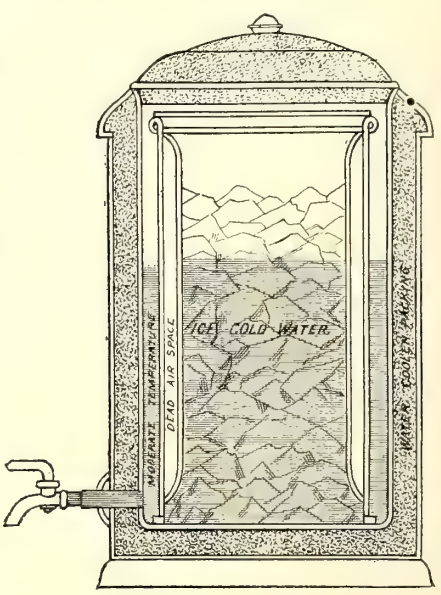
The shaft is the first of three for the Boston Elevated Railway. It is of fluid compressed nickel steel, hydraulically forged hollow on a mandrel, oil tempered and annealed. It is 37 ins. diameter in the center, with a 17-in. hole through its axis, and is 27 ft. 10 ins. long. The metal of which it was made showed tests of 50,000 lbs. elastic limit and 18 per cent elongation in test pieces 1 in. diameter and 10 ins. long. Shipments, approximating this size, will frequently have to be made by railroads in the future.

The Bethlehem Steel Company has in hand orders from the Edward P. Allis Company, Milwaukee, Wis., for the Metropolitan Street Railway Company, of New York city, eleven shafts of exactly the same size, also from the Westinghouse Machine Company, Pittsburgh, Pa., orders for sixteen similar shafts for the Third Avenue Railway Company, of New York city, and two for the Brooklyn Edison Illuminating Company, also from the Westinghouse Electric & Manufacturing Company, Pittsburgh, orders for fifteen shafts a little smaller in size for the water power plant at Messina Springs, N. Y. The power plants for which these shafts are intended are designed to be equipped with engines of 8000 h.p. capacity. In all probability even larger units than this will be called for in the future, as the tendency toward centralization of power is in that direction. It is stated that the engines for the power plant, made necessary by the change from steam to electricity by the Manhattan Elevated Railway, New York city, will have a maximum capacity of 12,000 h.p. The shafts for these engines will, of course, be considerably larger than that shown in the illustration.

Receptacle for Water Cooler

A scientific ice-water receptacle for holding drinking water in waiting rooms, on street cars, in offices, etc., is being placed on the market by A. Major, of New York city. For this device is claimed a saving of 50 per cent in ice, and in addition a more agreeable temperature for the water than is obtained by simply putting a piece of ice in water in an ordinary cooler. The water is kept at a uniform temperature, resembling very closely that of cool spring water.

The new device is very simple, consisting of an independent receptacle, open at the bottom, as shown, and having double walls, with a dead air space between them. It also has a double cover. This receptacle is designed to be placed in any cooler, and should be about 1½ ins. smaller all the way around than the cooler in which it is to go. The ice is placed in the inside vessel, which, having no bottom, permits the water to circulate in and around it, keeping, it is claimed, the water from getting extremely and unnecessarily cold, and preventing the ice from melting as rapidly as it ordinarily would. Mr. Major, whose address is 461 Pearl Street, has succeeded in introducing his invention quite successfully throughout the United States. The receptacle is made in any size to fit any cooler.



NEW WATER COOLER

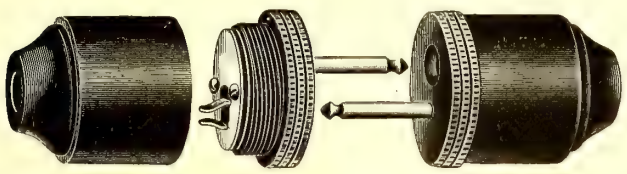
Tickets for Tramways

A good idea of the extent of the tramway business is obtained by a glance over the catalogue of T. J. Whiting & Sons, of London, manufacturers of tramway tickets. This company has been engaged for a long time in the business of printing tramway tickets for all parts of the world, and its catalogue contains reproductions of these tickets. They include tickets from cities throughout Europe, Asia and Africa and in all languages, including Chinese and various dialects of Hindoo. The catalogue gives an excellent idea of the firm's world-wide connections and reputation.

Electric Trailer Connector

At this period of the year there are varying calls for train capacity, through picnics, trolley parties, baseball games, etc. This means frequent additions of trailers to motor cars. Safety of connecting current devices doubtless is more sought for by electric railway managers than articles giving ease of operation. A combination in one device of these two elements makes it of greatest usefulness. The Wood's trailer connector, as illustrated herewith, is claimed to possess these qualities. It has the particular advantage that at no time (after connection to lighting circuit) is there any exposure of live metal, the connecting pins being absolutely "dead" until beyond the reach of the conductor's fingers. This safety factor also is worth noting as applying to inquisitive or careless passengers.

The Wood's trailer connector, as well as a complete line of electric railway supplies, is carried by the Central Electric Company, Chicago, as selling agents for the Central Union Brass Company, St. Louis, Mo.

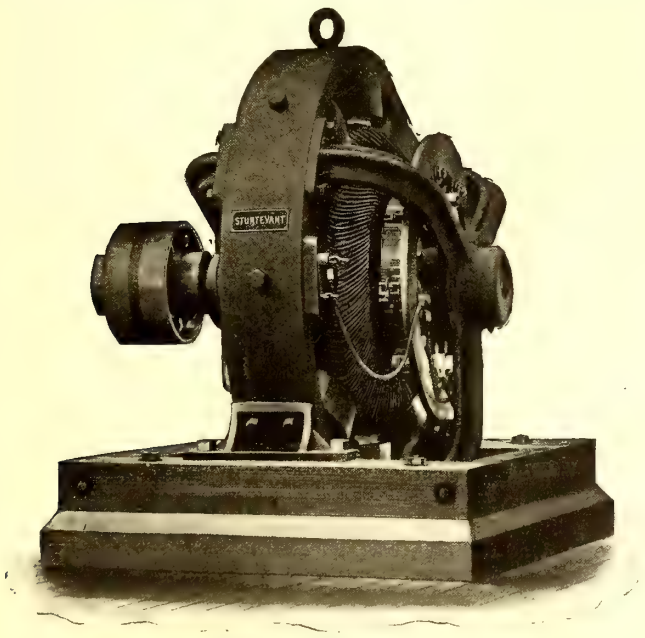


CONNECTOR FOR TRAIL CAR

New Type of Dynamos and Motors

The B. F. Sturtevant Company, of Boston, has made a specialty of the construction of eight-pole generators and stationary motors, running in size from 3 kw. to 110 kw. The motors of this type were designed originally for driving fans for subway work, and their use in the Boston subway has been described in the STREET RAILWAY JOURNAL. They have been found, however, so economical and desirable that the Sturtevant Company has increased the number of sizes in which these motors are built, and recommends them not only for ventilating, but for general power purposes about car houses and power stations.

The field ring, which also constitutes the frame of these machines, is of wrought iron in the small, of cast steel in the medium, and of cast iron in the large sizes. The field cores are of wrought iron, and the pole shoes of cast iron, of such peculiar shape and size as to render these machines capable of meeting extreme variations of load without sparking or the necessity of adjustment.



NEW MULTIPOLAR DYNAMO

The field coils are machine wound, thoroughly insulated, and of such open construction as to secure the maximum radiation and ventilation. The armature core is built up of laminated slotted discs, which are solidly clamped between two brass rings having corresponding slots. The coils are machine wound, of uniform size and shape, and thoroughly insulated, the armature being of the drum type.

The commutator is of large diameter, the segments being of fine rolled or drop-forged copper. For high voltages or small outputs at low speeds two sets of reaction brushes, of fibre-graphite, are usually employed, and from the character of the design require no adjustment. Tripod bearing yokes are provided, as shown above, except in the largest machines, which are equipped with special bases and pedestal bearings. The shaft runs in gun-metal sleeves, and is lubricated by means of ring oilers.

Water Guards for Trolly Poles and Ropes

The accompanying illustrations show a water guard invented by Thomas Hawken, superintendent of the Rockland, Thomaston & Camden Street Railway, of Rockland, Maine. The guards are made of rubber, and that on the trolley pole is intended to keep the rain from running down the pole and also the rope. That on the rope protects the rope only and rear platform, and when the car is in motion the water drops clear of the car. The method of application is clearly shown in the engravings.



GUARD ON POLE



GUARD ON ROPE

It is not necessary to use both of these devices, but, as some managers or conductors would prefer to have the device on the rope and others on the pole, Mr. Hawken makes both types. The guard has been given a severe test for several months on the Rockland, Thomaston & Camden Railway, and has given perfect satisfaction.

Large Sales of Boiler Cleaning Device

The Union Boiler Tube Cleaner Company, of 240 Penn Avenue, Pittsburgh, Pa., was organized in 1895 for the purpose of introducing an entirely new industry, that of removing scale from the interiors of the tubes of water tube boilers, and it is one of the largest concerns of the kind in the world, having machinery especially designed for this specific business. Its devices are patented abroad, as well as in the United States, which enables this company to safely contract for thoroughly cleaning boilers under a time limit, with bond for heavy penalty for non-fulfillment, or to sell or lease tools for cleaning all makes of water tube boilers having straight, horizontally inclined or vertical tubes and those having curved tubes, such as the Climax, Stirling, also the Hazelton, having closed end tubes, the latter three types having been heretofore considered impossible to clean.

This concern commenced business as a firm May 1, 1895, a time of great depression in the industrial world, notwithstanding which the evident merits of its devices caused their immediate adoption in a number of the power plants in the United States and England. The continued demand for these cleaners has compelled the manufacturers to greatly enlarge their works, despite which the factory is overcrowded with orders.

Large Orders for Registers

The business of the New Haven Car Register Company is constantly increasing, and the company reports a large number of new orders. Of its recent large orders one is for several hundred machines for the Third Avenue Railroad Company, New York city. The company has also received large orders lately from St. Joseph, Mo., and additional orders for its registers for the Market Street system, of San Francisco, from Oakland and Los Angeles, Cal., in both of which cities its registers are in use.

Large Sprinkling Car

Wendell & MacDuffie, of New York City, have sold during the past summer three sprinkling cars, which are said to be of larger capacity than any ever before built in this country. Two of these



END VIEW OF SPRINKLING CAR

were sold to the North Jersey Street Railway Company, and one to the Philadelphia & Westchester Street Railway Company. The tank cars were manufactured by the Taunton Locomotive Manufacturing Company, of Taunton, Mass.

In the accompanying illustrations one of the cars furnished to the North Jersey Street Railway Company is shown. The tank proper is 24 ft. long and about 64 ins. in diameter. The car is mounted on Peckham 14-B double trucks, and is equipped with Van Dorn couplers, North Jersey Street Railway Company's standard bumpers, and Sterling brakes, in accordance with specifications. The tank is completely housed in, there being four dummy windows fitted with curtains. The sprinkler has a total capacity of 4000 gals. of water.

A Handsome Catalogue

The Gold Car Heating Company, of New York, has recently published a very tasteful catalogue of its various types of car heaters for steam and electric railways. Mr. Gold has made a life study of the heating of cars, and the list of railroads whose cars he has equipped with heating apparatus is a most extended one, and includes roads in all parts of the world. Altogether about 20,000 cars and locomotives have been equipped with the Gold system.

As is well known, the Gold Car Heating Company manufactures both steam and electric heaters. In the latter, which is the type, of course, in which electric railway managers are most interested, special attention has been given to securing a good circulation of air around the heated wires and distributing the heat in a uniform manner through the car. The degree of heat can be regulated by a three-point switch. The company also makes electric heaters for car house and miscellaneous uses.

The catalogue is very fully illustrated and is handsomely printed.

A Successful Car Fender

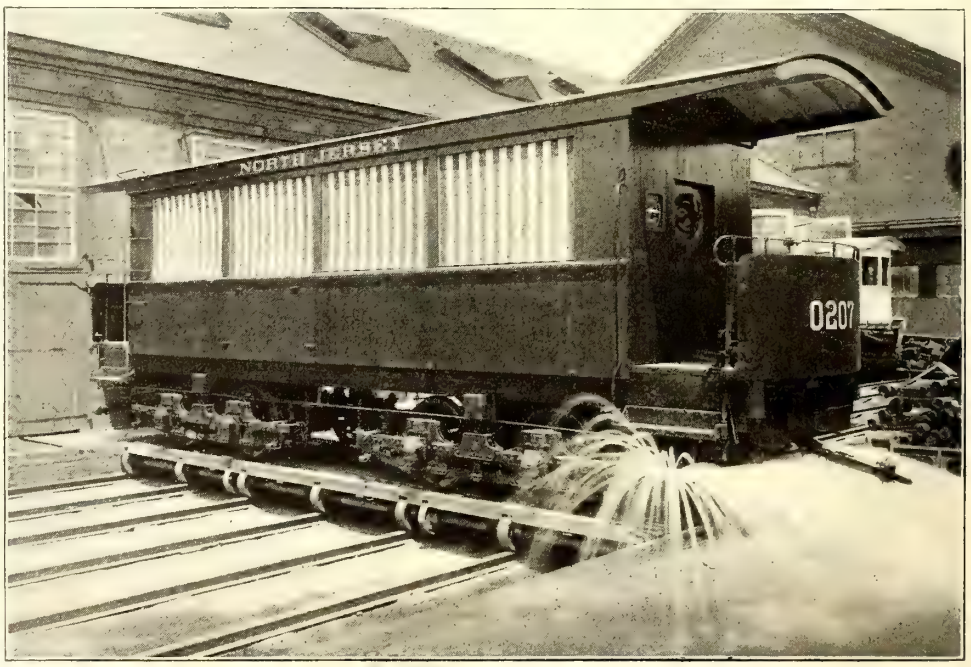
The Hipwood-Barrett fender, a test of which was described in the July issue of the STREET RAILWAY JOURNAL, is exciting a well-deserved interest among street railway officials. When the fender is dropped to the ground by a slight action of the motorman's knee, its construction is such that it conforms perfectly to any unevenness in the roadbed, by means of the five distinct sections. As these have a resilient action, there is no danger of stubbing, and a tension holds them close to the roadbed. The tests have shown it to be infallible in picking up a body, no matter in what position it may be standing or lying on the track. These features also prevent impairment of efficiency by oscillation of the car.

Attached to the sections are lips just forward of the bed, which, allowing a body to readily pass over them when being picked up, successfully prevent its falling back on to the track again, and continued tests have proved the adjustment of the tension to be such that snow, ice or mud cannot possibly interfere with the action. The fender is folded up and disposed of under the car when a trailer is to be used or a disabled car pushed along, or when housing, which, taking but three seconds to accomplish, will recommend its use to all railroad men.

New Road in Wisconsin

On July 4 the cars on the Waupaca & Chain o'Lakes (Wis.) Electric Railway were started for the first time. The building of this road has been in contemplation for the past two years, but only recently were the franchises secured and financial arrangements made. The contract for the entire construction and equipment, including track and overhead work, cars and equipments, was awarded to the Electrical Installation Company on May 18 last. Work on the grade was started May 26, and cars put in operation, as above stated, July 4, thus making thirty-two working days for the entire building of 5 miles of road complete. No better record than this can be shown in the United States, especially in this year of never-ending delays in delivery of apparatus and materials.

One of the features of this remarkably fast piece of work was



SIDE VIEW OF SPRINKLING CAR

the laying, lining and surfacing of 23,000 ft. of track in sixty working hours. Had it not been for delay in receipt of special work for track the line could have been open for traffic June 25. The road is built on standard lines throughout, using cedar ties, 50-lb. T rail, crown bonds and 00 trolley wire with both span and bracket construction. The city end of the line is ballasted with stone, the suburban portion with gravel for its entire length. This road reaches one of the most delightful spots in the State of Wisconsin, and opens up a new territory such as cannot fail to make the road a paying investment. W. B. Baker and Irving P. Lord are the owners of the line.

Compressed Air Cars in Chicago

The Compressed Air Motor Company, of Illinois, with headquarters at Chicago, reports that it placed in operation on May 30, 1899, one of its compressed air motor cars, replacing one of the horse cars in the night service of the North Clark Street Cable Railway. It is stated that this car has performed a continuous service, carrying passengers each night without failure or delay, and, it is said, entirely with satisfaction to the street railway officials. Since May 30 an additional compressed air car has also been put on, and air cars are now doing the "owl" service between the City Hall and the city limits.

On the first and second trips at night one or two trail cars are attached to the motor car, and in a single round trip of 7 miles 417 passengers have been carried.

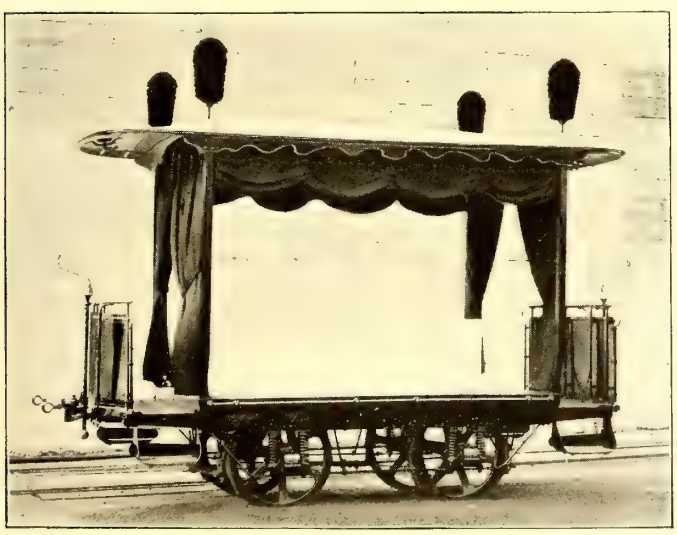
Patent Litigation

The Thomson-Houston Electric Company has been granted preliminary injunctions restraining the Worcester & Clinton Street Railway Company from infringing claims 20, 21, 22, 27, 28, 29 and 31 of Letters Patent No. 393,323, covering a system of electrical controllers, and claims 3, 4, 11, 19, 20, 23, 25, 26 and 27 of Patent No. 424,695 granted to Van Depole, and covering a suspended switch.

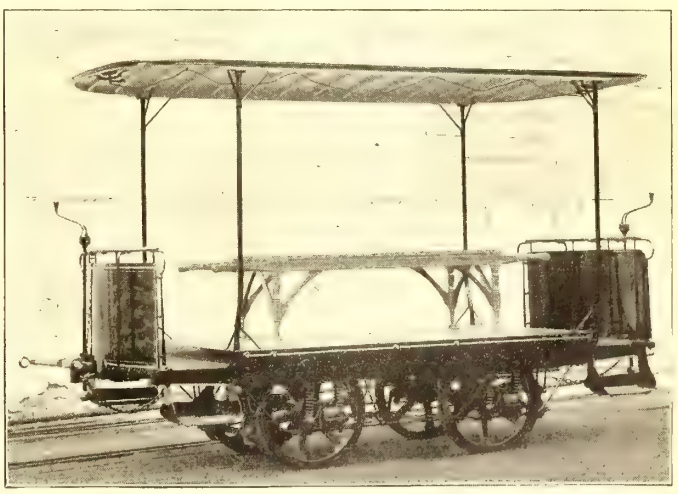
The Thomson-Houston Electric Company has also been successful in its suit against the Central Union Brass Company for infringement of the Van Depole Patent No. 424,695; and also against the Mill Creek Valley Street Railway Company for infringing Patent No. 393,323.

Open Funeral Cars

The Mexicans of all classes have a very sensible idea about the utilization of their street railways for transportation of funerals. In America a few steam railroads provide funeral facilities, but the idea of using the ordinary street car, whether propelled by animal power or electricity, does not seem to have been carried out to any great extent in America. The two cars illustrated were built recently for the Cia Tranvias de Merida Yucatan by the J. G. Brill Company. The road is narrow gage and is operated by animal power. The cars are but 9 ft. long by 6 ft. in width over all. One of them is of the plainest possible sort, merely a platform carrying a bier with a light roof supported by four rods at the corners. The other one is somewhat more elaborate, draped curtains at the corners and an enclosed bier in the center are provided, while the roof is decorated with plumes. A small crucifix is placed in the center of each roof. The inside of this car is finished in white and gold. The cheaper car has the ordinary carlin finish. The casket can, of course, be placed in the car from either side. For the mourners the ordinary horse cars are provided, and, as the cemeteries are made termini for the roads, the system is one which is in every respect sensible.



FIRST CLASS HEARSE

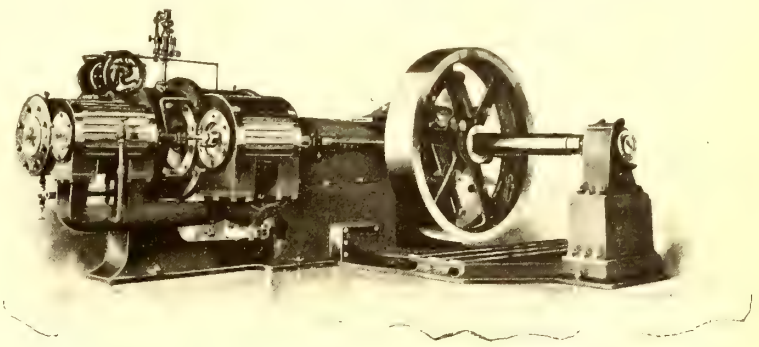


SECOND CLASS HEARSE

A Well Known System of Compound Engines

Although it is but a comparatively short time since the practicability of a short-stroke, quick-acting, wheel-governing compound engine has been admitted by the leading engineering talent, the demand for such engines is now very extensive and is constantly increasing, and under proper operating conditions the economy of the compound engine is unquestioned.

Recognizing these conditions, the Harrisburg Foundry & Machine Works, of Harrisburg, Pa., has developed a complete system of engines of this nature, one size of which is shown herewith. In this design the low pressure cylinder is placed next to the engine frame, since this method insures a more substantial attachment than otherwise, and the high pressure cylinder, with the generously proportioned connection between them, has a bracket support which rests upon the end of the sub-base, which extends the full length of the engine. The bottom of this bracket support is planed with a tongue, which is fitted accurately in a corresponding groove in the top surface of the sub-base, bolts being provided in longitudinal holes, thus allowing expansion and contraction, but preventing any lifting tendency. Ample opportunity is provided for repairing or adjusting the piston and rings without having to detach the high pressure cylinder, piping, connections, etc., this being a most important consideration.



REAR VIEW OF ENGINE—GENERATOR REMOVED

The receiver, between high and low pressure cylinder, is a neat flanged casting with bolt attachment. The larger sizes are built with separate valve connections, whereby the high pressure valve is automatic in action, and the low pressure valve is driven by a fixed eccentric, so arranged, however, that the cut-off may be set by hand at any desired point. In this way, it is claimed the most economical results possible can be obtained under almost any changing conditions. A further advantage is obtained in this regard by the arrangement of the heads of the piston valves, which are adjustable, and so may have both "lead" and "lap" changed also to suit any and all conditions. The engines are provided with the Ideal automatic oiling system, and in closely graduated sizes, from 25 h.p. to 1200 h.p. The accompanying illustration shows the engine arranged for direct connection to generator. Belted styles are, of course, also built. There are already nearly one hundred of the Harrisburg engines of this style in operation.

New Method of Welding Rails in Germany

Herr Dr. Goldschmidt, chief chemist of the experimental laboratory of Essen, has invented a new method for welding street car rails, which is described as follows:

The Goldschmidt method for the production of high temperatures, as applied to the welding of street railway rails, has been tried on portions of the Essen Street Railway, after the possibility of the welding of rails of the Phœnix, or grooved section, of 180 mm. (7 ins.) height had been thoroughly demonstrated in the laboratory. The practical application of the principles are identical with the experimental. The rail ends, which must be perfectly square and thoroughly clean, are firmly forced together by a special clamping device. The general construction of this apparatus, of which several types were made and tried, consists of several cast steel pieces, which securely hold the rail ends in both a vertical and horizontal position, making it easily transferable from one joint to another. The total space it occupies when in position at the joint is about 80 mm. x 50 mm. x 30 mm. (3 ins. x 2 ins. x 1.2 ins.) When sufficient pressure has been secured the joint to be welded is covered by a sheet-iron casing, corresponding to the contour of the rail surface, and the whole covered with sand. The welding process proper is now ready to take place.

The welding compound, which is composed of pulverized oxide of iron and aluminum, is prepared in and poured from a crucible by means of long tongs.

A small portion of the compound is ignited in the crucible by means of a fuseé (zundkirsche), and the remainder is gradually brought around it so that the ignited portion is completely covered. Finally, a coating of fluid corundum appears, which radiates intense heat and a brilliant light. A residual metal settles in the bottom of the crucible. Inasmuch as the top layer of this corundum solidifies rapidly, it is necessary to remove it by means of an iron rod just before pouring. At first the fluid metal will run into the mould and cover the joint with a thin, hard coating. The corundum solidifies at a temperature considerably higher than that of the iron to be welded. When the metal that collected on the bottom of the crucible begins to flow, this coating referred to above prevents it from coming in contact with the rails and thereby injuring them. The sheet-iron form is also protected in this way, and permits its use over and over again. On cooling, the whole mass can be easily removed, on account of its brittleness, by being struck with hammers. During the application of this intense heat at the joint the metal expands, but, owing to the presence of the clamp, still greater pressure is caused, and the result is a perfectly sound weld, as has been demonstrated by breaking tests. A bending test, made by loading a joint with a weight of 45,000 kg. (99,000 lbs.), with supports 70 c.m. (27.6 ins.) apart, showed a permanent set of 2 c.m. (0.79 ins.) only, but a rupture occurred considerably later, by the application of a live load.

The entire work of welding a joint on the track can be accomplished by the aid of three men in a few moments. By using this device all cumbersome machinery is eliminated, the only necessary requisites being the metallic compound, which can be shipped in barrels; clamps, crucibles and a few other small utensils, thereby reducing the cost of transportation to a minimum. The cost of this operation is such that it can easily compete with the old method of fish-plates and copper bonding as a means of effecting a rail joint.

The New Street Railway Management in Washington

Col. George Truesdall, ex-Commissioner of the District of Columbia, and for many years closely identified with the business and public interests of Washington, has been elected president of the Washington Traction Company and of the street railway companies which it controls. The other officers of the properties are Charles A. Lieb, of New York, vice-president; H. D. Merrick, treasurer; James B. Lackey, secretary, and V. B. Deyber, assistant treasurer. The new directors are George Truesdell, O. T. Crosby, Charles A. Lieb, S. C. Stevens, George W. Young, Nathaniel Wilson, James B. Lackey, V. B. Deyber and H. D. Merrick.

Col. Truesdell is a native of Fayetteville, N. Y., but has lived in Washington for many years. He has been prominently connected with the city's real estate development, particularly in the suburbs, and is said to have been the original projector of Eckington and builder of the Eckington & Soldiers' Home Railway Company, which was one of the first electric railways in the country, and the first to use center-pole construction. Largely through the building of this road and the excellent results thereby given to the district, the property greatly increased in value, and houses were built so rapidly as to make this one of the most populous of Washington's suburbs. Col. Truesdell served as District Commissioner for three years under the Cleveland administration.

Street Railway Conditions in St. Petersburg

The street railways of St. Petersburg are single track lines, operated by horses, with double deck cars, of which three are usually run together. By the terms of the franchises the roadbed and rails become the property of the city on the expiration of the charter, the other property to be purchased by appraisement. The city has had possession of and has been running the best line, about ten miles long, for a year, and a suit is now pending to get possession of the remainder of the system. The city intends to equip the Nevsky Street Car Line with some electric system, but details have not yet been decided upon, and a number of interests are endeavoring to secure contracts. Belgian capitalists have been particularly active in their attempts to obtain contracts and franchises.

Personal

MR. H. A. JONES has been appointed secretary of the Oswego Traction Company, of Oswego, N. Y.

MR. JOHN A. WILSON has been appointed chief engineer of the Trenton Passenger Railway Company.

MR. FRANK J. SPRAGUE sailed for Europe on Wednesday via steamship St. Paul, to be gone for about six weeks.

MR. P. H. KING has been appointed manager of the Montgomery & Chester Electric Railway Company, of Montgomery, Pa.

MR. J. L. YOUNG, JR., is the new auditor of the Richmond Traction Company of Richmond, Va., taking the place of Mr. J. A. Cook.

MR. GEORGE W. MOFFAT has resigned his position as superintendent of the Doylestown & Willow Grove Trolley Road, of Doylestown, Pa.

MR. A. K. BAYLOR, general manager of the British Thomson-Houston Company, has arrived in America, where he will remain until about Sept. 10.

MR. WM. J. BURNS, general manager of the West End Traction Company, of Pittsburgh, died on June 16, 1899, in Paris, France, where he had been staying for his health.

MR. A. G. CARLSON, chief draughtsman of the Chicago City Railway Company, sailed for Europe on July 12 for a short recreation trip. He will visit Sweden before he returns.

MR. ROBERT P. LINDERMAN has been elected president, Mr. E. M. McIlvain vice-president, and Mr. R. W. Davenport general superintendent of the Bethlehem Iron Company.

MR. G. F. GREENWOOD, formerly general manager of the Consolidated Traction Company, Pittsburgh, will, it is stated, go to Cuba this fall to reconstruct the street railways in Havana.

MR. W. B. BROCKWAY, secretary of the Toledo, Bowling Green & Fremont Electric Railway, has been placed temporarily in charge of the system, owing to the death of President Jacoby.

MR. SAMUEL G. BOYLE has been elected secretary and treasurer of the Louisville Railway Company, of Louisville, Ky., to succeed Mr. James Pettus, who retires on account of ill-health.

MR. DANIEL T. HUNT has succeeded Mr. Charles T. Yerkes as president of the North and West Chicago street railway companies, which are leased to the Chicago Union Traction Company.

MR. EDWIN JACOBY, president and treasurer of the Toledo, Bowling Green & Fremont Electric Railway Company, and a prominent business man of Toledo, died last week after a short illness.

MR. J. HOWARD WILSON, president and general manager of the Mobile Light & Railway Company, of Mobile, Ala., has resigned his position to look after private business interests in New York.

MR. J. E. WOODBRIDGE, editor of the American Electrician, was married to Miss Ethel Hotchkiss, of New York, on July 25, at Grace Church. He and his bride left soon after the ceremony for Chicago.

MR. THEODORE STEBBINS, vice-president and manager of the Schenectady Railway Company, of Schenectady, N. Y., has been succeeded in that position by Mr. R. H. Fraser, of Des Moines, Iowa.

MR. W. R. CASSELS, who has been for many years connected with the electric lighting interests of Buenos Aires, Argentina, was in the United States, during July. He will return to Buenos Aires, via London.

MR. J. M ATKINSON, well known in street railway circles in connection with the Atkinson protected rail bonds, was married on June 21 to Miss Elizabeth Amolia, at the First Presbyterian Church, of Lynchburg, Va.

MR. C. C. JOHNSON, secretary and superintendent of the Raleigh (N. C.) Electric Company, has been appointed manager of the Ithaca (N. Y.) Street Railway Company, and will assume his new duties about July 15.

MR. A. K ASHWORTH has retired from the office of manager of the Youngstown Park & Falls Street Railway Company, of Youngstown, Ohio, and has been succeeded by Mr. Robert T. Ivory, formerly track superintendent.

MR. JOHN GRAHAM, the retiring general manager of the Wilkesbarre & Wyoming Valley Traction Company, of Wilkesbarre, Pa., was tendered a banquet on June 23, by his friend and business associate, William J. Harvey.

MR. N. GRABURN, assistant superintendent and electrical engineer of the Montreal Street Railway, has been appointed to the position of electrical superintendent of the Glasgow (Scotland) Tramways, and will leave Canada within a few weeks.

MR. P. A. B. WIDENER, the well-known street railway financier, of Philadelphia, is president of the National Export Exposition, which intends to hold a very extensive national exhibit of manufactures, in Philadelphia, from Sept. 14 to Nov. 30, 1899.

MR. H. J. MALOCHEE, of New Orleans, under whose supervision the Orleans Railroad of New Orleans was rebuilt, has been appointed constructing engineer of the Huntsville Electric Railway, of Huntsville, Ala., and material will be ordered and work begun at an early date.

MR. A. C. RODENBOUGH, who has accepted the superintendency of the Easton, Palmer & Bethlehem Electric Railway, of Easton, Pa., in connection with his present duties as superintendent of the Easton Transit Company, has appointed Nathan Capon division superintendent.

MR. J. H. PASSMORE, of Reading, Pa., will, on July 1, assume the duties of manager of the Schuylkill Valley Traction Company, of Norristown, Pa. Mr. A. G. Davids, formerly manager of this system, has resigned, and will go to Gloucester, N. J., to take charge of a railway at that place.

MR. WILLIAM KELLY, JR., has been appointed general passenger agent for the Niagara Gorge Railway Company. Mr. Kelly has been for some years the general Eastern passenger agent of the Chicago, Milwaukee & St. Paul Railroad, and is secretary of the Buffalo Passenger Association.

MR. GEORGE E. SCRANTON, superintendent of transportation of the Columbus Street Railway Company, of Columbus, Ohio, will leave on Sept. 20 for Havana, Cuba, where he will assume the direction of the construction of a street railway system to be built by a syndicate of Eastern capitalists.

MR. JOHN E. SEWELL, general manager of the Waterbury (Conn.) Traction Company, has been appointed general manager of the Connecticut Light & Power Company, with headquarters at Waterbury. This is the company recently formed by the consolidation of several Connecticut electric railway and lighting systems.

MR. CHARLES G. BURTON has accepted a position with the Chicago office of the Westinghouse Electric & Manufacturing Company. Mr. Burton has had an active electrical career, having originally been with the Brush interests, and later with the Central Electric Company, of Chicago, and the Sprague Electric Company, at Chicago.

MR. EUGENE CLARK, formerly superintendent of the Plank Road line of the North Jersey Street Railway Company, of Newark, N. J., has been succeeded in that position by Mr. James McDonough, who has had charge of the South Orange line. Mr. P. McDermott, of Jersey City, takes Mr. McDonough's place on the South Orange line.

MR. H. N. HURT has been appointed superintendent of the Atlanta Railway Company, of Atlanta, Ga. Mr. Will Glenn has been appointed assistant superintendent and purchasing agent, and Mr. N. W. L. Brown has been appointed superintendent of construction. These gentlemen hold similar positions with the Atlanta Consolidated Street Railway Company.

MR. M. F. H. GOUVERNEUR, who was formerly manager of the Wilmington (N. C.) Street Railway Company, and later on of the Yonkers Street Railway Company until its consolidation with the Union Railway Company, of New York city, has just accepted a position as general manager of the Mobile Light & Railway Company, of which Mr. J. H. Wilson is president.

MR. HORACE B. ROGERS has been chosen manager of the Brockton & East Bridgewater Street Railway Company and the Brockton, Bridgewater & Taunton Street Railway Company in place of James W. Shaw, resigned. Mr. Henry Reynolds has been elected secretary and treasurer. These changes are made in consequence of the consolidation of the two companies.

MR. W. E. COOKE, formerly connected with the Peckham Motor Truck & Wheel Company, and the Walker Company, is now in Perth, Western Australia, constructing a tramway for the Deep Leads Company, which owns several mining properties in Australia. Mr. Cooke reports the country a fine one, with conditions which do not differ very greatly from those found in America.

MR. and MRS. PHILIP DAWSON of London, who have been traveling in America for some two months, sailed for London via steamship "Trave," on July 25, having made a host of new friends as well as renewed many old ones. On July 24 Mr. and Mrs. Dawson gave a farewell luncheon at Delmonico's to their friends in New York and vicinity, of whom about twenty were in attendance.

MR. ALLEN R. FOOTE, the well-known authority on street railway legal and financial matters, has recently undertaken the publication of a new weekly paper, known as the "Other Side." It will be the object of this periodical to give the current views and expressions of writers and thinkers on both sides of such questions as treat on the relations of the public to quasi-public institutions.

MR. JOHN LUNDIE, whose office has been for some time in the Empire Building, has removed to 925 Exchange Court Building, 52 Broadway. Mr. Lundie's report to the Boston Elevated Railway Company, covering the cost of train service at different speeds, schedules, etc., has been presented to the company, and Mr. Lundie is now engaged on other important special work in a similar line.

COL. C. F. MORSE has retired from the position of president and treasurer of the Metropolitan Street Railway Company, of Kansas City, Mo. At the annual election of this company the following officers were elected: President, W. H. Holmes; vice-president, L. E. James; general manager, Conway F. Holmes; treasurer, W. E. Kirkpatrick, of Chicago, and general superintendent, W. A. Saterlee.

MR. GEORGE C. DRESSEL, president of the Dressel Railway Lamp Works, of New York, died July 3. He was born in Germany in 1828, and learned the trade of coppersmith. He came to this country when he was still a young man and entered the employment of the New York & Harlem Railroad, where he remained for eighteen years. In 1881 he began the manufacture of railroad signal lamps.

MR. C. R. HEAP, of London, the British representative of the C. & C. Company, of New York; the Wagner Company, of St. Louis; the Partridge Carbon Company, of Sandusky, and other American concerns, has been in America on a business trip for some time, and sailed by the New York on July 12. He reports that the business in Great Britain for American apparatus is very large and is constantly increasing. He has placed orders for apparatus to a considerable amount in America.

MR. S. L. NELSON, general manager of the Springfield Railway Company, of Springfield, Ohio, took occasion, upon the celebration of the fortieth anniversary of his birthday, which occurred June 23, 1899, to present each of the employees of the company with which he is connected with different sums of money, ranging from $1 to $10, as a token of his appreciation of their faithful services. The gifts amounted in all to over $600. The men in turn, to show their regard, presented Mr. Nelson with an elegant leather-covered chair and a number of small silver articles.

MR. S. W. CHILDS has charge of the construction of the Perth Tramways at Perth, Western Australia, immediately under Mr.

W. E. Cooke. Mr. Childs was engaged for some time in the United States in railroad construction work, having been connected with the building of the street railway systems at Brooklyn, Columbus, Ohio; Baltimore and Charleston, S. C. At the latter place he had full charge of the construction of the entire system, including the building of about 30 miles of track, erection of power house, car barns, etc. In 1893 he accepted a position with J. G. White & Company, and is now in Perth as their representative.

MR. LOUIS J. MAGEE, managing director of the Union Elektricitäts Gesellschaft, of Berlin, who went to Germany from America some years ago, has just been given special and very unusual honors in being elected one of six directors of the Association of German Electricians (Verbund Deutscher Elektrotechniker). Over this directory Herr von Siemens presides and Gisbert Kapp is general secretary. The association, which is seven years old, has 2395 members. Mr. Magee was instrumental in forming the Union Elektricitäts Gesellschaft in 1892, to take up the Thomson-Houston business for a large part of Europe and European and Asiatic Russia, and has become widely known in Germany and other countries as an engineer and business man.

MR. EDWARD B. WYMAN and MR. ALLEN H. P. STONEHAM, of London, were in the United States last month for a short visit. Both of these gentlemen are prominently connected with the Deep Leads Electric Transmission Company, of Victoria, Australia, and with the Perth Tramways at Perth, Australia. Mr. Stoneham is managing director of several, and director in a number of large mining companies in Victoria, Western Australia, British Columbia and other parts of the world. He is the chief owner of, and individually financed the Perth Tramways. He is also interested in a number of power transmission properties in different parts of the globe. Mr. Wyman is the managing director of the Deep Leads Transmission Company, and the Victorian Deep Lands, Ltd., and a director of the Kalgoorlie Power syndicate. He is an American, and was engaged for several years in the electric heating business in the United States. In addition to his connection with the Deep Leads enterprise he is interested in several other mining projects.

MR. J. B. CAHOON, general manager of the Elmira Municipal Improvement Company, which operates the electric railway, lighting, gas and waterworks of that city, has resigned his position in order to accept that of general manager of the Syracuse Underground Electric Wiring Company, which controls the franchise for underground wiring in Syracuse, and has also a franchise for operating an electric plant. The new company is composed of Messrs. William L. Elkins, Stephen Peabody, Henry Seligman, Hollister & Babcock, Robert C. Pruyn and local capitatlists, and will have a capital of $500,000, nearly all of which will be spent immediately in putting up a new electric lighting plant. Mr. Cahoon is a graduate of the Annapolis Naval Academy, class of 1879. In 1889 he became connected with the Thomson-Houston Company, and organized the expert department of the General Electric Company after the consolidation in 1894. He later became chief engineer of the local companies committee, and at different times had charge of thirty-seven electric lighting and two street railway properties owned by the General Electric Company. He went to Elmira in 1895, where his record has been exceptionally good.

AMONG THE MANUFACTURERS

THE UNION TRACTION COMPANY, of Philadelphia, is making some tests with the Christensen air brake on its York Road line.

C. W. MOFFETT has taken the management of the Boston office of the Heine Safety Boiler Company, of St. Louis, in place of Russell Walker, recently resigned.

W. H. WISSING has been appointed general agent for Nagle, Holcomb & Company, of Chicago, and will have his headquarters at 642 Century Building, St. Louis, Mo.

R. W. BLACKWELL & COMPANY, of London, have been successful in the suit brought against Greenwood & Batley, Ltd., of Leeds, for £608 15s. 2d., claimed to be due for material furnished.

THE PARRISH SIGNAL COMPANY, of Jackson, Mich., has just finished the installation of a block signal system on the Rochester Railroad, at Rochester, N. Y., which is giving perfect satisfaction.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has published another of its regular bulletins, this one being No. 51. It describes in detail the installation of chloride accumulators in the Dun Building, at New York.

THE MILWAUKEE RAIL JOINT & WELDING COMPANY, of Milwaukee, Wis., has closed a contract for 2000 joints for the Columbus Street Railway Company. The work of installing these joints is to begin during the month of August.

THE PECKHAM TRUCK COMPANY, of Kingston, N. Y., and New York City, was awarded a contract last month for 200 trucks by the Boston Elevated Railway Company. This is in addition to the order given the same company a few months ago.

FRED. H. FITCH, having become financially interested in the Electrical Installation Company, of Chicago, was at a special meeting of the stockholders held June 17, elected a director, and at a subsequent special meeting of the directors elected vice-president of that company.

THE STILWELL-BIERCE & SMITH-VAILE COMPANY, Dayton, Ohio, has been awarded the contract for the turbine wheels for the Virginia Electrical Railway & Development Company. The order calls for four pairs of Victor wheels, the contract price being about $20,000.

THE JOSEPH DIXON CRUCIBLE COMPANY, of Jersey City, has prepared a pamphlet describing in full the new process of brazing by immersion, a process that is particularly adapted to the bicycle trade, but is also applicable wherever the uniting of two metals by brazing is desired.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, has recently received orders for four Warden oil filters and refiners, from the Alaska Treadwell Gold Mining Company, of San Francisco, for use in Alaska. Two of these were purchased after the first two had been thoroughly tried.

MAYER & ENGLUND, of Philadelphia, the well-known supply dealers, have found their New York business grow so rapidly as to compel them to establish an office in this city. This enterprising firm has therefore opened an office at 85 Liberty Street. It will be in charge of Edward L. Philips.

GEORGE HIPWOOD, of the Hipwood-Barrett Car & Vehicle Fender Company, of New York, has sold the European patents on his car fender to Hermann Romünder. The company will manufacture fenders for the European trade, and will be represented at Cologne, Germany, by Ferdinand Romünder.

THE PROVIDENCE ENGINEERING WORKS, of Providence, R. I., states that the cylinder dimensions of the Greene engines installed by them at the power station of the United Traction Company, of Pittsburgh, are 20 ins. and 38 ins. x 48 ins., and not 28 ins. and 38 ins. x 48 ins., as stated in the last issue.

THE LACLEDE CAR COMPANY, of St. Louis, reports that this has been one of the best and most satisfactory seasons it has ever had. Although its big plant has been running to its fullest capacity the work has nearly all been for its regular customers, who it has endeavored to take good care of by filling the orders with its usual promptness.

THE MILWAUKEE RAIL JOINT & WELDING COMPANY, Milwaukee, Wis., has secured the contract for cast welding 2000 joints for the Columbus Street Railway Company, Columbus, Ohio. The steel jacketed joint which this company is manufacturing has long since proved itself a success, and is meeting with the approval of street railway men everywhere.

THE SHERWIN-WILLIAMS COMPANY, manufacturers of paints and colors, and having offices at Cleveland, Chicago, New York, Montreal and Boston, are sending to the trade a very unique paper-weight, consisting of a very ugly looking animal resting upon an imitation bronze base. This little gift will be appreciated by all fortunate enough to be presented with one.

THE KEYSTONE LUBRICATING COMPANY, of Philadelphia, is receiving proof almost continually of the satisfaction given by the Keystone motor greases, in the shape of testimonial letters from prominent firms, stating they have used and tested these lubricants, and will hereafter use no other brand. One letter states 10 lbs. of Keystone grease lasted a car for two months, during which it ran 8205 miles.

THE CONTINENTAL CONSTRUCTION COMPANY, of Boston, Mass., has just declared a semi-annual dividend of 5 per cent. This company is now building and equipping the Buffalo,

Hamburg & Aurora Street Railway, a Buffalo (N. Y.) suburban line of 22 miles in length. The company gives its whole attention to the building and equipping of electric railways, and has some other good orders in hand.

GATES & RANDOLPH, of Chicago, the new firm of engineers and contractors, have brought out a pamphlet describing a few of the specialties which they handle. These are, improved generators and motors, manufactured by the Triumph Electrical Company, of Cincinnati; the Warren inductor, Empire electric instruments, Scheffer transformers, wattmeters, ammeters, voltmeters, etc., circuit breakers and arc lamps.

A. L. IDE & SONS, of Springfield, Ill., are sending out a catalogue which fully sustains the concern's reputation for careful and painstaking work. The brochure describes the "Ideal" automatic cut-off steam engines, and great care has been taken to make it of real value to engine purchasers. The latter half of the book describes the different parts in detail, cross sections being shown of the cylinders and pistons, cross-heads, etc.

THE WARD-LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., has just issued its catalogue No. 996, devoted exclusively to a description, with price list and cuts, of the Carpenter enamel rheostats. The catalogue contains information regarding 125 different standard forms of field rheostats, all of which are carried in stock by this company. It is noticed the prices quoted are very much lower than those given last year.

THE JOHN A. ROEBLING'S SONS COMPANY, of New York, brought out last month a very pretty Fourth of July souvenir, being a printed and photographic reproduction of the Declaration of Independence, the latter, with signatures appended, and with a beautifully printed cover, showing in antique style an old bell-ringer passing through Philadelphia streets proclaiming the declaration. The whole thing is a charming souvenir well worthy of preservation.

A. L. IDE & SONS, of Springfield, Ill., has filed suit in the United States Circuit Court by Addie F. Ide, Roy W. Ide and Francis P. Ide, executors under the last will and testament of Albert L. Ide, against the Trorlicht, Duncker & Renard Carpet Company, Joseph F. Chuse and Richard Heap. J. F. Chuse is a resident of Mattoon, Ill. The complainants claim to have a patent on improvments in lubricating devices for engines. They pray for an injunction against infringement.

THE HARRISON SAFETY BOILER WORKS, of Philadelphia, Pa., is sending out a neat brochure, which it has been pleased to call "A Peculiar Sort of a Treatise on Feed Water Heaters and Steam Separators." The book, however, sets forth in an extremely forcible manner the claims made for these Cochrane specialties, and it should be in the hands of all steam users who are looking for up-to-date methods of increasing the efficiency of the plants under their charge.

THE CENTRAL ELECTRIC COMPANY, of Chicago, Ill., called attention in its advertisement last month to "The Gem" overhead material, which was also described in the reading columns of the same issue. Through a typographical error in the advertisement the beaded skirt, one of the distinctive features of "The Gem" material, was made to read beaded shirt, and this correction is made in order to stem the flood of orders for beaded shirts which the company is receiving as a result of this error.

THE BETHLEHEM STEEL COMPANY, on the 26th of June formally took over the property, etc., of the Bethlehem Iron Company, of South Bethlehem, Pa., which latter company has leased its works, etc., to the former company. The officers of the Bethlehem Steel Company are: Robert P. Linderman, president; Edward M. McIlvain, vice-president; Abraham S. Schropp, secretary; C. O. Brunner, treasurer; R. W. Davenport, general superintendent; Owen F. Leibert, chief engineer; Charles P. Coleman, purchasing agent.

THE MORRIS ELECTRIC COMPANY is the name of a new corporation just formed as the successor to Elmer P. Morris, of New York. Mr. Morris is treasurer of the new organization, and the business will be carried on largely on the same lines as formerly, with the exception that the company will also engage quite extensively in the manufacture of specialties for the electrical trade. Mr. Morris reports an excellent showing in orders for the last month, particularly in rail bonds. Many contracts have come from foreign countries.

THE SIEGRIST LUBRICATOR COMPANY, of St. Louis, Mo., reports that the Arnold Electric Power Station Company, of Chicago, Ill., after a most thorough investigation of the different kinds of oiling systems, has awarded it the contract to equip the large new power and electric light plant now being erected for the "Imperial Electric Light, Heat & Power Company," of St. Louis, Mo., with the Siegrist "automatic oiling system." This power station is to be one of the most elaborate and perfectly equipped plants in the country.

THE ELECTRICAL INSTALLATION COMPANY, of Chicago, has just completed 5 miles of track and overhead work at Waupaca, Wis., it having had the contract for the complete equipment and construction for the Waupaca & Chain o'Lakes Electric Railroad, which is mentioned elsewhere in this issue. It also has on hand four separate contracts for extensive track and overhead construction for the Metropolitan Street Railway Company, of Kansas City, Mo., as well as additional work for the Vicksburg Railroad, Power & Manufacturing Company.

THE McGUIRE MANUFACTURING COMPANY, of Chicago, is sending out a collection of loosely bound sheets, each one bearing a large half-tone engraving and a short description of some one of the company's specialties. These include the McGuire adjustable traction truck, the No. 39 double truck, the No. 35 motor truck, the solid steel Columbian truck, the No. 28 double frame "L" truck, and the combination snow plow and sweeper. Upon one page appears a list of over seventy-two street railway companies using the McGuire plow and sweeper.

THE SIMONDS MANUFACTURING COMPANY, of Pittsburgh, Pa., announces that it has transferred its Pacific Coast agency from the C. B. Kaufman Railway Supply Company to the Electric Railway & Manufacturers' Supply Company, of 548 Mission Street, San Francisco, Cal. The Kaufman Company has no longer any connection with the Simonds Company, and all communications intended for the latter concern should be addressed either direct to Pittsburgh or to the new agents. A stock of gears and pinions will be carried in San Francisco, as heretofore.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, presents in its new catalogue reproductions and descriptions of its apparatus for direct current electric light and power, and particular attention is called to the special applications of its slow speed direct-connected motors, which are shown therein, and in which the company takes pardonable pride. The company's new factory is equipped with the most modern and improved machinery throughout, all electrically driven, and every department is under the most thorough inspection of experts in each particular line.

THE IRONSIDES COMPANY, of Columbus, Ohio, reports activity on all lines of its specialties, both in domestic and foreign trade. Among the products of this company is a special lubricant for gear teeth, that forms a deposit on the working surfaces of teeth, protecting the parts from wear, and incidentally avoiding noise of operation. It is in use by many street car companies on their motor gearing, whose endorsement indicates satisfaction experienced in decreased noise and retarded wear. The Ironsides Company is publishing a series of very readable pamphlets describing its specialties. These include, in addition to the lubricant, boiler scale solvents, gear shields, rope fillers and shields, etc.

THE GENERAL ELECTRIC COMPANY, of Schenectady, has published its usual number of bulletins during the past few weeks, among them being No. 4186, devoted to single-phase alternating current generators, 125 cycles; No. 4187, to artificial light for mills; No. 4188, to electric railway locomotives, etc. The company has also issued from its press a very entertaining little pamphlet entitled "A Trip to the Schenectady Works of the General Electric Company." This last was published for the benefit of the delegates to the recent convention of the National Electric Light Association, and is a brief resumé of the most noteworthy features encountered in a trip from New York to and through the great Schenectady works.

THE CLING-SURFACE MANUFACTURING COMPANY reports rapidly increasing sales, not only in this country, but many orders are being received from Australia, European and South American countries, with a fast growing business in Mexico, all seeming to prove that the truth of the company's motto, "The days of tight belts are over," is being accepted by belt users. A recent letter from the engineer of Brown, Durrell & Co., of Boston, to the company says: "Having tried cling-surface on my 12-in. dynamo belt, I have been able to carry full load with 22-in. sag on belt, with no perceptible slip. It surpasses my expectations, and I can cheerfully recommend it to do all that is claimed for it if directions are followed."

THE NEW YORK SAFETY STEAM POWER COMPANY, of New York, is having excellent success in the manufacture and sale of the Worthington steam boilers, described and illustrated in a recent issue of the STREET RAILWAY JOURNAL. Among the recent orders which this company has received for these boilers are three boilers for the St. Dennis Hotel, New York; two boilers for the Heermance Refrigerator & Cold Storage Company, New York, and boilers for the Hygeia Ice Company, Polytechnic Institute, of Brooklyn; Seminole apartment building, New York, and Grand Union Hotel, New York. The latter has been using two of these boilers for the last six or seven years, and has recently placed an order for a third boiler.

G. A. DENTZEL, builder of steam and electric motive power carousels and organs, of 3635-41 Germantown Avenue, Philadelphia, has recently shipped carousels to the following places: One to Idlewild Park, Pittsburgh; one to Kenwood Park, Pittsburgh; one to Youngstown, Ohio, and one to Parkersburgh, W. Va., in addition to many that were shipped during the winter for the early spring business. He also recently shipped one to Para, Brazil, which has given such satisfaction, and has proved so profitable, that Mr. Dentzel has recently received a letter from the people to whom he sold the carousel, stating that the order would be followed by others in the near future. Mr. Dentzel has also recently placed a carousel in Washington Park, Philadelphia, and Castle Rock Park, near Philadelphia.

THE HARRISBURG FOUNDRY & MACHINE WORKS, Harrisburg, Pa., is to be congratulated upon its new publication entitled "A System of Engines." Although primarily a trade catalogue, the work has been so extended and enlarged as to comprise a very valuable treatise upon the theory and practical operation of the modern steam engine. The book has been published in two editions, one in paper cover for general distribution, and the other handsomely bound in heavy cloth covers, and printed on extra fine paper, and known as the "library edition." This latter will be very extensively circulated, with the compliments of the company, to the mechanical and electrical professions. This company reports its factory is running night and day to keep up with orders on hand, although its present capacity is three times greater than it was in 1897.

JOHN S. NOWOTNY, of 313 East Second Street, Cincinnati, Ohio, announces to the public and his many friends in the electrical business and kindred lines that he severed his connection with the Nowotny Electric Company March 31, 1898. Mr. Nowotny founded the Nowotny Electric Company, and managed the business from its infancy until March 31, 1898. The assignment of the Nowotny Electric Company, which occurred June 30, 1898, in no way affects him. After severing his connection with the above named company he immediately started the manufacture of Nowotny's semi-vacuum long-burning inclosed arc lamps and electrical specialties. The latter business is owned solely by him and operated under his personal supervision and name, and is in no way connected with the Nowotny Electric Company.

THE DUPLEX CAR COMPANY, of New York City, is building cars for the Buffalo, Hamburg & Aurora Street Railway Company, the Ithaca Street Railway Company, the Norfolk Southern Street Railway Company, the Norton & Taunton Street Railway Company, the Bristol County Street Railway Company, Greenville (Miss.) Street Railway Company, Winneconnet (Mass.) Street Railway Company, Allentown & Kutztown Traction Company, Monmouth Traction Company (Pa.), etc, and Duplex cars are going as far away as Honolulu. The Duplex Car Company reports that its representatives abroad have recently visited Armenia, and are making extensive preparations to introduce these cars on the continent. Contrary to some expectations it has been found that it is possible to keep this type of convertible car as warm in winter as the ordinary closed car.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, Ohio, reports June sales as follows: Deere & Company, Moline, Ill.—One 75-kw. moderate speed belt driven generator; Consumers' Park Brewing Company, Brooklyn, N. Y.—two 50-kw. engine type generators, one 7.5-h.p. type "H" motor, one 10-h.p. type "H" motor, two 20-h.p. type "H" motor; Pacific Coast Borax Company, Bayonne, N. J.—one 100-h.p. type "H" motor (375 r.p.m.), one 25-h.p. type "H" motor, one 15-h.p. type "H" motor, one 25-h.p. type "N" motor (back geared); Ruppert Brewing Company, New York—one 100-kw. engine type generator, one 50-kw. engine type generator; Southern Electrical Supply Co., St. Louis, Mo.—one 50-kw. engine type generator, one 25-h.p. type "H" motor, one 12.5-kw. type "H" generator, and many others.

New Publications

Some Glimpses of Elmira. Paper. Illustrated. Published by the Maple Avenue Railroad Company and the West Side Railroad Company, Elmira, N. Y.

This handsomely illustrated pamphlet is a complete street railway guide to Elmira and the surrounding country, and particulars of interesting features in the neighborhood are given. The book contains a large number of advertising pages.

"How Should the Franchise Question Be Settled?" a paper submitted to the League of Illinois Municipalities in 1899, is the title of Part I. of Mr. Foote's able work; "Powers of Municipalities," a paper submitted to the Commercial Club, of Indianapolis in 1898, is the title of Part II.; and "Cost of Service to Users and Tax Payers," a paper submitted to the National Conference of Mayors and Councilmen, at Columbus, Ohio, in 1897, is the title of Part III.

This book is cordially recommended to street railway managers and other students of municipal problems, as an indispensible part of their working equipment.

Practical Electricity. Cloth. 286 pages. Illustrated. Price, $2.00. Published by the Cleveland Armature Works, Cleveland, Ohio.

This book is written throughout by practical men for the purpose of reaching that class of mechanics who are daily called upon to operate electrical machinery without knowing very much of the general construction. The principal feature, which is believed to be original, is the review of each chapter. After the reader has finished a chapter sufficient questions to thoroughly review the subject and to bring out all the important points, are asked at the end of the chapter. These questions the reader must study out and answer for himself, according to his judgment. He can then verify the same by turning to the back of the book, where all answers to questions are given.

Municipal Public Service Industries. By Allen Ripley Foote. The Other Side Publishing Company, 126 Market Street, Chicago, Ill. Cloth. 337 pages. Octavo. Price, $1.00.

Mr. Foote has undoubtedly given more time to the study of municipal problems, particularly those affecting public service industries, than has any other American economist, and his writings are always valuable and interesting. The present volume is composed of three discussions of questions involved in the ownership, operation and proper regulation of municipal public service industries, written for different occasions, and now published with a full index to facilitate an examination of the elements of the subject and a study of it in its entirety. The problems are examined from the standpoints of taxpayers, users of the services, employees and investors, and a scheme is presented by which it is hoped that municipalities and private capital can come together on a fair, equitable and permanent basis to avoid the many difficulties and disagreements which now occur.

Trade Catalogues

Catalogue for 1899 and 1900. Published by the Gold Car Heating Company, New York. Cloth. 80 pages. Illustrated.

Catalogue. Published by Gates & Randolph, Chicago. 20 pages. Illustrated.

Feed Water Heaters and Steam Separators. Published by the Harrison Safety Boiler Works, of Philadelphia. 48 pages. Illustrated.

Catalogue. Published by the Bullock Electric Manufacturing Company, of Cincinnati, Ohio. 62 pages. Illustrated.

Catalogue. Published by A. L. Ide & Sons, Springfield, Ill. 16 pages. Illustrated.

The Application of Storage Batteries to Isolated Plants. Published by the Electrical Storage Battery Company, Philadelphia. 6 pages. Illustrated.

Various Catalogues. Published by the General Electric Company, of Schenectady, N. Y. Illustrated.

A System of Engines. Published by the Harrisburg Foundry & Machine Works, Harrisburg, Pa. 111 pages. Illustrated.

Rheostats. Published by Ward, Leonard Electric Company, of Bronxville, N. Y. 15 pages. Illustrated.

Brazing by Immersion. Published by Joseph Dixon Crucible Company, Jersey City. 48 pages. Illustrated.

Various Catalogues. Published by The Ironsides Company, of Columbus, Ohio. Illustrated.

Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, SEPTEMBER, 1899. No. 9.

A CROSS COUNTRY ELECTRIC RAILWAY IN EASTERN MASSACHUSETTS

The remarkable electric railway system of Eastern Massachusetts, a system comprising nearly 1500 miles of track contained within but five counties, and paralleling and cross connecting with the closely-woven network of steam railroad lines contained in the same area—all giving transportation facilities to the people of this favored section unequaled in the world—has been developed in three different stages.

In the first stage, the half dozen independent horse railway properties in Boston and the immediate suburbs were reduced by consolidation to two, electricity was adopted, and, thus possessed of greater competitive power in the suburban transportation field, the lines of the metropolitan system were pushed into an outer fringe of suburbs, still, however, contained within a radius of about 10 miles of the central business district.



CAR HOUSE, TRANSFORMER STATION AND WAITING ROOM OF THE NORFOLK WESTERN STREET RAILWAY

The mileage of this consolidated metropolitan system was then (1890) larger than that of any other street railway property in the world. The money requirements for reconstruction and electrical equipment were so heavy, the organization was so complex, and the engineering and operation problems were so absorbing that the management had little time or disposition to add to its burdens by reaching out still further into the surrounding country, although the beautiful clusters of cities and towns, north, west and south, must have offered great temptations, in spite of the more or less uncertainty in those days about the traffic-developing power of electric traction.

The second stage, therefore, came in the building by independent companies of a large number of "feeder lines" tributary to the metropolitan system, and laid out still on lines radiating from the city proper. These lines were generally profitable almost from the first, and later on became quite distinctly so, as a rule, though a rule not without exceptions. The increase of transportation facilities brought about a movement of the population from the city and the near-by suburbs to the remoter ones, buildings went up rapidly, and while there was little direct "booming" of real estate, such as is found in newer and less conservative districts, there was a substantial and very heavy growth of population and increase of values, which had a reflex action upon the prosperity of the electric railways in the new territory.

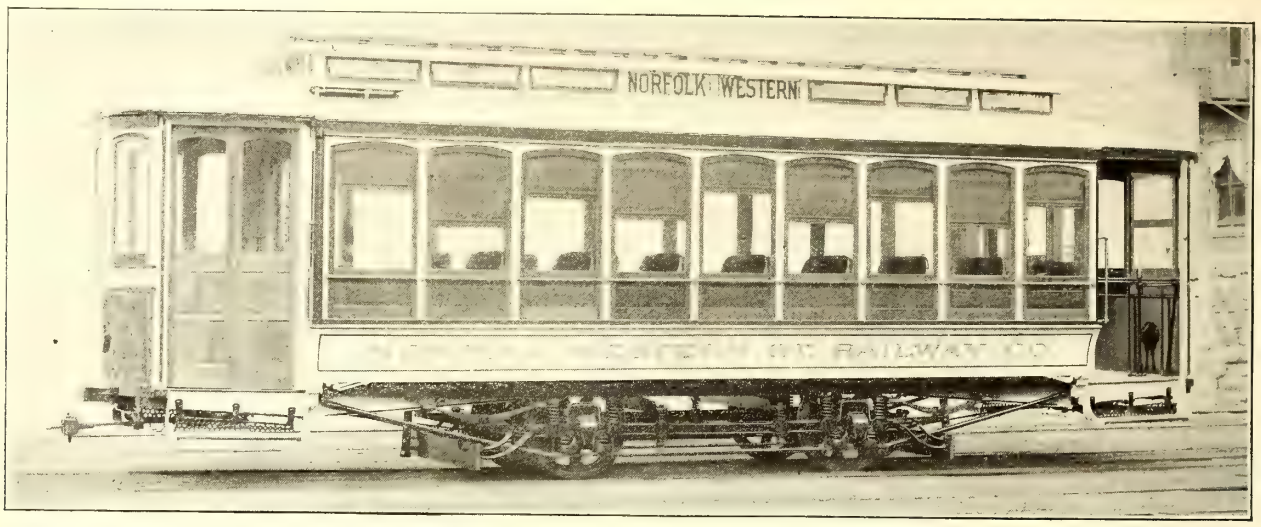
Now, Boston is by no means the only business and manufacturing city in Eastern Massachusetts. Lynn, Lowell and Lawrence on the north, Worcester on the west and Brockton on the south, are all centers of an independent money-making activity, each with its own suburbs and townships more or less dependent upon it for trading purposes. It came about naturally, therefore, that these cities also should first have their own local systems, and should then follow the example of the Boston lines in gradually extending to adjoining townships. The result was, therefore, a series of little independent street railway networks separated from the metropolitan system, but awaiting only opportunity, courage and capital to become firmly welded thereto.

Thus has come the third stage in Massachusetts' electric railroading, by which "cross country" connecting lines are building everywhere throughout this rich territory. It is now a joining together of small towns and of suburbs each with the other, the metropolis itself being only indis-

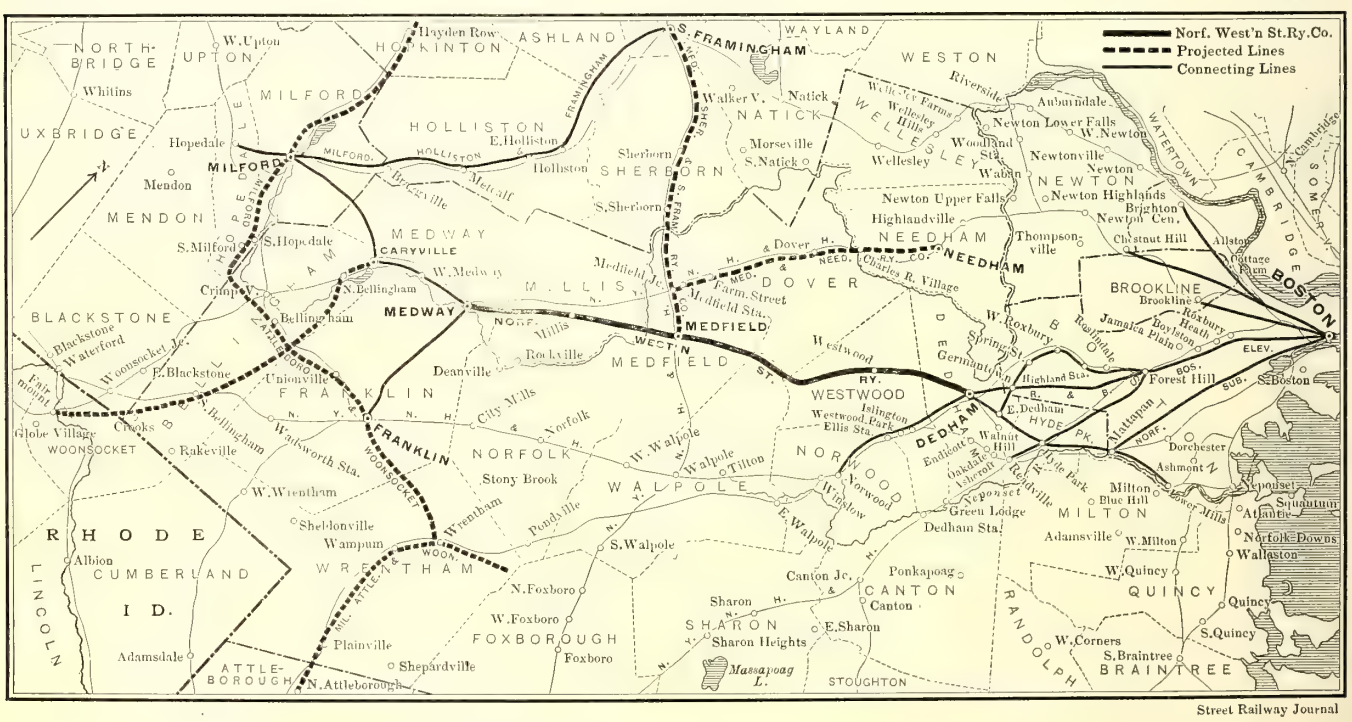
tinctly visible through many transfer connections. Pleasure riding has become a science in Eastern Massachusetts, and guide books, time tables, posters and all the varied literature which we have been accustomed to think of as belonging solely to railroad passenger departments have been drawn into service to increase the movement of the population from one point to another. Parks have been developed to some extent, although the magnificent park and boulevard system which the State of Massachusetts has so wisely provided in this beautiful district, furnishes in itself almost sufficient attractions to the people for pleasure riding.

Nevertheless, these cross country lines must, as a rule, look to the future rather than the present for any large profits, and it is probable that their destiny lies largely in consolidation, rather than in independent existence. This consolidation has, in fact, already commenced, for during the past few months there have been brought together under one control more than thirty street railway properties, built in the first and second stages of development, and forming the "Massachusetts Electric Companies," so called. As the earning power of the cross country lines is ascertained and established, it is probable that further absorptions may take place.

One of the most prominent centers of electric railway activity in the entire district of Eastern Massachusetts is the quiet town of Dedham, lying 10 miles to the south of Boston, and forming the terminus of the "Dedham Circuit Line" of the New York, New Haven & Hartford Railroad, upon which an excellent train service is given. Dedham is connected with Boston through Forest Hills and with the coast line by electric railway lines which have a large patronage. Within the last two years a line has also been built to Islington and Norwood on the south, and in May, 1899, the Norfolk Western Street Railway Company, the subject of this present article, opened its line from Dedham through Westwood to Medfield. Construction is now going on from Medfield through Millis to Medway (see map herewith), and these lines will eventually connect with the Milford, Attleborough & Woonsocket Street Rail-



CONVERTIBLE CAR, NORFOLK WESTERN STREET RAILWAY COMPANY



MAP OF NORFOLK WESTERN RAILWAY AND ALLIED LINES

way, to be built by the same parties in interest. From Medfield also will be built the Medfield, Sherborn & South Framingham Street Railway and the Medfield & Needham Railway, both owned also by parties interested in the Norfolk Western Street Railway Company. At Milford and Dedham the Norfolk Western system joins the line of the Massachusetts Electric Companies, thereby obtaining Boston connections.

By the last Massachusetts census, in 1895, the population of Dedham was 7211, of the town of Dover 668, of Westwood 1800, of Medfield 2872, a total population



TRANSFORMER STATION AT WESTWOOD

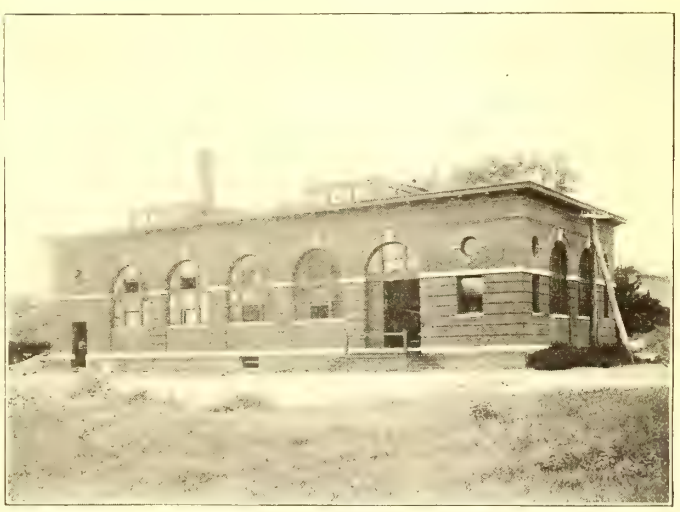


DEDHAM TERMINUS

reached by the portion of the line so far built, of 12,551. Adding to this population that of Millis and Medway we obtain a total population for the present and projected lines of the Norfolk Western system alone of about 34,551. The fare from Dedham to Westwood is 5 cents, from Dedham



MEDFIELD TERMINUS



POWER STATION AT MEDFIELD

to Medfield 10 cents, and when the extension to Medway is completed an additional 5 cents will be charged. The distance from Medfield to Boston by the combined electric roads will be 19 miles and the fare 20 cents, as against the steam railroad distance of 24 miles with 56-cent fare, while from Medway, which is on another branch of the New Haven system, the distance from Boston is 26 miles and 61 cents fare is charged, while by the electric road the distance is 24 miles and a 25-cent fare will be charged.

The country through which the line passes is distinctly a farming region except that Dedham has a large suburban residential population. The country is exceedingly beautiful in summer, the line passing through pleasant groves and long, quiet country roads to its termini at Dedham and Medfield Squares.

It is obvious that in building cross country lines of this character, where cars must be run at comparatively infrequent schedules, at least until sufficient traffic is developed to warrant closer ones, the investment account should be kept as small as possible. The distribution system particularly might easily be a heavy burden to carry if ordinary 500-volt direct current distribution were adopted, or if power stations were placed ill advisedly. On the other hand, speed is a necessity in this cross country work, and great care must be taken with the roadbed and equipment to permit high speeds to be obtained.

The Norfolk Western Street Railway Company has built its line thoroughly and well, and no money has been spared to give the property the best chance of success from an engineering standpoint. As a consequence, it is in many respects a model cross country road, the characteristics of which may well be carefully studied by those who are proposing to do work of a similar character.

The line as so far constructed from Dedham to Medfield is 9 miles in length. Its maximum grade is 5 per cent and its curves are from 125 ft. to 145 ft. radius. The track is placed chiefly on the side of the road, with bracket pole construction, and there are a number of crossings from

one side of the road to the other, which, joined with the general crookedness of the country road over which it runs, makes the track itself follow anything but a straight line. In Dedham and Medfield 90-lb. girder rails are used, and between the cities 60-lb. T rails. The ties are oak, and are placed 18 ins. apart between centers, and the rails are laid with broken joints, each joint laid on two ties. The sub-structure is rock ballast and gravel, and is firmly settled and placed so that the track is quite smooth and easy running. The rails are double bonded and cross bonded every 100 ft. with Chicago bonds. The poles are of hard pine and chestnut, and iron brackets are used.

The rolling stock consists of four Brill convertible cars, three Laconia open cars and twelve smaller Ellis cars, used for trailers. The Brill convertible cars differ materially from any of the same type which have hitherto been put in operation. They are completely vestibuled, so that the same winter protection is given as in cars for the most extreme northern service. The vestibules are arranged so as to have as much window surface as possible, thus giving the motorman a clear view in all directions. The body length is 22 ft. 11 ins., and the length over all is 32 ft. The windows are fitted with sash and panels which lift out. These panels are all cherry, and are finished in the natural color of the wood. When they are removed the car becomes to all intents and purposes open. The curved panels below the seat not only strengthen the body, but add to the safety of the car in case of accident. The drop platform and a step with 13-in. rise bring the tread of the step within $15\frac{7}{8}$ ins. of the head of the rail.

Inside, the car is 8 ft. 2 ins. in the clear. On each side of the center aisle are seven seats, with reversible backs, and at the ends are four stationary seats. The total seating capacity of the car is thus thirty-two. The seats are upholstered in red plush. The interior finish over the windows is of cherry and the head lining is of maple veneer highly decorated.

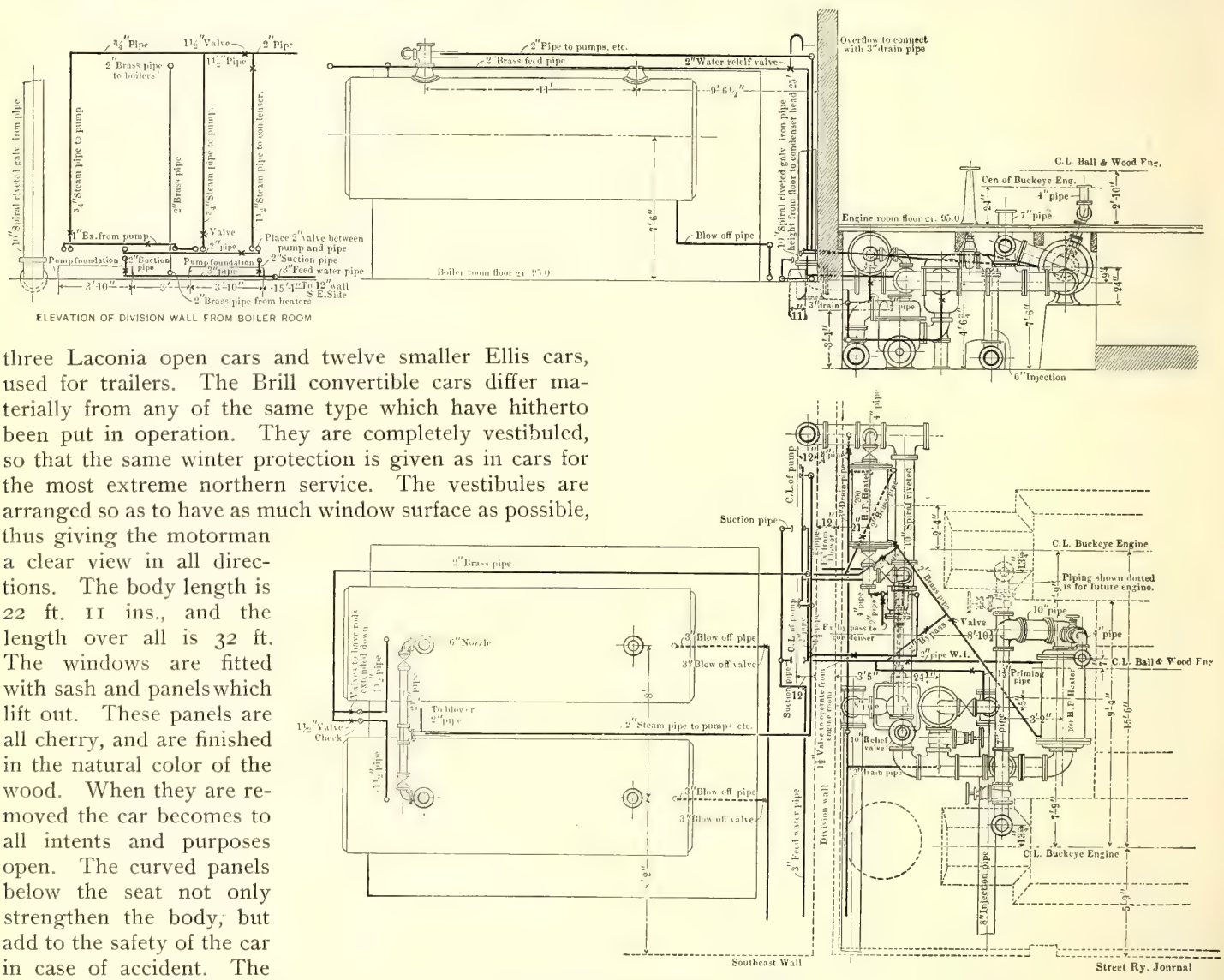
A Gold electric heater is placed under each seat. The car is lighted with nine lights within, and one for the headlight. New Haven registers are used.

The cars are mounted on heavy No. 21-E Brill trucks, with an 8-ft. wheel base. The wheels are 33 ins. in diameter and the gage 4 ft. $8\frac{1}{2}$ ins. "Composite" brake shoes are used, manufactured by the Barbour-Stockwell Company. The electrical equipment consists of two G. E. 1000 motors, with series multiple controllers, etc. Sterling brakes are used.

The company also owns a Wason snow plow and a Trenton tower wagon, and has fitted up a short car as a watering car, which will run over the road regularly.

The three-phase system of electrical distribution has been adopted for this road after the most careful consideration on the part of the company's engineers, Hodges & Harrington. The power station is located at a point in Medfield about 2 miles southwest of the present Medfield terminus of the constructed road, and is thus in position to feed the line both ways, towards Dedham and towards Milford. A 60-cycle 2080-volt current is generated at this station, at which pressure it passes over the line to the transformer station at Westwood, where step-down transformers deliver it at 340 volts alternating to rotary converters, from which a 550-volt direct current passes to the trolley wire. By means of the high voltage line transmission the three-phase feeders from Medfield to Westwood consist of but three 00 wires and a single direct-current feeder runs $1\frac{1}{2}$ miles each way from the Westwood transformer station, and is 0000 in size. A 00 trolley wire is used. The fluctuations on the line, which would naturally be somewhat heavy owing to the small number of cars used, are reduced in amount by the use of a storage battery consisting of 264 cells of the chloride type, made by the Electric Storage Battery Company, of Philadelphia.

The power station at Medfield Junction is a handsome,

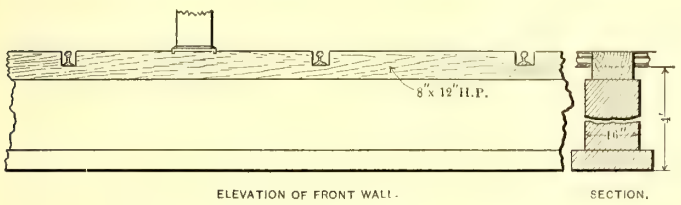


PLAN AND ELEVATION OF POWER STATION AT MEDFIELD

ELEVATION OF DIVISION WALL FROM BOILER ROOM

well-built brick and granite structure, 85 ft. long x 40 ft. wide, containing the engine room, 48 ft. x 40 ft., and the boiler room, 37 ft. x 40 ft. A tar and gravel roofing covers the station. It was built in 1898-9 by the Jarvis Engineering Company, Hodges & Harrington being the consulting engineers and Robert Coit, the architect. In the engine room is a 250-h.p. Ball & Wood engine and two 140-h.p. Buckeye engines, belted to four General Electric three-phase generators by 16-in. belts.

The boilers are three in number and are of the tubular pattern, and are of 125 h.p. size. The station has two American feed-water heaters, two separators, an 8-in. x 22-in. Dean condenser and two 6-in. x 3¾-in. x 7-in. Dean pumps. Coal is obtained by a side track from the New

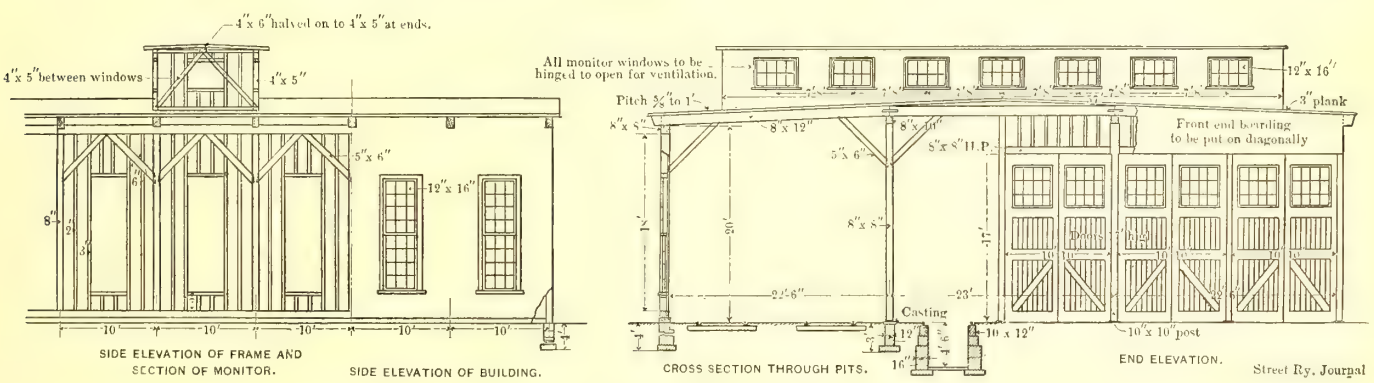


SECTION OF FLOORING IN CAR HOUSE

Haven Railroad. Ground connection is made by a copper plate sunk in the ground and surrounded by charcoal.

At Westwood are found three exceedingly neat and attractive buildings, one a car house, the second the transformer and storage battery station, and the third a passenger waiting room.

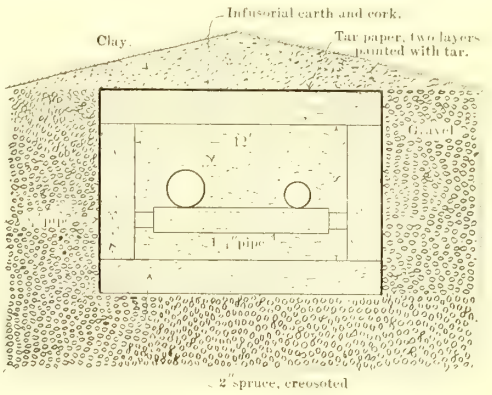
The car house is of wood, 130 ft. x 69 ft. in size, and has a capacity of thirty-two cars. To the central portion are appended two wings, one the superintendent's office, the other the motormen's and conductors' lounging room. In the latter each man has a separate locker for his extra clothing, etc., and there are toilet rooms fitted with every convenience. Entrance to the car house is made by switches running in generous curves both ways from the main line, which latter passes the waiting room, which is immediately in front of the car house. No transfer table is used in the car house, but cars are run upon any one of the car tracks desired, by means of switches. The three central tracks have deep pits connected with each other below, so that passage can be had from one to the other,



WESTWOOD CAR HOUSE

and another pit running at right angles permits motors to be brought from the pit to the surface on an inclined plane overhead. In the car house are cranes and hydraulic apparatus of sufficient strength to make it possible to lift a car while trucks are moved and replaced or motors attached. In the pits are steam pipes connected with a boiler in the transformer station, by means of which the barn will be kept warm and the cars dried out in winter. At the rear of the car house are the repair shops, consisting of a carpenter and machine shop, in which are an 8-ft. lathe, an upright drill, a band saw, a hack saw and a grindstone, all run by a 5-h.p. motor. Three men are employed here.

The transformer and storage battery station is built of field stone, and presents a novel and attractive appearance. It is divided into three sections, of which the one in front nearest the road is for the batteries, the central one for the



CONDUIT FOR STEAM PIPES FOR HEATING WESTWOOD CAR HOUSE

transformers, while the rear room contains a 100-h.p. boiler and pump, which are used for heating and pumping. Back of the group of buildings on the hillside is a standpipe, and somewhat forward of this is a large well sunk to a depth of 30 ft. and usually full of water. The standpipe is kept filled with water for fire and car-washing purposes, and when emptied to a certain point the boiler is fired and the water pumped from the well to fill the standpipe.

In the transformer room are six step-down transformers, built by the General Electric Company, and of its type H, each having a capacity of 30,000 volts and adapted for a 60-cycle transmission. On a line at right angles with these transformers and with the station switchboard are two rotary converters of the General Electric type, 4-75-1800, and of a capacity on the direct current side of 136 amps. at 550 volts. On the three-phase side the voltage is 340, delivered from the step-down transformers. The speed of the converters is 1800. The switchboard is of marble, and contains two Weston continuous current ammeters, two Thomson alternating current ammeters, a Weston ammeter for the battery circuit, and necessary switches, automatic cutouts, battery circuit breakers, etc.

The waiting room at Westwood is also built of field stone, and, in addition to accommodations for passengers, contains a cigar, confectionery and news stand and other conveniences of a similar character. It has a large open fire-place, which will probably come into excellent use during the winter months.

On the front of the car house are large balls of incan-

descent lamps, which are illuminated at night and add to the attractiveness of the spot. There is also a clock similarly illuminated, so that the time can be seen day or night. The company possesses a car which it has specially fitted up for excursion travel with a large number of incandescent lamps, and at present it is sending this car over the line each night and into the terminal towns as a kind of advertisement and an attraction to travel. The result has been that the cars have been quite fully loaded in the evening hours, although ordinarily little traffic would be obtained at such hours.

The company employs eight motormen, to whom it pays $2 a day for a ten-hour service.

The officers of the company are as follows: president, J. F. Merrill; treasurer, James A. Fitton; superintendent and electrical engineer, Edward C. Spring. The chief engineer of the power station is A. E. Read. One of the parties largely interested in the system is John R. Graham, of Quincy, general manager of the Quincy division of the Massachusetts Electric Companies.

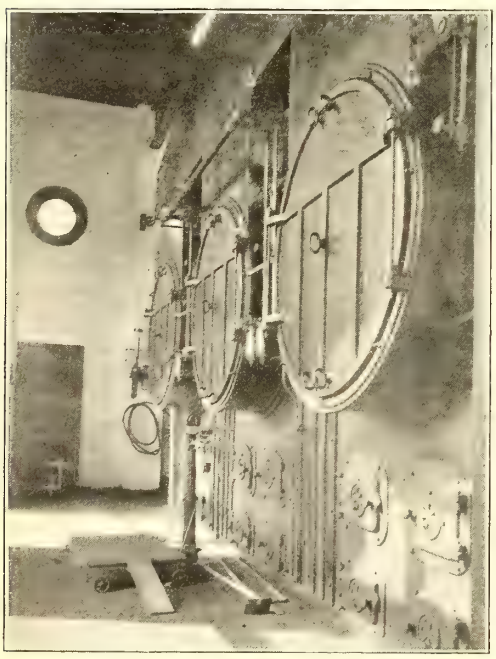
A Difficult Piece of Track Conversion

There is now in course of construction on a section of Broadway, New York city, an open conduit track, the work on which is about as difficult an undertaking of its kind, outside of switches and crossings, as can be imagined. The Metropolitan Street Railway Company has had in use for a year and a half on this section its standard underground trolley track with central conduit and slot carrying the Amsterdam Avenue cars. The Third Avenue Railway possesses a right of way through the same street on what is known as its Boulevard line. To operate the latter line electrically and by the independent power system of the latter company a separate pair of conductors in a separate conduit were needed, but the company was not allowed to lay another pair of tracks. The existing conduit is therefore being pushed over to one side to give room for the other conduit beside it between the track rails.

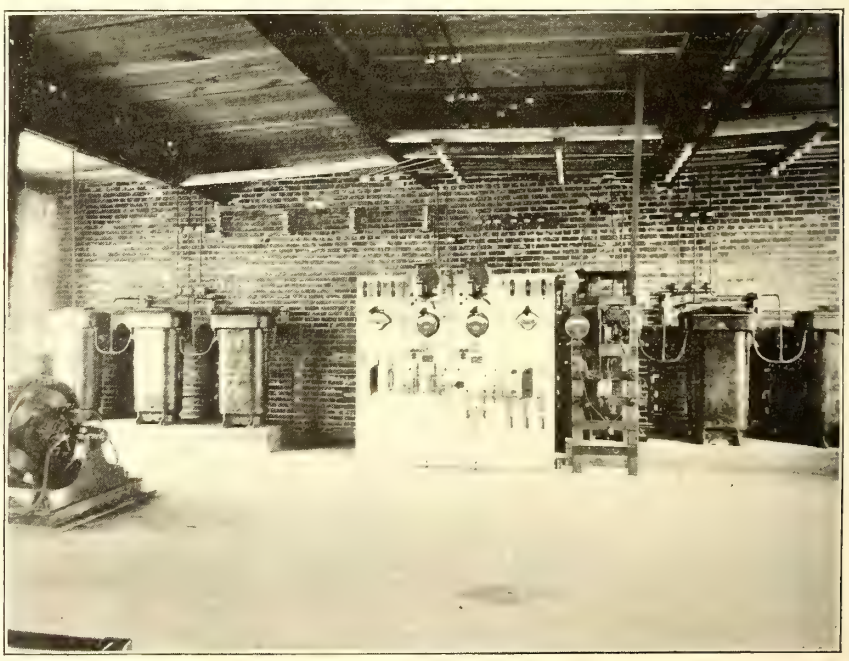
Difficulties are introduced by the fact that the track is being kept in service for the Amsterdam Avenue cars with a headway of about two minutes and the conductor rails must therefore be kept "live" throughout the progress of the work. The line runs all night, so that there is no opportunity to work while it is shut down. The change is being accomplished as follows: The pavement is first removed and the heavy concrete foundation and conduit wall is broken up and removed piece by piece from around the yokes and live conductor rails, the track being shored up meanwhile to carry the heavy double truck cars which constantly run over it. Temporary wooden yokes are then inserted to maintain the gage of the track rails, and the old yokes are loosened from them and pushed to one side, carrying with them the old slot rails, insulators and conductor rails. The conductor rails are then removed in single rail lengths, and the free ends are fitted with outwardly flaring slippers to prevent the shoes on the plows of the cars from being carried away, the cars being allowed to drift through this open section. The old yokes are promptly removed and replaced by new ones fitted with apertures for the two conduits symmetrically placed between the track rails. The track as completed has only one pair of track rails and two slots.



STORAGE BATTERY ROOM IN TRANSFORMER STATION



BOILER ROOM AT MEDFIELD



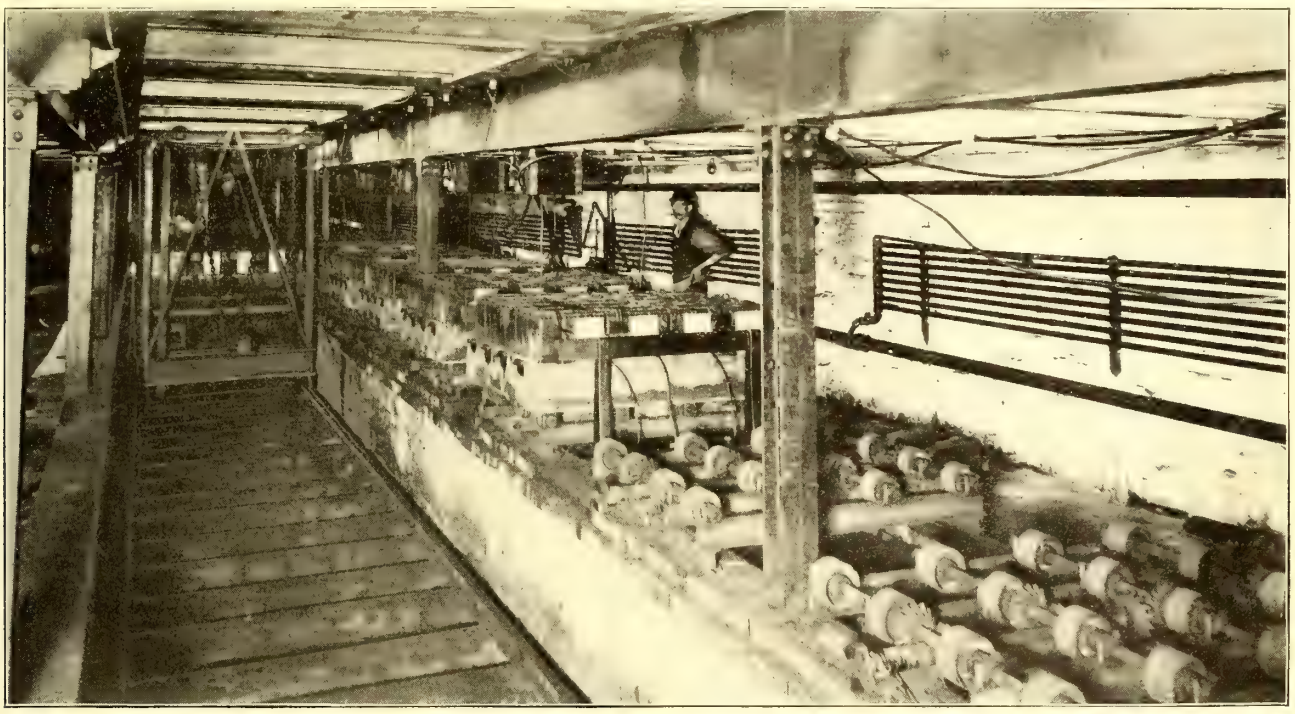
TRANSFORMER ROOM

The Englewood & Chicago Storage Battery Line

The storage battery cars on the line of the Chicago Electric Traction Company, formerly known as the Englewood & Chicago Street Railway Company, have now been running a little more than two years, and are said by the management to be handling the traffic in a satisfactory manner. It is not claimed, however, that cars can be operated more cheaply by the storage battery than by the overhead trolley system, but that for suburban lines of this character, or in cities where the overhead trolley is not allowed, the storage battery provides a very efficient and acceptable method of electric traction. The cost per car mile for operating the system in 1898 was 8.7 cents, and during the month of August it was as low as 7.2 cents. This year it is a little higher owing to track repairs which were not required during the first two years of service.

The original equipment of the line embraced 24 miles. The main system extends in a southwesterly direction from Sixty-third Street and South Park Avenue to the village of Blue Island, with a branch running to Morgan Park. On this branch is a 9 per cent grade, up which the cars are assisted by a balance weight system designed by M. H. Bronsdon, of Providence, R. I. The system has recently been extended as a single track line a distance of 5 miles to Harvey, and the cars are now running through to the latter place, where a small power station has been erected. The company has in regular operation twenty-five cars, for which forty batteries are provided. The latter are of the Electric Storage Company's type, manufactured in Philadelphia, and what is known as the Manchester plates are employed.

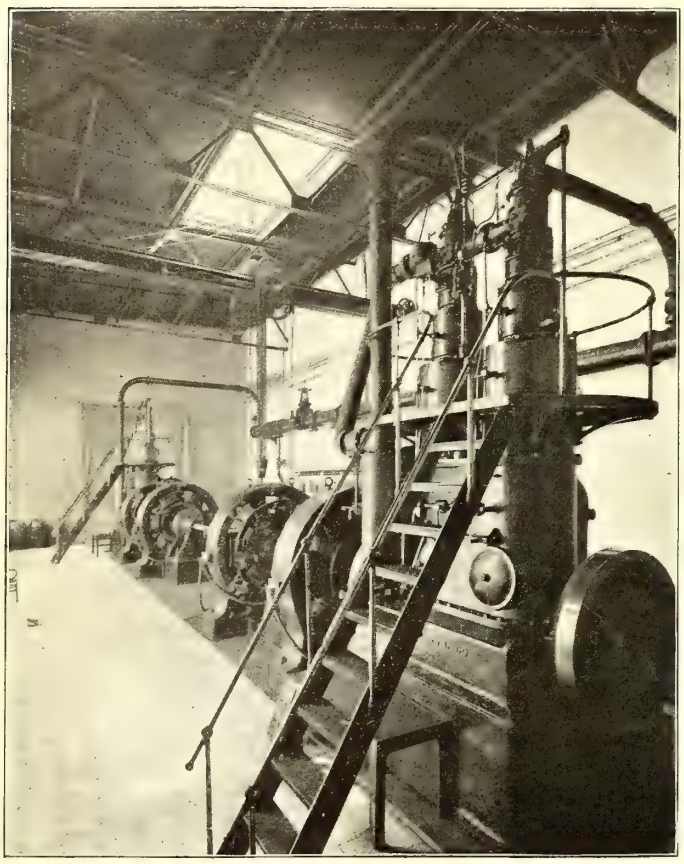
Each battery is composed of 72 cells, arranged in a tray, by means of which it is shifted about or removed or replaced in the car. The weight of each battery, including the tray, is about three tons. The cars are mounted on Dupont trucks. The battery is carried in the middle of the truck between the axles, and is removed and replaced from beneath. A 525-lb. wheel and a 4-in. steel axle are employed. Each car is equipped with a 50 h.p. Walker motor, which is mounted outside the axle, and during the hours of excessive traffic each motor car hauls a trail car. The distance traveled by one charge of battery is 11 miles. A much longer distance can be run when necessary, but about this distance is regarded as the most economical. Each cell of the battery is charged to an e.m.f. of 2.18 volts. In the trip of 11 miles this is reduced to two volts, and it is seldom that the batteries are reduced below this rate. The life of the positive plates of the battery is sufficient for a distance of 23,000 miles, and the negative plates for about twice that mileage, or the negative plates will usually outlast two sets of positive plates. The plates are run until the surface is too much reduced by the dropping out of the active material from the grids. Worn plates are not repaired, but the waste material, in the form of fine powder, is sold to the junk dealers. In service the plates do not buckle, but it is found to be of advantage to thoroughly wash and clean them after making about 4,000 miles. The electrolyte is composed of distilled water with chemically pure sulphuric acid at a density of 12.25. This is found to be reduced by 15 degs. on account of spilling and evaporation in about three weeks, when the cells of each battery are replenished and the fluid is brought up to the standard.



STORAGE BATTERY PIT AND SHIFTING CAR

The main power station is located at Eighty-eighth Street and Vincennes Road, about 5½ miles from the northern terminal of the line, and the most interesting feature of the station is the arrangement and location of the batteries and the method employed for shifting and replacing. The battery pits occupy two long rooms in the basement, as illustrated on this page. These pits extend under the car house in a line at right angles to the car tracks and the street tracks which pass in under an alcove extending in front of the station. Each battery pit is provided with a sunken way, in which is a track over which a shifting car operates. There are two of these cars, one in each pit. Each tray of battery is located on a nest of rollers, as shown in the illustration, which are connected by a system of shafting and beveled gear, the main shaft terminating in a clutch at right angles to the line of the tracks. The shifting car is constructed of a steel framework, is equipped with five motors and is controlled by levers arranged at the middle section of the car, as shown. At each end of the car is a platform equipped with rollers, the same as those for supporting the batteries in position. This platform is

fitted with an elevating apparatus, by means of which the exhausted battery is removed and a fresh battery substituted. For loading the battery on the platform, the car is run into position, when the shaft on the car platform is automatically coupled to that supporting the battery; the shaft is then revolved by the car motor and the battery rolls forward on to the car platform. The car is then run

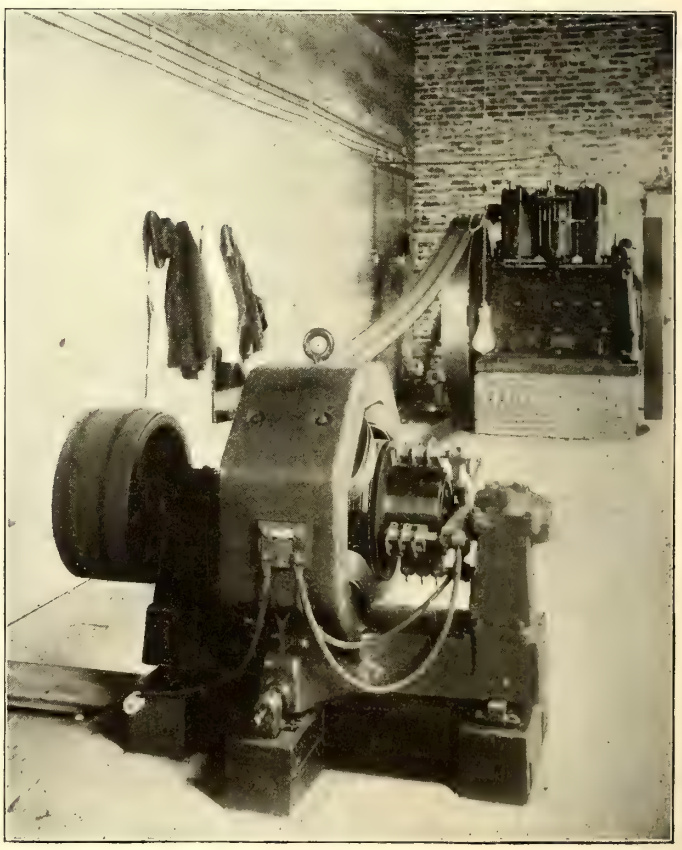


MAIN POWER STATION

down the line directly under the shifting pit, when the vacant platform is raised and the exhausted battery lowered from the car. The battery or shifting car is then moved forward, bringing the fresh battery directly under the shifting pit, when this in turn is elevated and automatically hooked into the truck, while at the same time the connections are automatically made by contact springs, located on the sides of the tray. The platform is then lowered and the replenished car proceeds on its course. An expert in handling the shifting car has been able to remove and replace a battery in 28 seconds, ordinarily it requires about one minute and a half. The exhausted battery is returned and shifted to the charging stand in the same manner as described for loading.

All the appliances for charging and shifting the batteries have been designed on very ingenious and economic lines, and it is hard to conceive how they can well be improved upon, as no hand labor whatever is required in shifting or in making connections for charging. In charging the batteries a current of only 160-volt pressure is first employed. Afterwards this is raised in stages to 170 volts and finally to 180 volts. The motors are wound for operating normally under 135 volts pressure, but have never been injured by the ordinary voltage delivered from the battery. During more than two years of service no repairs whatever have been required on the motors. The manager would prefer to have two motors to the car, especially for winter travel, and it is the intention of the company to provide two motors on all new cars. As it is, only a little difficulty is experienced in keeping the cars operating during snowy weather. The snow plows and sweepers are equipped with three sets of batteries, and are as efficient as the trolley sweepers in keeping the tracks clear from snow and mud. The power equipment of the main station consists of two 250 h.p. Willans' central valve high speed engines and four 250 kw. Walker generators. The engines are vertical, triple expansion, condensing and run at 380 r.p.m. One is placed at each end of the engine room, and they are connected by a system of hollow shafting and clutches so that either one of the engines can be made to operate either or all of the four direct coupled generators, one engine and two generators being regarded as a unit, however. In charging the batteries three circuits are employed, as above described, so that one generator may be run at 160, the second at 170 and the third at 180 volts. When only two generators are run the voltage is 166 and 178. During the time of light loads but one engine is run, but for heavy traffic both are employed.

These engines were made by the M. C. Bullock Manufacturing Company, of Chicago, and are of the same type that this firm had running on exhibition at the World's Fair in 1893. They have been in constant service in this storage battery plant since it was installed in 1896, and are still working without any apparent depreciation. Each engine, as illustrated, is really a double vertical engine, and each half consists of three tandem cylinders, or is a tandem triple expansion single action engine, with central simple valve gear, with a fourth cylinder at the base, which acts as an air cushion. An important and particular feature of



HARVEY SUB-STATION

this type of engine is the drainage arrangement, which is accomplished by having the pistons dished downward in the center, while the hollow piston rod has a ring of ports flush with the surface of the piston, being in the best possible place for drainage. This feature is claimed to make a saving of at least 15 per cent in the steam consumption, as there is no water left in the cylinder to rob the incoming

steam of its heat during the period of admission. Paradoxical as it may seem, the piston speed, 500 ft. per minute, owing to the short stroke, only 8 ins., is slower than in so-called slow running engine. In these engines the diameter of the three cylinders is as follows: Low pressure, 23⅝ ins.; intermediate, 14 15-16 ins.; high pressure, 10¼ ins. The engines run entirely noiseless, and the governing features are unusually sensitive and efficient. Among the claims for this type of machine are durability, economy and safety.

The boiler equipment consists of three 200-h.p. Heine boilers, provided with Roney mechanical stokers. Jet condensers are employed and there is a cooling tower, installed by the H. R. Worthington Company, which consists of a steel tank, 30 ft. high and 12 ft. in diameter. This is partly filled with vitrified sewer pipe placed on end so that the water when pumped to the top of the tower trickles over the pipes to the tank below. The cooling blast is provided by a large fan, operated by an electric motor, which serves to cool the water that it may be used over and over again for condensing purposes.

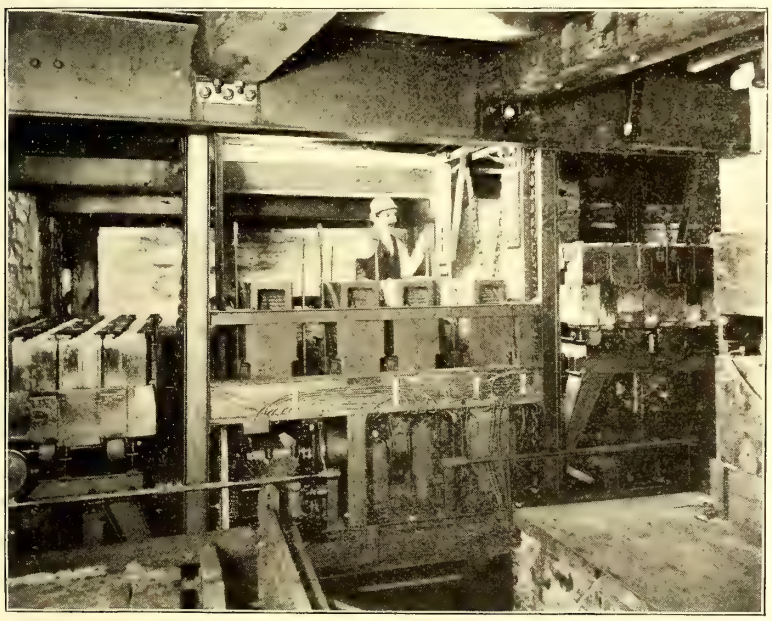
The new power station at Harvey is equipped with a 50-h.p. Nash triple cylinder gasoline engine, manufactured by the National Meter Company, of New York, run at 250 r.p.m. This is belted direct to a 40-kw. Eddy generator, manufactured by the Eddy Manufacturing Company, Windsor, Conn. This generator is operated in multiple with a stationary storage battery in the station so arranged that when the current is not being delivered to the car batteries it is charging the stationary battery. This battery consists of 95 cells of 320 amp. hours' capacity. This station is provided with two extra car batteries, the same as those described above, and which are charged in connection with the stationary battery. The arrangement is such that a steady load is provided for the engine and the car batteries are charged without an undue expenditure of power. The battery shifting device provided for the Harvey station differs somewhat from that described for the main station, as the trays are mounted on trucks and are rolled by hand power by means of a windlass under the elevating platform, which is raised and lowered by means of a stationary motor. The Harvey power station is a one story plain brick building, 30 ft. x 70 ft., and is divided lengthways into two sections. In one is located the track and pit on which the car is run for battery shifting. The other section houses the power equipment.

In connection with the operation of the line, a funeral car is operated when chartered, which serves to carry the attendance at funerals for the different cemeteries that are located along the line. This car is named Virginia, and is handsomely upholstered; in fact, it is finished very much like the private cars on other lines. End doors through the front vestibule provide for loading and unloading the box containing the body.

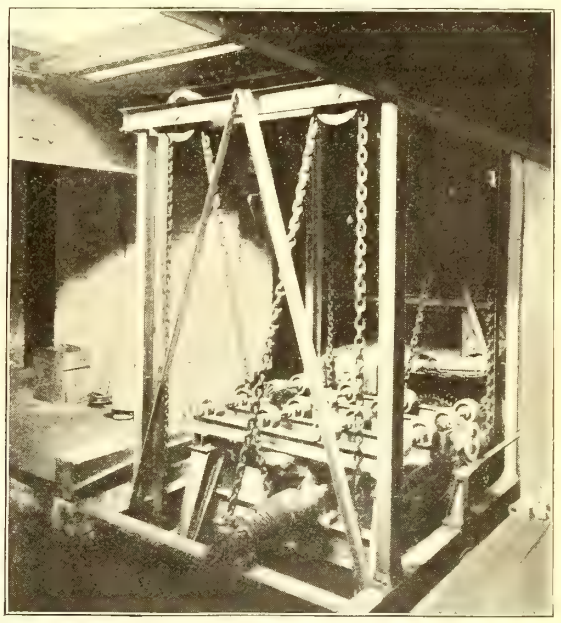
The system is now operated under the management of E. R. Gilbert, with A. E. Davis as superintendent.

Electric Road Between Haarlem and Zandvoort

During the first days of July the electric road between Haarlem and Zandvoort, the first of its kind in Holland, was put into operation. This occurrence has a particular significance, as the Netherlands, with their vast commercial interests, have heretofore arrayed themselves against the introduction of electric roads, and up to this time the short accumulator road, Haag-Scheveningen, operated in summer alone, was the only electric road in existence.



BATTERY SHIFTING CAR



END OF SHIFTING CAR

The projectors and owners of the new road are the Eerste Nederlandsche Trammaatschappij, of Amsterdam, the capital of which is 1,000,000 fl. The line was built and equipped by the Siemens-Halske Company. The generating station contains three units of 170 h.p. each, consisting of vertical engines direct connected to the well-known interior pole machines of the Berlin firm. The line is 16 km. (10 miles) long, and has two tracks along nearly its entire length. It also serves for the transportation of freight. At present the rolling stock consists of twelve small and eight large motor cars, nine trailers and four freight cars.

Card Catalogue of Employees.

The Milwaukee Electric Railway & Light Company uses the card catalogue system for keeping track of all employees, each being given a card on which is contained the history of his connection with the company from its beginning. This card shows the date of entering the pay-rolls, the occupation, the department, the salary per month, report number, the date of leaving service and the reasons therefor, the age, whether married or single, and the home address.

Practice in the Repair Shops of the North Chicago Street Railway Company

CUTTING GEARS AND PINIONS

All the gears and pinions employed on the lines of the North and West Chicago Street Railway Systems are cut and finished at the Limits Repair Shop, located at the corner of North Clark Street and Dewey Street. These shops are under the supervision of V. T. Lynch, who has designed most of the tools, or, in fact, all the tools described in this connection. For cutting the gears and pinions two old planers are employed. These have been fitted up with a cross-head, which carries the shafting and cutting tools, and have been provided with a belt shifting device and other attachments, as shown in Fig. 1. Two cutting tools are employed on each machine, one known as the stocking cutter, the other the finisher. These are attached to the ends of shafts which are driven from either side of the machine, so that the cutters are placed one in rear of the other, near the middle of the machine. The same general design is employed for both the pinion and gear cutting machines. For making the malleable iron gears blanks are employed, which are planed and mated, when after being bored out and turned down to the proper diameter, they are made ready for the gear cutting. Seven of the blanks are arranged on a shaft, as shown, with a templet or pattern wheel at the end. The bed plate carrying the gears is then started and the blanks, passing under the cutters, are each cut to the proper depth for a line of teeth. When finished the nest of gears is turned one notch by hand and fastened in place, when a second cut is made, and so on until finished. The pinions are cut in nests of six in the same manner as described for the gears, only one attendant being required for the two machines. In the operation a pump forces the lubricating mixture in quite a large stream to each of the cutters. The two machines have a capacity of eight pinions and two gears complete in ten hours. The blanks for the pinions are cut from hot rolled steel bars or shafts. These are drilled, turned to accurate size and cut off to a suitable length on a lathe, as shown in Fig. 2. The original bars are long enough for sixteen pinion blanks. For drilling the holes in the shaft two operations are required. A twist drill $1\frac{1}{8}$ ins. in diameter is first employed, and this is followed by a second about $2\frac{1}{4}$ ins. in diameter, and when sufficient depth is drilled, a section forming a single blank is cut off on the lathe.

Fig. 3 illustrates a keyway cutting device for cutting the keyway in the gears. This is a home-made machine, the frame work being constructed of two steel flat bars, the same as employed for grip slides on the grip cars. The gear is placed at one end of the machine, as shown, where it is held in position when the shaft or bar carrying ten cutting knives, which are placed 4 ins. apart, is forced endwise through the bore of the gear. Each of these knives is of the full width of the keyway, and each in succession is set about 1-32 in. higher than the other, so that by one motion of the shaft through the bore, a complete keyway is finished. This shaft, carrying the cutters, is forced endwise by means of a screw, cut on its outer extremity, and which is actuated by a nut in the driving gear, the shaft having a travel of about 4 ft. This is actuated by a countershaft and small gear, which is driven by means of

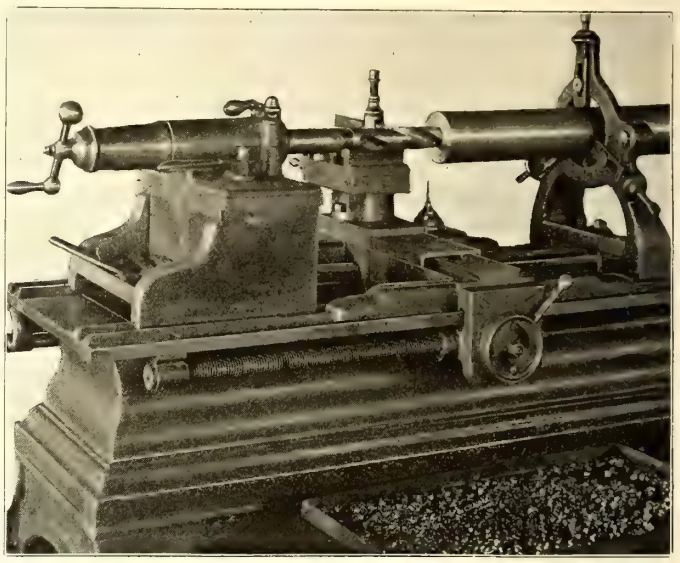


FIG. 2.—DRILLING AND CUTTING PINION BLANKS FROM HOT ROLLED BAR

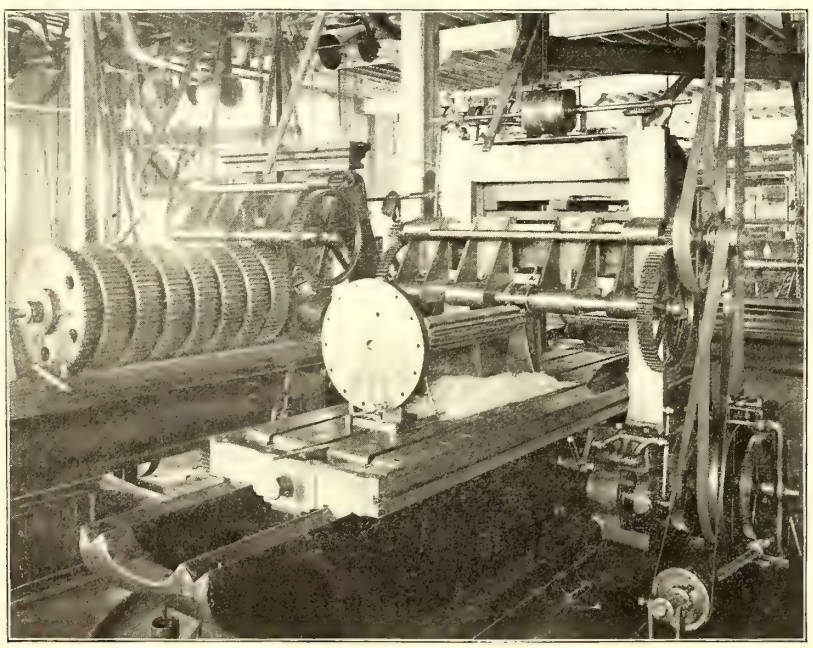


FIG. 1.—LATHE FOR CUTTING GEARS AND PINIONS

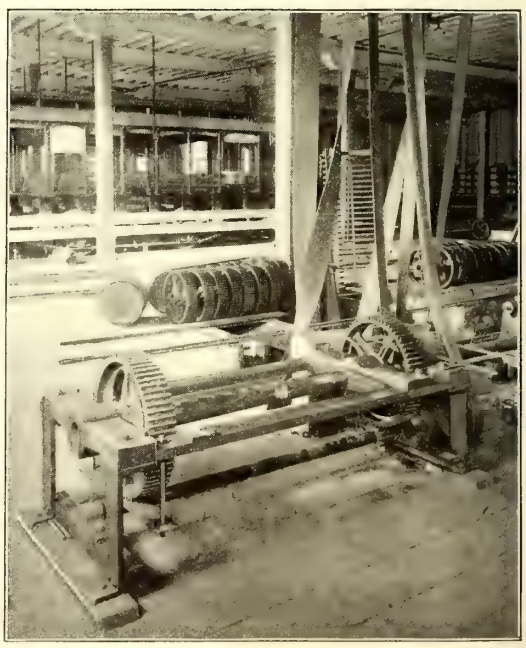


FIG. 3.—KEY WAY CUTTING DEVICE

belting from the overhead shafting. By the use of this machine it requires about a minute to cut a keyway in a gear, including the time consumed in putting the wheel in

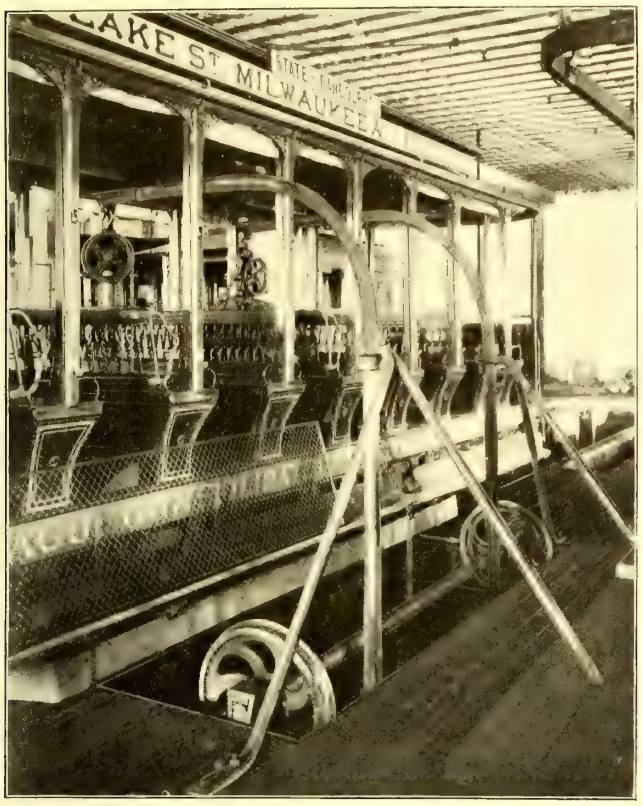


FIG. 4.—CRANE FOR LIFTING MOTORS FROM CAR ON TRANSFER TABLE

position and taking it out, and all the ways are cut to an exact size.

An electric motor drives the shafting for all the shop machinery, and there is an air compressor made over from one of the Connelly gas motors that were employed on this system some years since for driving the motor cars. These shifts the belt, starts or stops the compressor, at the same time cuts off or lets on the flow of water through the water jacket of the cylinder.

USE OF COPPER

Hard-drawn copper bars are employed in commutator construction. In practice it is found that the life of the commutator varies greatly, depending on the service. The cars on the lines of heavy traffic are the ones on which most of the repairs are necessary; the others seldom come in for repairs. It is the practice of these shops to return the copper wire employed in field coils to the manufacturers, after a coil has been damaged, to have it reinsulated,

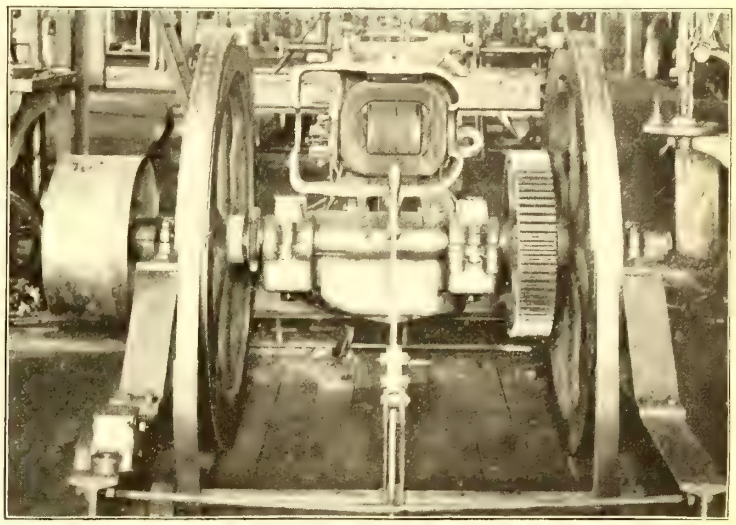


FIG. 5.—FRICTION BRAKE FOR TESTING ARMATURES

as it is found to result in quite a saving in the matter of motor repairs. Before shipping the coil away, however, the old insulation is all burned off.

MOTOR CRANES

In the repair department two stationary cranes of special design are employed for lifting motors or armatures out



FIG. 6.—FENDER FOR CABLE CARS, SAFETY GUARD SPRINGS BETWEEN CARS AND GUARD RAILS

provide the pressure for operating the power hammers in the blacksmith shop, will furnish the power for some pneumatic hoists which are about to be installed, and also blows the shop whistles. These compressors are provided with an automatic starting and stopping device, which was also designed by the superintendent of the shops. This device

from the open and sometimes from closed cars. These cranes consist of 3-in. bars of iron, bent as shown in Fig. 4, and braced in position at the end of the run of the transfer table. For removing any part, the car is placed upon the transfer table, when it is run in position to bring the ends of the cranes well within the car, as shown. Hand hoists

are then attached, the armature or frame is lifted to a suitable height, the car is moved away from the crane and the part which has been lifted from the car is lowered and shifted about the shop on trucks.

ARMATURE TESTING DEVICE

In Fig. 5 are shown the method and appliances for testing armatures. The motor case is mounted in brackets when the armature is put in place and current applied. By means of a gear wheel on the shaft, power is communicated to the two 4-ft. fly wheels, about each of which is a band brake, which is operated by means of a lever shown between the wheels. By means of the brake any degree of power within the capacity of the motor is obtained, and when the consumption of current reaches a certain amount, as indicated by the meters, the test is suspended. In addition to testing, this machine is sometimes employed as a motor for driving the shop shafting. For this purpose a belt pulley is attached to the end of the axle, so that the power is readily transmitted by belt to the shafting. This is used in case the motor which drives the tools of the repair shop should be out of order or undergoing repairs.

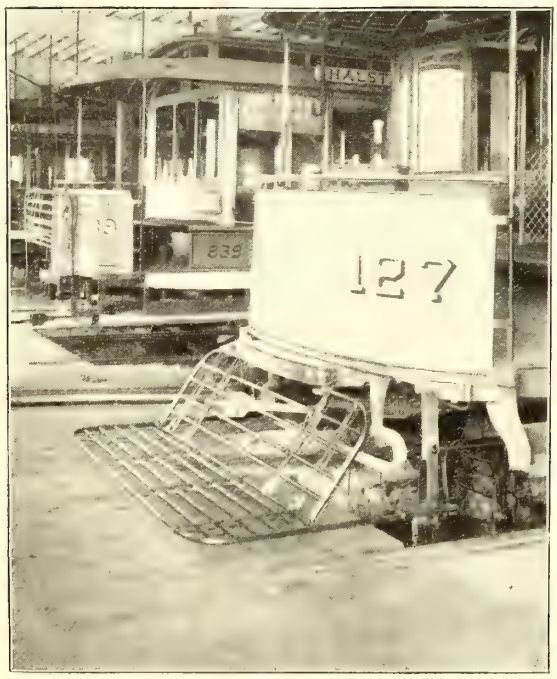


FIG. 7.—FENDER FOR ELECTRIC CARS

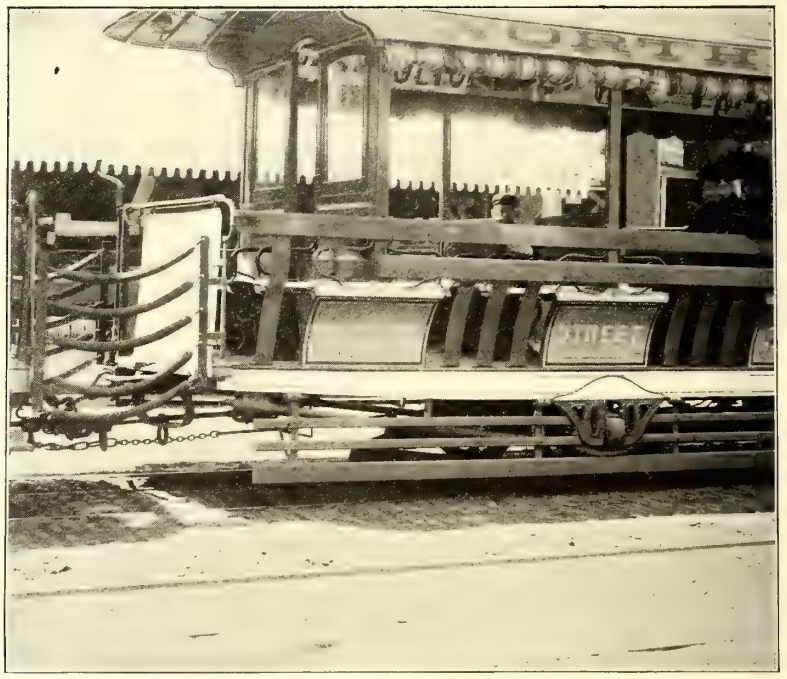


FIG. 8.—SAFETY DEVICES FOR TRAIL CARS

FENDERS AND OTHER SAFETY DEVICES

All of the cars, both electric and cable, on the North and West Chicago systems have recently been equipped with fenders to comply with the city ordinance to that effect. The fenders are all home-made, and that designed for the cable cars is shown in Fig. 6. It is of the stationary type, and is constructed from steel springs bent and arranged as shown in the engraving, the outer or front edge being reinforced by a sheath of rubber belting. The design of fender for electric cars is shown in Fig. 7, and was designed and patented by V. T. Lynch, superintendent of the shop. In the foreground the fender is in position for service, while that in the background is folded up against the dashboard. These fenders consist of a frame work of steel tubing, about 1 in. in diameter, and are provided with wooden rods, which are supported in position between thin strips of steel. Near each end on the underside, curved bars are riveted, which serve as runners for lifting the fender over rough places when it strikes the paving. The upper portion folds against the flat portion, when both can be turned up in position, as shown. A simple bracket on each side of the platform under the dash serves to hold the fender in position. It is attached to the platform by an elbow-shaped casting, having a spiral spring, which gives to the fender the proper tension, so that when a body strikes the fender it will move down and back, preventing a sudden shock when it is again lifted in position by the spring. Two brackets under the bumper, with small hooks, as shown, assist in holding the fender in position and provide for a quick adjustment or for a release when it is necessary to fold it up. There are also two chains by which the device, when folded, is attached to the dash rail. These fenders are very light, are constructed at little expense and are claimed to be working in a very satisfactory manner, having picked up without injury quite a number of persons. It is also noted that since the fenders were adopted there have been less accidents from collision with vehicles, the motormen being more cautious than when fenders were not employed. It is the practice of the company to charge the motormen with all damage to the fenders, unless they can prove that a collision was unavoidable.

Among other safety appliances employed on the trains of both the North and West Chicago systems are guard springs, in sets of five, placed between the grip-car and trailer and between the trailers on the right-hand side of the train, Figs. 6 and 8. These springs, together with the method of attaching them to the dashboard, were designed by the general manager of the two systems, J. M. Roach, and have been patented by him. These spiral springs are made of No. 5 wire, and are 26 ins. in length and $1\frac{3}{4}$ ins. in diameter, and are attached to a hinged bar placed against the dashboard, as shown. On the trains that do not run the same end forward all the time the springs are attached to hinged bars, which can be removed by lifting them up out of the carrying sockets, so that any set of five springs can be moved from one side to the other without detaching the individual springs. In rounding curves the springs stretch sufficiently to permit of the relative adjustment of the cars and always form a safeguard to prevent people falling between the trail cars.

Permanent guard rails, together with metal guard strips, have been attached to the outside of all open trail cars. These, as well as the springs above described, are also il-

lustrated in Fig. 8. At first only the two wooden guard rails, as shown, were employed, but it was found that venturesome passengers would frequently attempt to board or leave the car by passing under the guard rails between the seats; hence the necessity of providing the metal strips, as shown.

Practice in the Repair Shops of the Chicago City Railway Company

TROLLEY WHEEL TURNING DEVICE

Fig. 1 illustrates a rapid method for turning the grooves in trolley wheels, as employed in the repair shop of the Chicago City Railway Company. A Reoric & Ayer milling machine is employed, to the bed plate of which the groove cutting device is attached. This consists of a frame work having a pair of movable heads, each of which carries a cutting tool shaped to correspond with the desired groove in the wheel. These cutting tools are placed one on each side of the trolley wheel, one just above and the other below the center of the shaft or mandrel which carries the wheel. The wheel is placed upon the mandrel, and held in place by a nut which is adjusted by hand; lugs cast on the back of the wheel engage the arms on the mandrel and cause it to turn. The wheel being in position, the heads carrying the tools are moved toward each other by means of a right and left screw, which is operated by a crank and gears, as shown in the illustration, so that the groove is readily cut to the desired depth. As soon as finished the cutting tools are caused to retreat by a reverse motion of the crank. The cutting tools are adjusted with reference to the distance from the mandrel by shifting the bed of the milling machine. By the use of this device one man is able to turn out complete fifty wheels in an hour, almost one a minute. Old wheels are turned down in the same manner as new, and the device is readily attached to the bed of the milling machine by clamps, as shown.

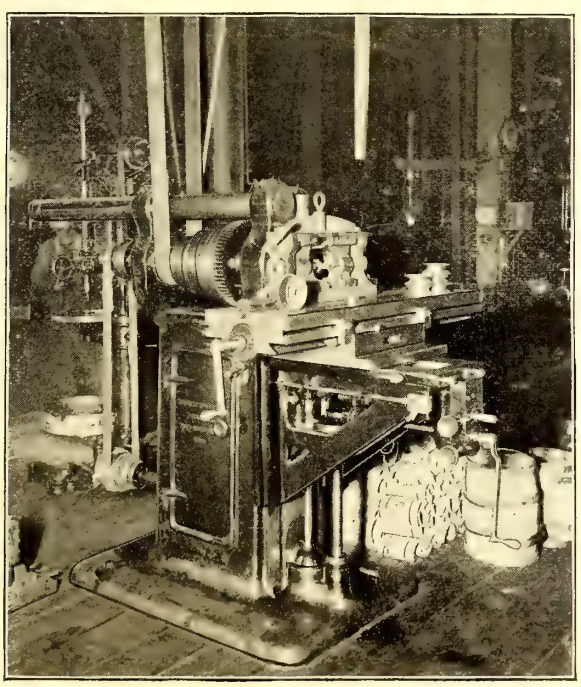


FIG. 1—TOOL FOR CUTTING GROOVES IN TROLLEY WHEELS

For placing the graphite bushings in trolley wheels a Crossly power press is employed, which is also used for punching and bending purposes. After the bore of the wheel is turned to the proper size, the bushing is placed in position by hand, and then under the plunger of the press, when, by one revolution of the wheel, it is driven half way in; then a large washer is placed on top and a second revolution pushes it home. This work is performed very rapidly, one man being able to place the bushings in four wheels a minute. This method of adjusting the bushings is preferred to that of hammering them in, as the blows from the hammer were found to crumble and dislodge the graphite.

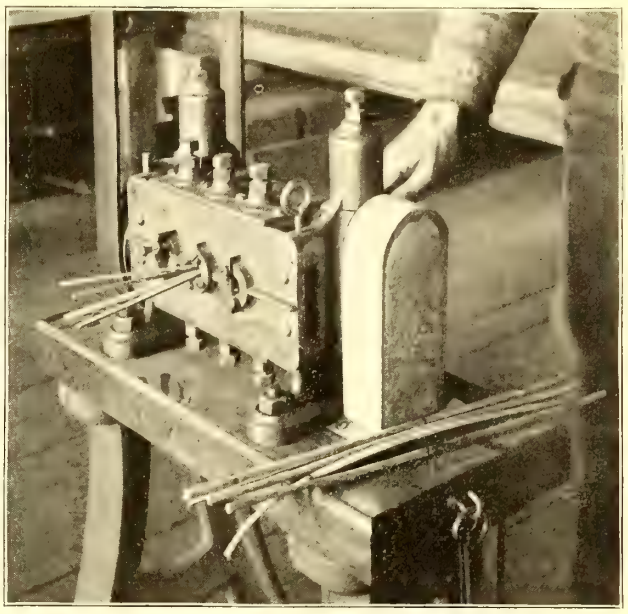
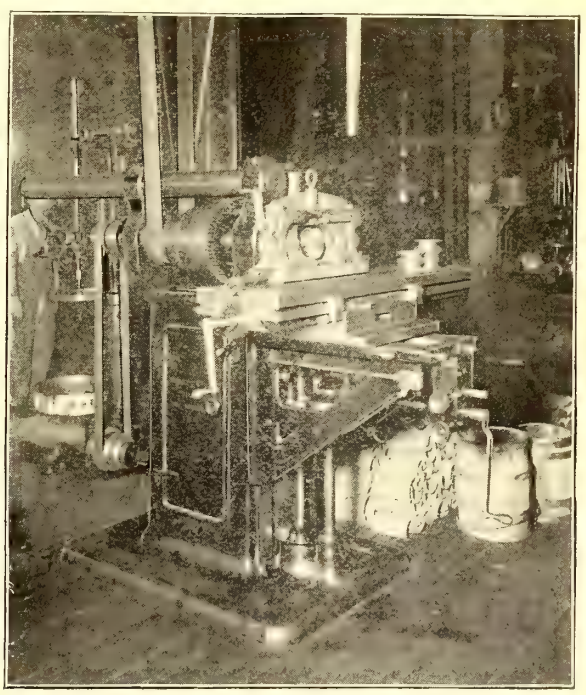


FIG. 2.—RATTAN SPLITTING MACHINE

MACHINE FOR SPLITTING RATTAN

Fig. 2 illustrates a rattan splitting machine. This consists of a frame work of brass with adjusting screws, behind which is a pair of rollers driven by a belt from an overhead shaft. These rollers have three grooves corrugated at their base and of about the size of a rattan. Opposite the grooves, in the outer face, as shown, is a set of knives placed across the tube through which the rattan emerges. There are three tubes and three sets of knives. The first one has a single knife and halves the rattan; the



second has a knife in the form of a cross, and quarters the reed; the third and last splits the reed into three parts. There is a funnel-shaped mouth on the side toward the attendant, and the reeds are fed into the different cutters according to their size. The small ones are halved, the medium size split into thirds, and the large ones are quartered. The reeds are first cut into suitable length for making the brushes for the sweepers and are fastened in bunches in holes in the back by means of rosin cement. The brooms are not formed by doubling the rattans and placing the two ends of a bunch through, as in ordinary practice, which results, as is well known, in the waste of a great deal of stock, but singly, as described above. By the process of splitting and using short reeds, the life of the brooms is greatly increased.

COIL TAPING STANDS AND BOBBINS

Fig. 3 illustrates different forms for holding coils to facilitate taping. These forms consist of a plain board having strips of different shapes nailed on the top, which form grooves to correspond with the shape of the different coils. The coils are held in position by buttons. These forms are mounted on stands having a revolving attachment, so that they are readily brought in position in front of the operator. A set of different shaped forms is shown on the platform, as are also the parts of forms employed in making the field coils. In connection with the taping stands are shown the bobbins in which the tape is enclosed and which greatly facilitates the winding of the tape about the coils. These bobbins consist of two-part circular boxes, made of wood or metal (light metal like aluminum being preferred), about 4 ins. in diameter. After the tape coils are wound to proper size, they are placed over the stem in the bobbin. The latter is threaded at one end, extends through the cover on one side and is fitted with a thumb screw, by means of which a suitable tension may be placed upon the coil of tape to prevent its running out too fast. There are two methods of adjusting the interior spring to provide the necessary tension; one consists of a slightly dished thin metal disc, which is placed each side of the roll of tape, and as the thumb screw is turned up, pressure is brought against the roll of tape. A second method consists in providing a small roller on a half spring, which, being pressed to one side, allows the roll of tape to be placed in position. Then when the bobbin is closed the tape is brought out over and under a set of four small bars which serve to give it sufficient tension, so that by holding the bobbin in the hand and passing it through the coil there is sufficient tension to form the wraps perfectly. By the use of the bobbin and stands the work of taping the coils is greatly facilitated and a more uniform finish can be secured than by the old method. These forms and bobbins were designed by W. C. Bryant, who is in charge of the motor repair department of the Chicago City Railway shops.

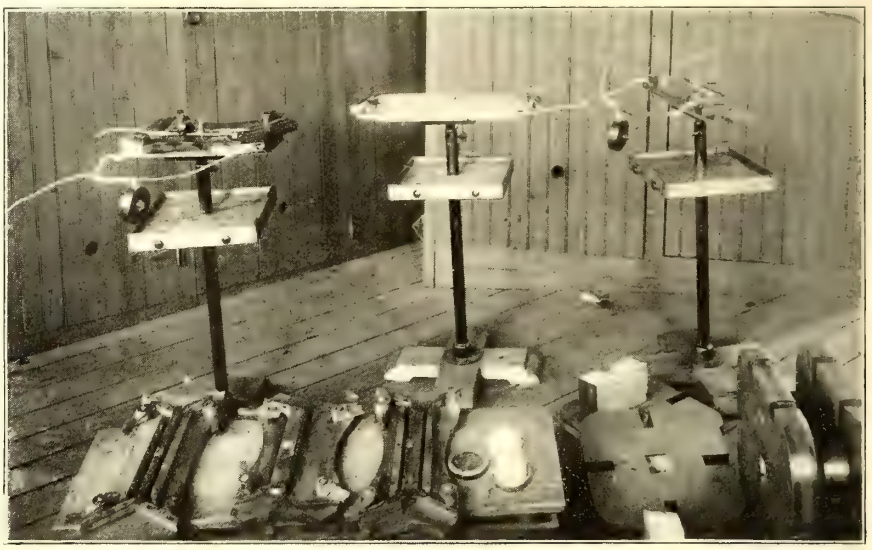


FIG. 3.—COILS FOR WINDING MOTOR COILS

A similar bobbin is also employed for taping car cables. This is made with a very stiff spring, and is mounted on a spindle in a clevis provided with a handle, so that the workman is able to wind the tape very tightly by pulling on the handle of the bobbin after the bobbin is passed once around the bunch of wire.

BAKING COILS

It is the practice in winding motors after the coils are taped to soak them in white paraffine wax. Then, as they are to be placed in the slots of the core, the completed coils are heated in an oven sufficiently to soften the wax and make the coil pliable, so that the wax acts as a lubricant. This facilitates placing the bottom coil in the slot and provides for the use of more insulating material in the bottom of the slot than when the coil is put in without heating.

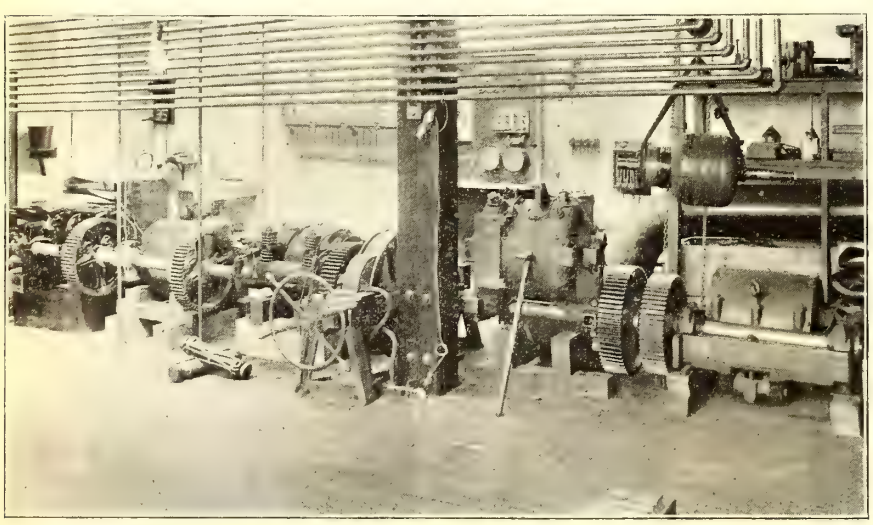


FIG. 4.—ARRANGEMENT OF FIELDS FOR TESTING FIVE TYPES OF ARMATURES

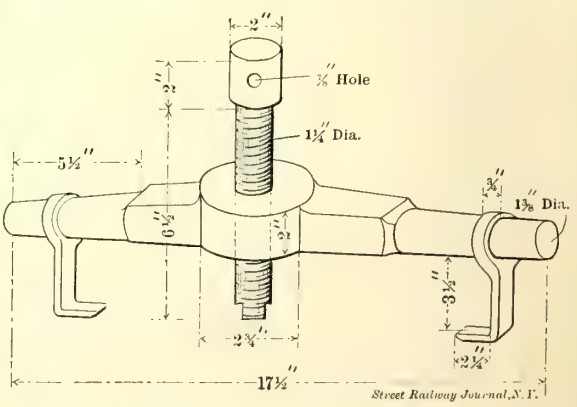


FIG. 5.—SCREW JACK FOR REMOVING FIELD COILS FROM POLE PIECES

ARRANGEMENT OF MOTORS FOR ARMATURE TESTING

Fig. 4 illustrates an arrangement of five motor frames for testing the different types of armatures employed on the lines of the Chicago City Railway. As will be noted, the shaft is provided with gears, into which the pinions from each armature mesh. The current being applied, the motor drives the shaft, and, as this carries a set of brake wheels near the middle, it can be regulated as to speed or power. At the same time the current consumed is registered by the volt and ammeters located on the switchboard, as shown. The braking mechanism consists of two old car wheels with the flanges on the outside, giving a broad braking surface. The brake shoes, which are placed one on each side of the wheel, and which are held in position by forged bars that bend over the axle and around the wheels, are hollow, and are provided with pipes, through which a stream of water is directed, designed to absorb the heat generated by the friction. The brake shoes are applied by means of a screw shaft, operated by a hand wheel, which is shown in the illustration. The covers of the frames are lifted and the armatures shifted about by means of a trolley hand-hoist, which is also shown, having an armature suspended above the frame. The controller, switchboard and resistance boxes are located back of the shaft and against the wall. Every armature, either new or old, is tested before being placed in service. The test for new armatures consists of a run of twenty-five minutes under 55 amps. of current, followed by a ten-minute run at 60 amps. Old armatures, however, undergo a test of only ten minutes with 55 amps.

DIVISION OF WORK

Ten hands, besides the foreman, are employed in the motor repair department, and the work in this department includes, besides repairs, the making of armature and field coils, the making of commutators entire after the bars have been repaired and the slot in the shank milled out, also the making complete of all the resistance boxes or rheostats



FIG. 6.—BRASS FOUNDRY, SHOWING INDIVIDUAL BLAST PIPE FOR EACH FURNACE PIT

employed on the system. The division of the work is as follows: Two men winding new armatures, one man repairing armatures and grounded commutators, (in this connection it is interesting to note that none of the armatures built in the shop has ever become grounded); one man turning commutators and binding them; one boy winding armature coils; three girls taping coils and cutting insulating material; two men building rheostats and repairing controllers, switches and fuse boxes; one man building and repairing commutators; one man winding field coils and repairing old ones, and one boy for miscellaneous work.

For removing a field coil from the pole piece, a screw jack has recently been devised which is made in the company's shop, and one is kept in each car depot, see Fig. 5. This consists of a bar, through the middle of which is a large screw, and on each arm of which is an adjustable hook. To use this jack the hooks are first placed under

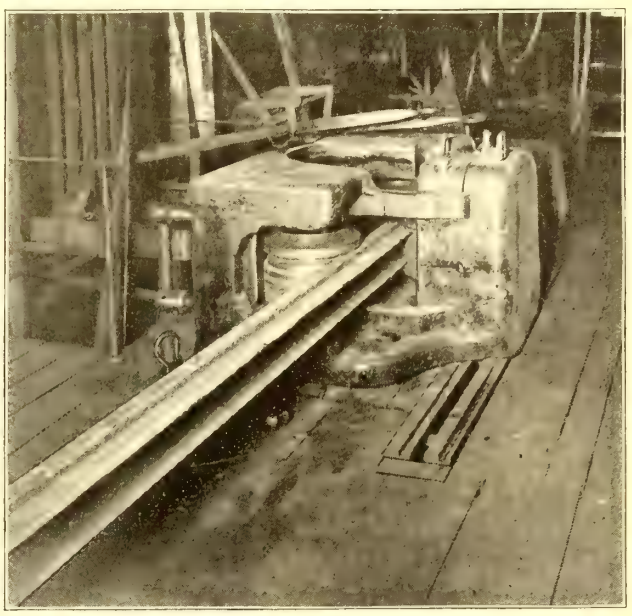


FIG. 7.—RAIL BENDER

the sides of the coil and the end of the screw adjusted to the face of the pole piece, then by turning the screw, the coil is readily drawn off from the pole.

About 1000 motors are employed on the system, and these embrace seven types, including the Westinghouse 12-B, of which there are the greatest number, Westinghouse 12-A, Westinghouse No. 3 and No. 49, Walker No. 5 and G. E. 800 and G. E. 52.

NEW FORM OF RHEOSTAT

A number of the motor cars of the Chicago City Railway Company are being equipped with a new form of rheostat, and in some cases with a double rheostat, especially those on lines of heavy traffic and where trailers are hauled. With the old form of rheostat the life has not been more than two and one-half to three years, and it was found that in 80 per cent of those burned out the short circuit occurred on the last half of the resistance. At the same time a good many burn outs occurred on the first half on lines where there were grades and the cars were held up by excessive street traffic, or when it was necessary to run a long distance on the first two notches. In order to provide for these contingencies and after experimenting with various types of rheostats, the electrical engineer of the company became satisfied that the most successful type of rheostat at present was that constructed of soft steel ribbon with ample carrying capacity (*i. e.*, at least from 25 to 30 per cent more current capacity than ordinarily needed), and that the last half of the rheostat should be of heavier ribbon than the first half, as ordinarily this portion carries current for nearly double the time than the first half. With

the new construction he expects to get three times the life out of the new rheostats than was formerly possible. The two rheostats to be used are known as No. 1 and No. 2, and are made up as follows: No. 1 is composed of six panels of specially made soft steel ribbon. In the first three panels the dimensions of the ribbon are .019 ins. x 0.562 ins., and the last three are made of .028 ins. x 0.625 ins., having nearly double the capacity of the former. The first four panels the dimensions of the ribbon are .019 ins. x 0.562 ins., No. 2 rheostat is composed of six panels, in which the ribbon is .028 ins. x 0.625 ins., which are connected in multiples of two, so that the connections for the two are as follows: R^1 to R^2, four panels in series; R^2 to R^3, eight panels in multiples of two, making the resistance as follows: R^1 to R^2, 3.3 ohms; R^2 to R^3, 1.2 ohms; R^1 to R^3, 4.5 ohms. In the manufacture of No. 1, 43 lbs. of steel ribbon are used, and 8 lbs. of asbestos installation. For No. 2, 45 lbs. of steel ribbon are employed, with 8 lbs. of asbestos. The layers of ribbon of which the rheostats are composed are formed from the coil on a forming board in panel style. This is a board about 12 ft. long, having flat steel pins on each edge a short distance apart. About these the ribbon is wound in zig-zag form by hand, and when necessary the ends are spliced, making a lap of about 2 ins., with parts riveted together. Being bent in proper form, the panels are removed from the forming board and placed upon a table, when strips of asbestos, which have been cut to the proper width, and which are about 1-32 in. in thickness, are placed between the folds or the loops composing a panel. The whole is then placed in a specially designed iron vise or press, in which a pressure of about ten tons is secured against the coil by means of two screws, which are operated by means of a crank placed upon the head. This press is laid flat upon the table, and being fastened in position, the folds are pressed very closely together and held in position by a yoke or clamping device which is placed over the coil by means of slots in the press. The panels are then placed in the forms or frames, and two frames are used in place of one because a single frame would be too heavy to handle.

The rheostat formerly used consisted of six panels of iron ribbon of two thicknesses, one being .017 in. x $\frac{3}{4}$ in. wide; the other .02 in. x $\frac{3}{4}$ in wide, which gave a resistance of about 4.2 ohms, which was divided as follows: R^1 to R^2, or the first contact to the second contact, 3.8 ohms; R^2 to R^3, 1.12 ohms. The amount of ribbon used was 40 lbs., with 7.5 lbs. of asbestos, which was in strips $\frac{7}{8}$ in. wide x 1-32 in. in thickness.

It is thought that the rapid rusting of rheostats is due to condensation while in the barns over night, as they come in off the road warm, and as the barns are usually damp, the condensation is excessive. Rapid rusting follows, and results in short circuits and burn outs.

BRASS FOUNDRY

Fig. 6 illustrates the furnaces and crucibles in the brass foundry at the repair shops of the Chicago City Railway. The particular feature for which this illustration is produced is the method of providing an individual air blast for each furnace pit. The air is conveyed from the storage tank in the header pipe located against the wall, and is directed by means of the descending pipes directly into each furnace. Each pipe is fitted with a cut-off slide valve, which regulates the flow to each pit. As has been previously noted, it is the practice in this repair shop to manufacture all the brass and copper work for overhead line purposes or car trimmings. The cupola for melting the babbitt and lead for journal boxes and for lining the cable carrying sheaves is also made here, as are composition metal grip dies, trolley wheels, and, in fact, all the brass and copper supplies that are required.

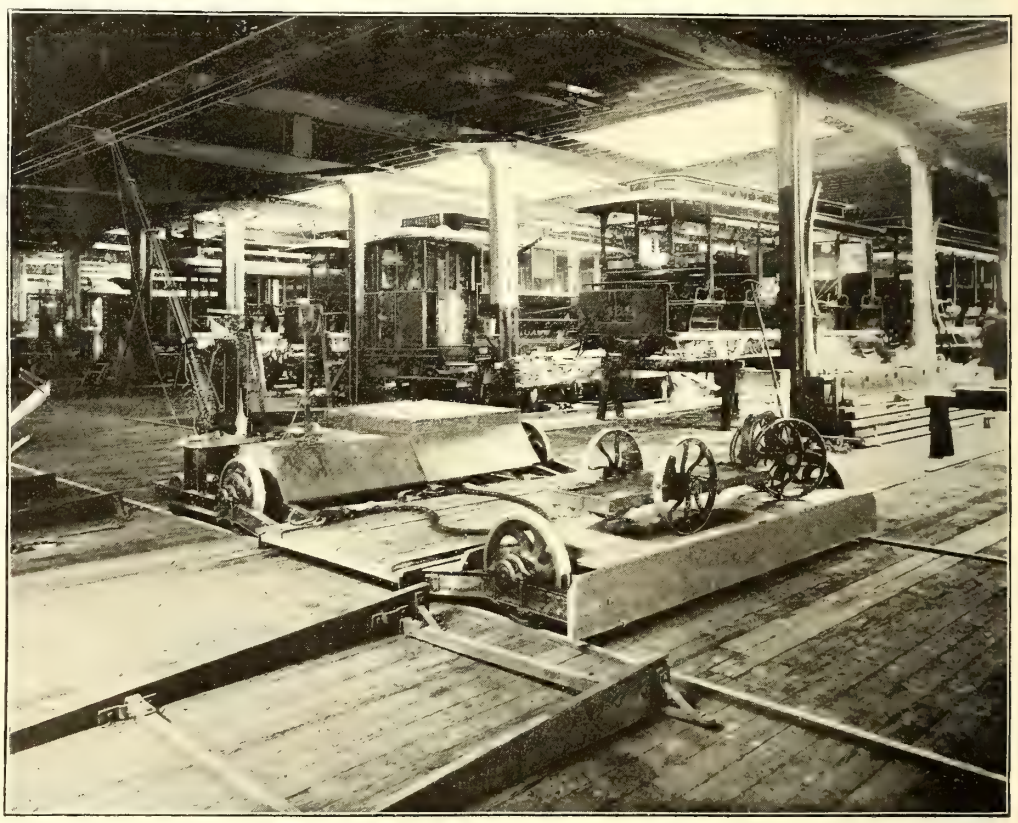


FIG. 8.—ELECTRIC TRANSFER TABLE AND WHEEL TRUCK

RAIL BENDER

Fig. 7 illustrates a power rail bender which is also employed in the same shops. This consists of three cast rollers, which are set vertically in a solid cast frame, but are revolved horizontally by means of shafting and gear placed under the floor and driven by a belt from the main shafting. The rollers are attached to adjustable guides, which slide back and forth in channels in the main casting and the two inside rollers are adjusted by means of large set screws, as shown. The belt is shifted and machine started by means of hand levers placed above the main casting, as shown in the illustration. By means of this machine rails of any size are readily bent to any arc by passing them repeatedly through the rollers. The rails are handled and adjusted by pneumatic hoists.

On the first floor of the wood shop are suspended racks on which the track tools and other repair tools, including the shovels, picks, buckets, hammers and hoes are stored. A careful record is kept of these, and each gang is charged the kits taken out. The rules require that all tools be

returned and delivered to the keeper when each job is finished. This prevents the tools being lost.

In this connection it is interesting to note that all the axes and picks employed on the lines are manufactured in the blacksmith shop of the company.

REMODELED ELECTRIC TRANSFER CAR

A transfer car has recently been remodeled in the repair shop of the Chicago City Railway Company. It is illustrated in Fig. 8, and is now working in a much more satisfactory manner than formerly. The original equipment of



FIG. 9.—STANDARD SINGLE TRUCK CAR

this car was an S. R. G. No. 30 electric motor, and wound for 500 volts circuit. The new equipment consists of a No. 3 Westinghouse, 25 h.p. motor, operated by the type K-2 controller, and in series with the armature are two car rheostats. There is also a two-panel rheostat, arranged in series with the field circuit and designed to choke off the current when the controller is on the first and second notch, after which it is cut out. This rheostat allows the cars to start easily with a heavy load, when it can be speeded up to the required degree. It will be noticed from the illustration that the table is supported by three pairs of wheels on a side, the small one within the frame being an idler, or a plain wheel without shaft or flanges. Current is obtained from a double overhead trolley, and the trolley pole has a wooden harp, which carries two trolley wheels, 14 ins. apart, and the wires lead down each side of the pole, as shown. A G. E. safety switch and a G. E. fuse box complete the electrical equipment. By means of a lever and system of friction clutches a drum is operated on which a rope is wound. This rope leads out onto the platform between two stationary iron pulleys, and is utilized for hauling cars on or off from the table. Triangular pieces of track are employed to lead up to the top of the table.

NEW CAR

Fig. 9 illustrates the new standard closed car designed by the Chicago City Railway Company. This car was briefly described in the July issue, and sixty have recently been ordered from the St. Louis Car Company. The color is seven shades of olive green. The body is 20 ft. long and the car is 30 ft. over all. Both ends are vestibuled and provided with folding doors, made in three sections. The sash is stationary, and the glazing is done in rubber. One of the particular features of the construction of the car is the precautions to deaden the noise. For this purpose double panels are used. The first, or inside, panel, which is attached to the inside of the posts, is in strips $\frac{5}{8}$ in. thick, while the outside panels are of the usual material and the space between is filled with mineral wool. A double floor is also provided, with tar paper between. The upper floor is really Everett matting, and is made of maple. The interior of the car is of stained cherry, with bronze trimmings. All the posts are hand carved, in what is known as the Empire style of decoration. The ceiling is of three-ply birds-eye maple, and the deck lights are of glass known to the trade as alligator pattern. Longitudinal Hale & Kilburn seats, upholstered in Wilton brussels, are employed. Hunter destination signs are mounted above the hood at each end, as shown, and are operated by means of a shaft depending from the ceiling of the hood.

TRUCKS

The cars are mounted on the Moore trucks, which were designed by C. E. Moore, master mechanic of the company. This truck differs essentially from the ordinary motor truck in that the frame work is chiefly of wood, instead of metal, the side bars being of Georgia pine, $3\frac{1}{2}$ ins. x $4\frac{1}{2}$ ins., reinforced on the outside by $\frac{3}{8}$-in. steel plate. There are no metallic springs employed for supporting the body, but the body rests on rubber cushions, as shown. There are two spiral springs in each yoke, and they carry the load. These trucks have an unusually long wheel base, the standard being 9 ft., and to facilitate rounding the curves a link motion is provided for the axle, the link being so attached as to permit a side movement of $2\frac{1}{2}$ ins. for each axle. Inside brakes are used, so as to avoid the use of brake

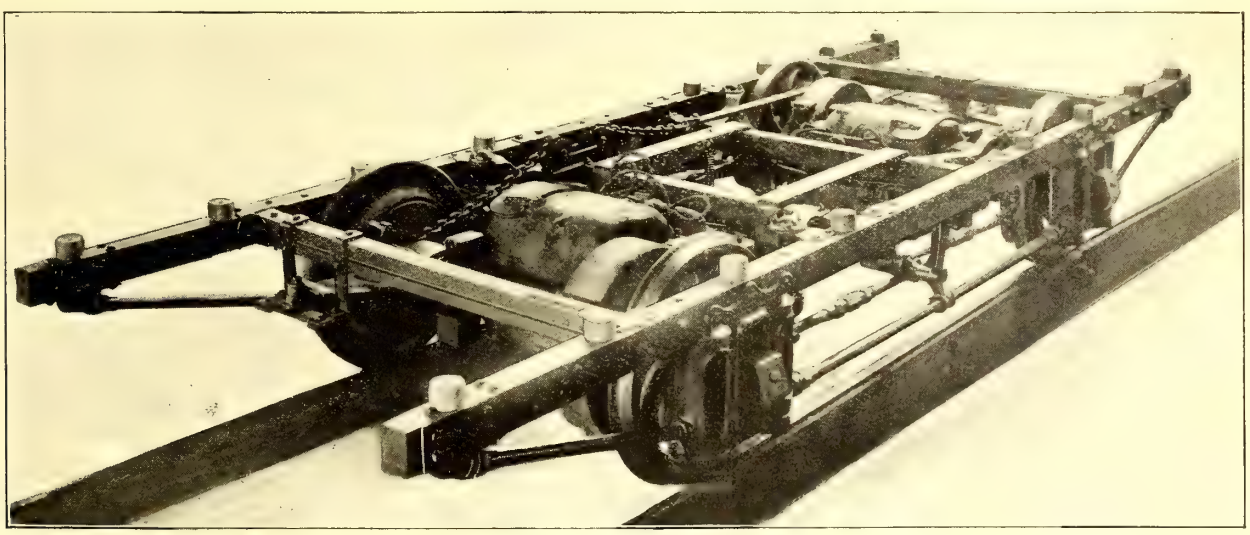


FIG. 10.—STANDARD MOTOR TRUCK

beams. They are operated by means of a tumbling shaft, which is supported by pendent brackets attached to the middle of the side bars. This bracket has a slotted hole in which the tumbling shaft revolves, providing for perfect equalization of brake shoe pressure. The wear of the brake shoes is compensated for by means of turn buckles in the connecting rods. The brake shoe holders are supported by means of pendant ball joint rods, which are attached to brackets bolted to the inside of the side beams. These supporting rods terminate in balls which are held in cast sockets, giving a universal movement to the shoe. Power for operating the brakes is obtained by means of the Price friction device, which is shown in position on the inside of one of the wheels and which has frequently been described in these columns. Power is transmitted to the tumbling shaft by a chain which droops between two rollers and passes beneath a roller on an arm of the tumbling shaft, which is lifted up by the application of the brake.

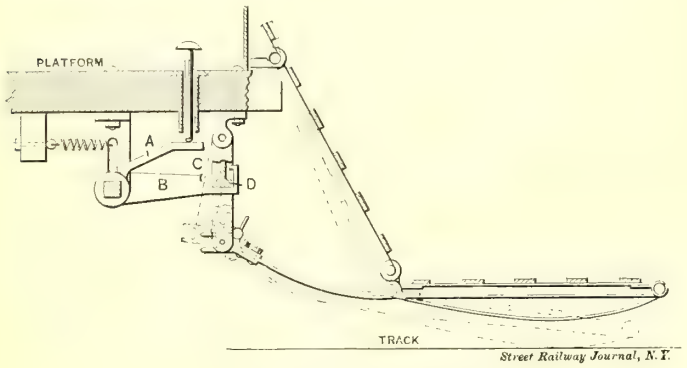


FIG. 11.—STANDARD FENDER

This arm is attached to the tumbling shaft by means of a ratchet arrangement, which provides for adjustment to compensate for wear on shoes. There is also a second arm to which a spiral spring is attached for releasing the brakes. The brake mechanism is also so designed as to work the brakes on the trailer at the same time, and when this attachment is in use, a second release spring assists in unwinding the chain from the friction drum.

Two bolts in each yoke support the pedestal binder and hold the spiral spring in place. These bolts are removed by taking off the bottom nuts. The top of the bolt can then be removed sideways to allow the head to be drawn out through a hole in the top of the cap adjoining and opening into the hole through which the bolt passes when in position. By this means the springs may be drawn down out of the pedestal yoke, when, by removing a nut from each corner brace and disconnecting cables, the truck can be readily dismantled.

The trucks are equipped with what is known as the Anti-Hot-Box Journal Bearing, and the oil box has an improved cover, which is absolutely tight. A large number of these trucks have now been in service on the lines of the company for over two years, and have given such universal satisfaction that they have been adopted as the standard, and the company is now building 200 in its own shops. It is claimed that the long wheel base will prevent teetering, while the body is supported throughout nearly its entire length. By the use of the yoke principle, a swing motion is secured, which allows the truck to round sharp curves without strain or undue wear on the wheel flanges.

FENDERS

Owing to the requirements of a recent city ordinance the cars, to the number of 1200, have all been equipped with fenders, which are illustrated in Fig. 11. These fenders were designed and patented by A. G. Carlson, chief draughtsman of the company. They are of the type known as folding fenders, and are supported by brackets placed under the platform. These fenders are light and strong, being built on a frame work of steel tubing known as structural steel tubing, the seam not being welded. The body of the fender consists of wooden slats, made of elm or hickory, and are 2 ins. wide by $\frac{3}{8}$ in. in thickness. On some of these fenders a wide slat is employed and park advertising signs are printed on this slat in white letters. The slats are attached by means of small bolts and nuts. The cross bars are of crucible steel, and on the under side are two curved bars or runners, which serve to lift the fender over rough places. There is also an attachment under the platform which provides for dropping the fender down to the paving. It is operated by means of a foot button extending through the platform, so that the motorman is able to drop the fender quickly, should he think there is danger of striking a person standing on the track. The dotted lines in Fig. 11 illustrate the position of the fender when dropped for action. These fenders, without the platform attachment, weigh only about 80 lbs., but have sufficient strength for picking up a large body.



FIG. 12.—POLE RAISING WAGON

When folded up the fender comes inside the line of the bumper, and is held in position by means of chains and hooks attached to the dash. The construction is such that

the fenders are readily taken off or shifted from one end of the car to the other.

Since the adoption of this fender, in May last, the cars have picked up sixteen people without injury, and in one instance a man and a woman were taken up by a fender at the same time, being caught in an attempt to cross the track.

POLE RAISING WAGON

Fig. 12 illustrates a pole raising wagon employed on the lines of the Chicago City Railway Company, by means of which, in the recent equipment of the State Street line for electric traction, a crew of seven men with two spans of horses are frequently able to raise and place 137 poles a day. This wagon is equipped with a boom, as shown, which may be lowered to any angle by means of the hoisting apparatus on the front end of the wagon. A set of three interchangeable booms are provided, so that the wagon is able to handle any pole up to 65 ft. in length. The poles, after being distributed, are hauled into position by an extra team of horses, when they are picked up by the block and fall attachment, the power being supplied by the extra team of horses attached to the end of the rope. The wagon is then readily put back into position, and the pole is lowered into the hole, after which the wagon and appliances are quickly moved to the next hole. The wagon is so constructed that it can be turned in a short radius and the team moved out of the way of passing cars. A second hoisting apparatus is placed near the rear of the wagon and can be employed for pulling the poles out of a concrete foundation, when, for any reason, it is necessary to remove a pole. This hoist is operated by hand power. The wagon is also employed for loading and unloading reels of wire from the supplying wagons, the boom being canted in such position as to permit of placing the reel in any position on the wagon. The tackle blocks are designed for two loops in the top block and one in the bottom, so that there is sufficient power for lifting the poles and securing quite rapid movement.

This derrick wagon is also used for unloading and piling rails, when it is operated by the windlass. It was found that the cost of unloading rails by hand from gondola cars and piling them in the yard was 39½ cents per ton; now, by the use of the derrick wagon, the cost is only 11½ cents per ton, including the labor and team for moving the wagon.

Splicing Cars in Philadelphia

When the electric lines in Philadelphia were equipped in 1894 and 1895 most of the cars were mounted on single trucks, and measured 18 ft. body. The management has, for some time, been considering the advisability of replacing some of these cars with long cars. The plan was suggested to utilize some of the short cars by splicing two together to make a long car. This has been done with a number of cars, and the results have been most satisfactory. The work was all performed in the shops of the Union Traction Company, and the accompanying engravings show the method adopted.



FIG. 2.—CAR SAWN IN TWO

Fig. 1 shows the car in its original condition. The body, as stated, was 18 ft. in length and had six windows. Fig. 2 shows the car sawn in two, and Fig. 3 with the two ends separated, ready to receive the piece which is built in the middle of the car. As will be noticed, the side sills are cut apart on a dovetail and the interior framing of the car has been entirely removed.

Fig. 4 shows the car with the sides spliced by the introduction of a sill insertion and two additional panels. The frame has also been completed and the car is ready for the



FIG. 1.—ORIGINAL 18-FT. CAR, AS USED ON THE LINES OF THE UNION TRACTION COMPANY



FIG. 3.—TWO HALVES OF BODY DRAWN APART, READY FOR SILL INSERTION

sheathing. As the sills in the new car are used only to hold the uprights, and are not depended upon for strength, a large steel angle is fitted to each side, as shown in Fig. 5. This angle forms the real sill of the car. In addition to the angle iron, a truss is placed behind the seats to reinforce this angle. The end of the truss rod is shown below the angle in Fig. 6, which represents the car in its finished condition, ready to receive the trucks. The cars, when

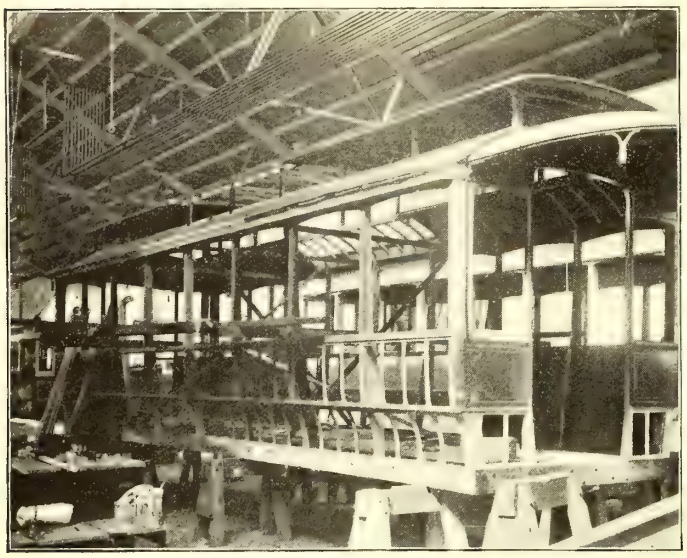


FIG. 4.—VIEW AFTER INSERTION OF PANELS

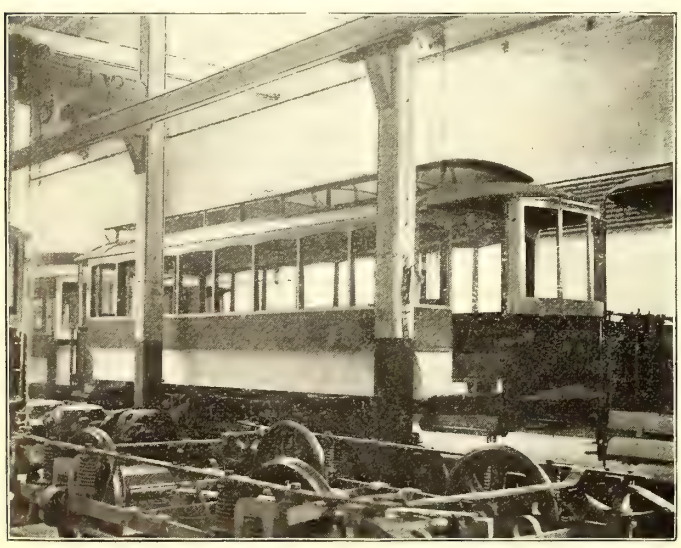
finished, have a 24-ft. body, the length being increased just one-third. When in use they are not carried on the single truck shown in the engraving, but on Brill maximum traction trucks.

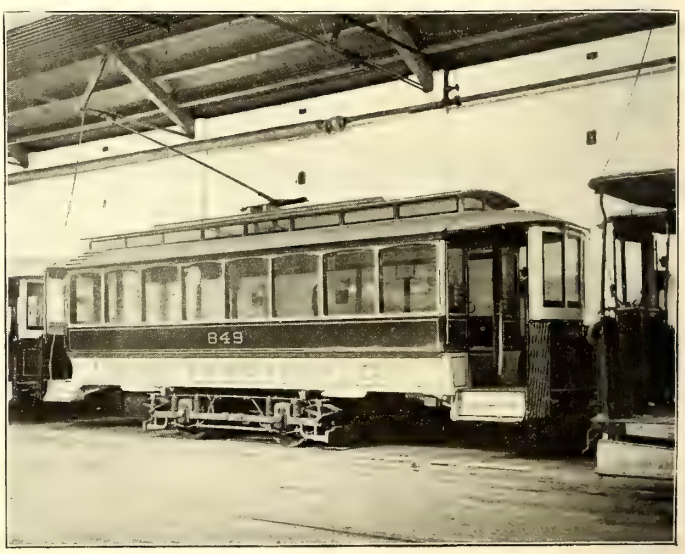
Off-Hand Trolley-Pole Repairs

Accidents to trolley poles are frequent, owing to the liability of the wheels to jump the wire. The force of the spring is sufficient to bend the pole badly, or even to break it in two, if an obstruction of stability is encountered during the rebound of the pole. Usually, the damage done consists of a plain bend near the middle of the pole, and this is allowed to remain as long as it is not great enough to prevent the wheel from staying on the wire when passing under intersecting overhead rigging.

Sometimes a pole receives a green bend which has the effect of twisting it so that the wheel stands at a considerable angle from the vertical. This is frequently so bad that the wheel will not stay on the wire. A rough and ready cure for this is to place a switch iron through the Y of the trolley yoke, then using the iron rod as a lever, twist the pole until the yoke stands true with the wire again.

Sometimes a pole becomes bent close down to the socket. A quite slight bend here, will bring the trolley wheel so low that the springs have not sufficient reserve force to keep the wheel in place. In such a case, take the pole down, thrust the butt-end into a casting underneath the frame of the car, then put two men on the free end of the pole and let them pull slowly, but steadily. If the pole be bent more than one way, straighten all the crooks and turns into one plane before trying to get them out, then the bends can be taken out for good. Care should be taken to so place the pole that the end is not jambed or dented to the extent that it will not go into the socket. Avoid this by a judicious placing of the pole in the casting, across which the purchase is taken. A little attention paid to this matter may save a pole which would otherwise be spoiled for further use.





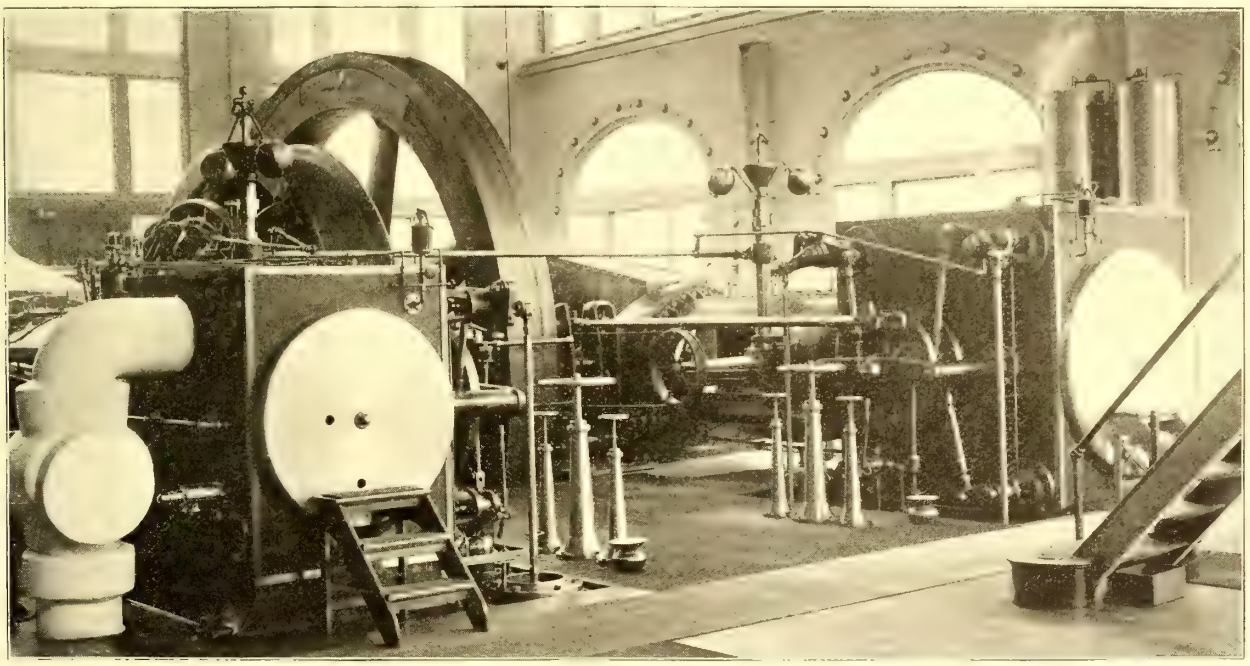
FIGS. 5 AND 6.—COMPLETED CAR

Taxing Street Railways

The opinion of the "Boston Herald" on the subject of street railway taxation is expressed in a recent editorial as follows: "Suppose it were possible for a city to collect, say, $400,000 in public franchise taxes each year from a street railway system. This money would then go into the treasury and would be a relief, to that extent, of the ordinary burden of taxation. On the other hand, if, instead of collecting this tax, the municipality compelled the street railway company, in consequence of the franchise given, to run more frequent cars, to run these cars to non-paying points, or at times in the night when there was no profit in maintaining the service, or compelled it to reduce its rate of fare, or give free exchange of tickets in all directions, it seems to us probable that the general benefit derived therefrom would be greater than that secured by having the same amount of money paid into the municipal treasury. It is altogether a question of policy, but to our mind a slight relief granted to a few taxpayers may be of less general advantage than the direct gain of improved transit service which might be enjoyed every day by hundreds of thousands of people."

"Kinks" from Hartford

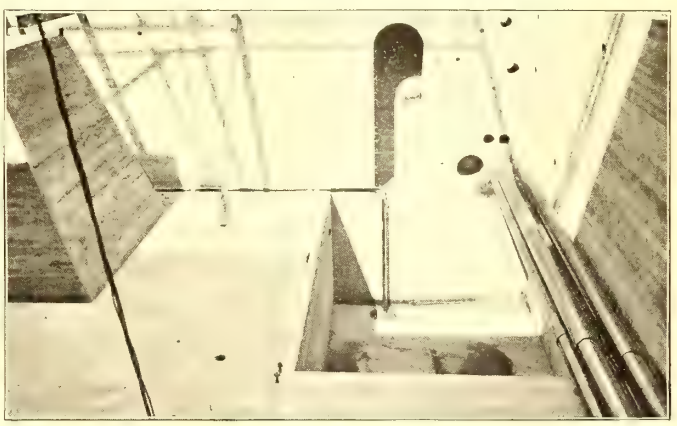
The Hartford Street Railway Company has recently been making several additions to its power station on Commerce Street. This station was described quite fully in the issue of May, 1895, of the STREET RAILWAY JOURNAL. Its original equipment consisted of Ball & Wood 300-h.p. engines, each belted to a 220-kw. generator. An addition to the capacity of the station having been found necessary, the company decided to try a Corliss engine, and consequently one built by the Pennsylvania Iron Works of 1250-h.p. capacity was installed. The engine is cross compound condensing, and is directly connected to a 800-kw. General Electric generator. An extensive series of tests, which has been conducted by the company, has disclosed but very little difference between the economy of the two types of machines. If anything, the large engine is slightly more economical, but only when running at full load, and this condition can best be assured, of course, by cutting in and out the small machines. Part of this difference can also be accounted for by the fact that the high-speed engines are belted to their generators, while the slow-speed engine is direct connected. The management speaks in the highest terms of both types of engine.



1250-H. P. DIRECT-CONNECTED ENGINE AND GENERATOR



FOUNDATION FOR ENGINE AND GENERATOR UNDER CONSTRUCTION



CONDENSER PIT

In installing the Corliss engine the question of foundations became an important one, from the fact that the station is built on a quicksand, close to the Connecticut River. This made the use of piling impossible, and the construction finally adopted was that of using concrete throughout for the foundation and side walls of the annex to the station in which the new unit has been placed. The work was done by the Hartford Paving and Construction Company. The foundation was constructed by day's work, and not by contract, and consists of 960.3 cubic yds. of Portland cement concrete, requiring 1996 cubic yds. of excavation to be moved in its construction. Atlas Portland cement was used exclusively, and the entire cost of the work was $6,412.39. The foundation is underlaid by a bed of soft clay and quicksand, into which the condenser pit penetrates. There are no piles or similar contrivances under the foundation, and its stability depends entirely upon the weight being properly distributed over the required area.

The engine foundations are battered 3 ins. to 1 ft., and are made solid with the floor, the side walls and pump pit, forming a monolith. All the pipes from the station are carried to the river through a concrete sub-way 10 ft. in diameter, giving plenty of room for access and inspection.

CAR HOUSES

The main car house of the company is located on State Street, near the center of the city. The tracks, which are

9 in. girder rails, are mounted directly on brick piers, 14 ins. x 16 ins., except where there is special work, where the rails are mounted on brick foundations. The piers are spaced about 15 ft. apart, one at each joint and one midway between the joints, and carry the rails on a cast-iron plate.

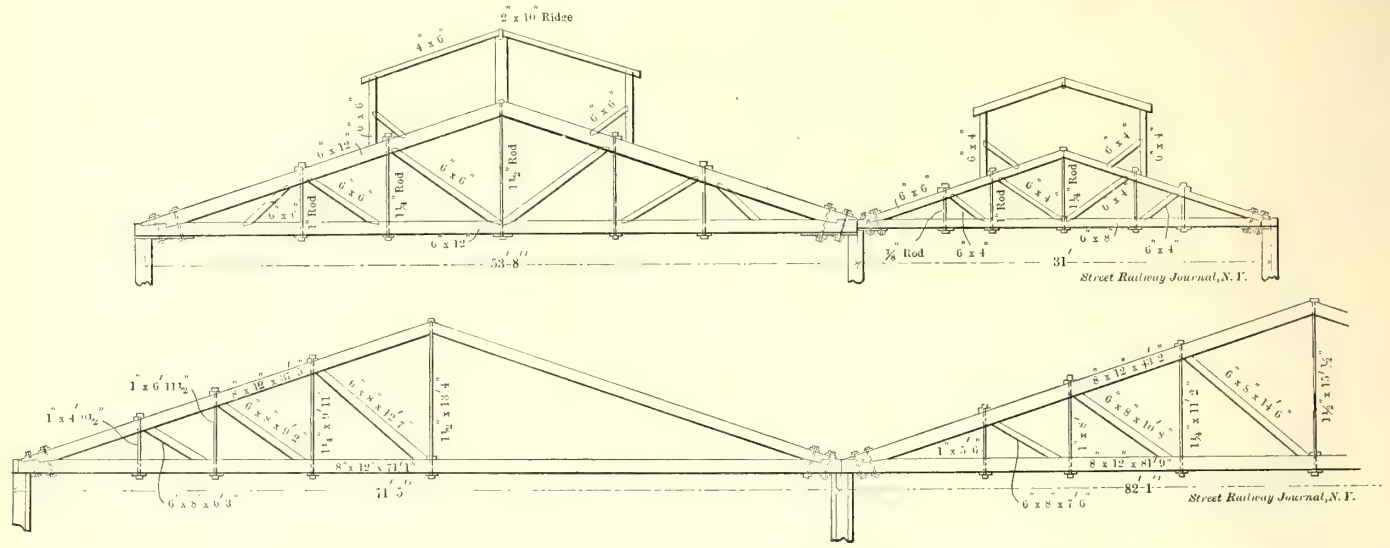


FIG. 2.—WOODEN ROOF GIRDERS—VERNON STREET CAR HOUSE

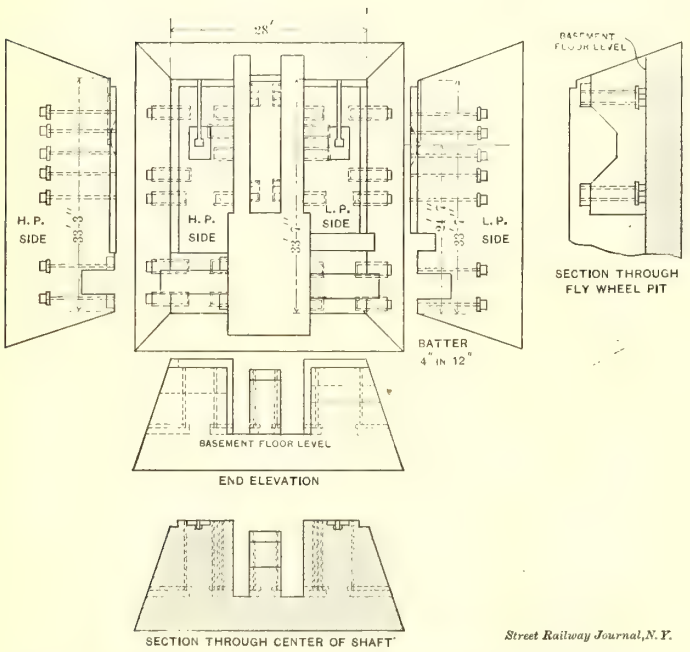


FIG. 1.—ENGINE AND GENERATOR CONCRETE FOUNDATION

They are held to gage by tie-rods, and the space between the rails is planked over, except where room is left for pit work. The floor is concreted, and has a pitch of 4 ins. to 100 ft., this being sufficient to provide for drainage.

The overhead conductors in the car house are steel T bars, which are attached to the roof girders. This makes a very firm running surface for the trolley wheel, and one which is indestructible. For skylights the company is a a very large user of translucent fibre, a very light material which reduces greatly the weight carried on the roof girders. It allows plenty of light to pass through it, and at the same time is unbreakable. The roof itself is the special roofing of the Berlin Iron Bridge Company, by whom the entire structure was built.

The company has also built on Vernon Street a large car house of somewhat different design, which is shown in the accompanying diagrams. This car house is of brick, with track on piers, as in the main car house. The roof girders, however, are of wood, and include one span of 82 ft. 1 in. At this place are also the repair shops and storerooms of the company.

STORAGE OF OIL

The oil for the headlights is stored at the main car house

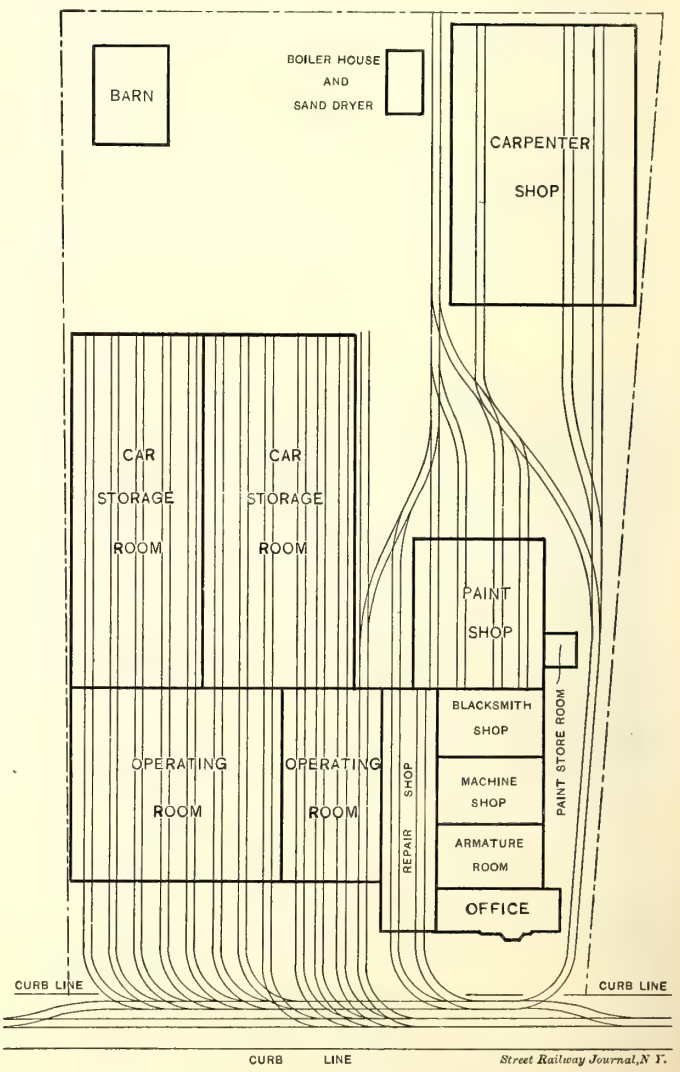


FIG. 3.—PLAN OF BUILDINGS—VERNON STREET

in a galvanized iron tank, which is buried in the ground near the car house. This tank has a capacity of 7 barrels, and when needed, oil is drawn from it by a hand pump. Underneath the pump is a drain, so that the waste oil runs

back into the tank. The placing of the supply of oil underground avoids all danger of fire.

EMPLOYEES' ROOMS

Above the State Street car house are rooms devoted to the use of the conductors and motormen. They are especially large and commodious, and include a meeting room, occupied by a club composed of the employees of the company. The room contains a piano, billiard table, etc. The club is organized as a benefit association, and membership in it is entirely voluntary. In the conductors' room the tables, at which the conductors sort their change, are arranged with low cross partitions, so that when several conductors use one table the coins do not become mixed.

TESTING CAR

The general manager of the company, N. McD. Crawford, has equipped one motor car for testing the apparatus

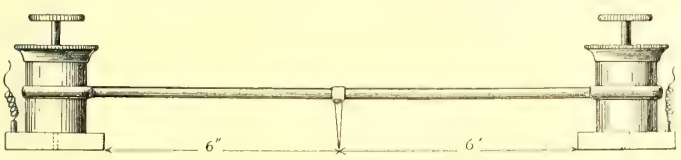


FIG. 4.—CONTACT DEVICE FOR TESTING BONDS

and equipment used on the road, and reports that the results secured by careful testing have saved the company many hundreds of dollars. The car is equipped with all the usual testing apparatus, including a Herrick testing set. This car is being used at present for the conduct of a careful series of tests on every rail bond used on the line. These tests are made after 12 o'clock at night, when the operation of the road has stopped. One hundred amperes are passed through each bond, and the drop in voltage is carefully noted by a milli-volt meter. If this shows a greater drop in voltage than $1\frac{1}{2}$ milli-volts an investigation is immediately instituted. The method of making contact with the rails was a problem upon which considerable thought has been expended. The device finally adopted was the invention of Mr. Crawford, and is illustrated in the accompanying engraving. It consists of two hard-rubber cylinders, connected rigidly by a rod 1 ft. in length. There is a pointer at the center of the rod, so that when this pointer is placed over the joint each contact point will be 6 ins. from the joint. The rubber cylinders terminate in two copper blocks, $2\frac{1}{2}$ ins. x 2 ins., and the top of each is fitted with a screw plunger. The cylinders are filled with mercury, which can be forced out of a minute hole in the center of the blocks by screwing down the plunger.

The rails are first cleaned by an H. P. Brown amalgam stick, after which the contact device is set on the rails, and the plungers screwed down slightly so as to force the mercury out from the cylinders through the bottom of the copper contact blocks, making excellent contact. The entire time required to set the apparatus and make a bond test is only three to four minutes.

ADJUSTABLE WATER RHEOSTAT

The car is fitted with an adjustable water rheostat, consisting of a barrel containing the negative plate at the base of the barrel. The positive plate is raised and lowered by a windlass, which can be set to hold the plate in any position. The barrel is covered, and a stone pipe leads from it to the outside of the car, so that all fumes, produced while the current is being passed through the rheostat, are conveyed outside of the car.

STORE ROOMS

The store rooms of the company are located at the Vernon Street car house, and a careful record is kept of all material which goes into the store room or is issued from it, with the price at which the material is charged in and out. One man is made responsible for all of this material, and does not issue any supplies except on written requisition. A separate compartment is devoted to each class of material. On each box is attached a card, shown herewith. This gives the name of the article, the unit in which it is bought and issued, i. e., pounds, individual pieces, dozen, etc., the maximum and minimum quantity ordered at one time to secure the most advantageous price, the amount of the material received or delivered at any date and the balance after each removal or delivery. From the latter, of course, an inventory of the shop rooms can be speedily obtained. The boxes containing the material are so arranged that the largest boxes are at the bottom, and they then gradually recede towards the top, so that no ladder is required to reach any material in the upper boxes, the storekeeper stepping from one box to another.

SAND DRYER

The sand for the sand boxes is all dried before using in a special heater located over the boiler room. This consists of a hopper, in which are a multiplicity of steam pipes. The sand is raised to this hopper by a bucket conveyor, and after passing through the hopper it is carried by gravity through a chute into the sand cars, of which the company has two. Most of the sanding is done from these cars, although each car is also equipped with De Witt sand boxes. Sand for the individual cars is supplied to the motormen at the different car houses in paper bags, which can easily be emptied into the sand boxes and then thrown away.

Article..... Unit..... Max..... Min.....

DATE.	REC'D.	DEL'D.	BAL.	DATE.	REC'D.	DEL'D.	BAL.

FIG. 5.—STORE ROOM RECORD CARD

Catalogue No. Article Trolley Wheels Name & Address of Blake Bros. Price Unit 1

Date	Rec'd	Price	Del'd	Bal	Date	Rec'd	Price	Del'd	Bal.
July 11	175	.60							

FIG. 6.—CARD USED IN ACCOUNTING DEPARTMENT

CHECKING BILLS FOR SUPPLIES

All bills for supplies are checked in the accounting department by means of a card catalogue, one of the individual cards of which is shown herewith. This gives the usual information as to the name of the person from whom the material is purchased, amount received, price, etc., and also the catalogue number, making it easy to order new goods. These cards are also employed for debiting the cost of supplies issued from the store room to the different accounts in the company's ledger.

SPEED CARDS

Special attention is given by the company to insure the maintenance of the running schedule adopted on the different divisions, and for preventing the motormen from running either ahead or behind, a time-table has been drawn

INSPECTOR'S CHECK

Fare Register Reading.

INSPECTOR'S CHECK.--Conductor will retain this check.

Fare Register Reading.

Minute	Hour			
		WETHERSFIELD	★	A
		MAIN STREET	★	B
0	1	CHARTER OAK AVE.	★	C
1	2	WINDSOR & RAINBOW	★	D
2	3	Cedar Hill & Blue Hills Av	★	E
3	4	ZION STREET	★	F
4	5	Vernon St. & Albany Av.	★	G
5	6	PARKVILLE	★	H
6	7	LAFAYETTE & BROAD	★	I
7	8	NEW PARK AVE.	★	J
8	9	ASYLUM AVE.	★	K
9	10	WEST HARTFORD	★	L
	11	CARDEN & ASHLEY	★	M
Jan.	12	TALCOTTVILLE	★	N
Feb.	A.M.	EAST WINDSOR HILL	★	O
Mar.	P.M.	SOUTH GLASTONBURY	★	P
Apr.	On time	BURNSIDE	★	Q
May	Late	Farmington & Unionville	★	R
June	Ahead	EAST HARTFORD	★	S
July	0 1	MANCHESTER	★	T
Aug.	1 2	ROCKVILLE	★	U
Sept.	2 3	NEWINGTON DIVISION	★	V
Oct.	3 4	A 2998		W
Nov.	4 5			X
Dec.	5 6			Y
N	6 7	10 9 8 7 6 5 4 3 2 1		Z
S	7 8	20 19 18 17 16 15 14 13 12 11		
E	8 9	31 30 29 28 27 26 25 24 23 22 21		
W	9			

Hour	Minute			
		WETHERSFIELD	★	A
		MAIN STREET	★	B
1	0	CHARTER OAK AVE.	★	C
2	1	WINDSOR & RAINBOW	★	D
3	2	Cedar Hill & Blue Hills Av	★	E
4	3	ZION STREET	★	F
5	4	Vernon St. & Albany Av.	★	G
6	5	PARKVILLE	★	H
7		LAFAYETTE & BROAD	★	I
8	6	NEW PARK AVE.	★	J
9	7	ASYLUM AVE.	★	K
10	8	WEST HARTFORD	★	L
11	9	CARDEN & ASHLEY	★	M
12	A.M.	TALCOTTVILLE	★	N
	P.M.	EAST WINDSOR HILL	★	O
On time		SOUTH GLASTONBURY	★	P
Late		BURNSIDE	★	Q
Ahead		Farmington & Unionville	★	R
1	0	EAST HARTFORD	★	S
2	1	MANCHESTER	★	T
3	2	ROCKVILLE	★	U
4	3	NEWINGTON DIVISION	★	V
5	4	A 2998		W
	5			X
	6	1 2 3 4 5 6 7 8 9 10		Y
	7	11 12 13 14 15 16 17 18 19 20		Z
	8	21 22 23 24 25 26 27 28 29 30 31		
	9			

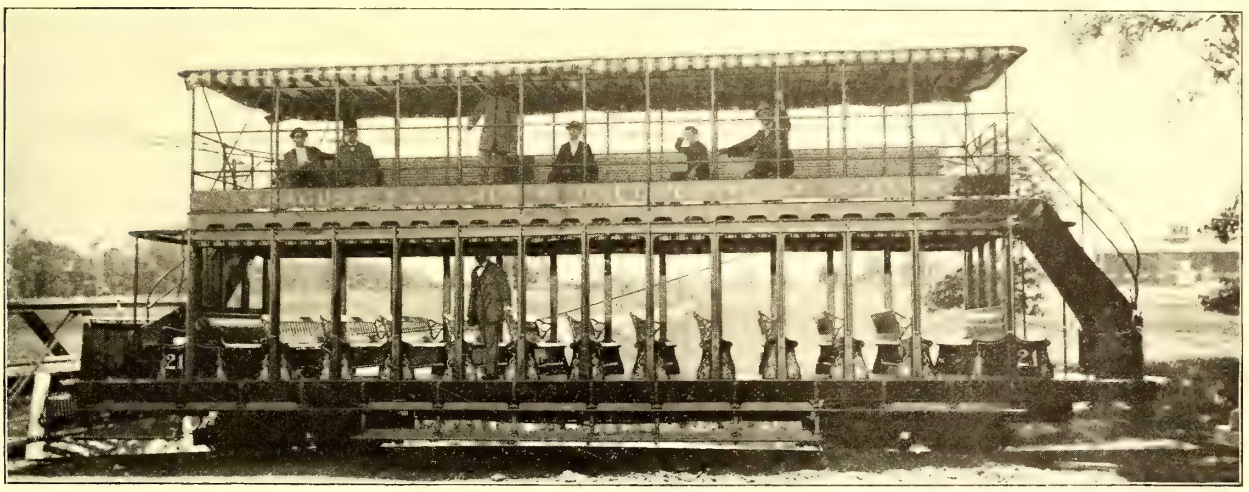
wheels, carrying four 30-h.p. Westinghouse motors, No. 3, and operated by two K 12 General Electric controllers. The car is to be fitted with sand boxes of the company's own make, and is equipped with fenders and four electric signal lamps, placed at each corner of the vestibule over the windows.

It is needless to say that the car is built strong for the uses for which it is intended. The company is well equipped for this kind of work, having all necessary shops and machinery.

Double Deck Cars in Syracuse

The Syracuse, Lakeside & Baldwinsville Railway Company has in operation four double-deck trolley cars, which are giving excellent satisfaction. H. S. Newton, general manager of the company, writes as follows concerning this new rolling stock:

"Our road at present is a summer line, having very heavy traffic at certain times. During last season we had quite a little trouble in handling this traffic satisfactorily with the ordinary type of cars, with trailers attached, and determined this year to make an effort to handle the people more expeditiously in a new way. The result has been the construction of the four double-deck cars above mentioned, which are of the fifteen-bench, open type, very heavily constructed below, and with the upper compartment capable of holding, on a pinch, 100 persons. We have shown our ability on more than one occasion to carry off a good-sized crowd at one load on one of these cars. Altogether, I can say that this class of rolling stock has proven eminently satisfactory."



DOUBLE DECK CARS IN SYRACUSE

Interesting Wheels Records in Los Angeles

There is considerable discussion as to the maximum mileage ever made by an electric car wheel, but if Los Angeles does not hold the record, it certainly comes very near doing so. T. J. Hook, superintendent of the Los Angeles Traction Company, reports that car No. 122, which is 38½ ft. long, and is mounted on Brill maximum traction trucks, recently completed 185,000 miles with the same full set of 33-in. driving wheels. The car weighs empty 11 tons, and the wheels were supplied by the Lobdell Car Wheel Company.

Up to January of this year the only effect noticed from this large mileage was that the flanges of one wheel of each pair had worn somewhat thin, and that the outer edge of the tread was chipped. The flanges were not so thin, however, as to require the removal of the wheels from the car, and the latter were kept in constant service until May 15, when one of the flanges was broken. Both pair were then removed from service, although the wheels at the other end of each axle were as strong and as sound as ever, so far as could be determined from inspection. The piece broken from the flange was about a foot long, and at the ends of the fracture showed silver-white iron. Between the ends the color of the iron was shaded between blue and purple, like that of pyrites of iron and pyrites of copper.

The facts as given by Mr. Hook tend to prove the theory that in most cases where the flanges of motor wheels break, especially after some service, the break does not indicate any defect in the metal, but is incident to the service. The difference in thickness between the flanges on one side and the other of the car must, of course, have been due to the grinding of the flanges against the rails in curving, and the location of the road must have been such as to bring this wear more to one side of the car than the other. This constant grinding on curves may be so severe as to heat the tread and flange of the wheel to an extent sufficient to start a fine crack at the base of the flange. The effect of this is naturally greater with a thin than with a thick flange, as the latter dissipates the heat more quickly. This crack in service gradually extends until a piece breaks out when some sudden thrust comes at that point against the flange.

The chill of a cast iron wheel is composed of crystals which are radial to the chill mould against which they are cast. This can readily be seen from any of the various photographic sections of wheels, which have been published in the STREET RAILWAY JOURNAL. These crystals naturally follow the radius of the flange, and, as the bases of these crystals have a cleavage, they easily separate under the action of heat. That this was the cause of the rupture in the case at Los Angeles is evidenced by the discoloration of the chill to a violet hue, which color can only be produced in the chill by heat. The chilled tread of wheels which are subjected to thermal tests show this conclusively. Another evidence of this is the fact that while a careful examination and the intentional breaking of the flanges of new motor wheels do not disclose the slightest evidence of a crack or any discoloration of the metal, the breaking of old wheels in this way frequently shows a condition of this kind.

STREET RAILWAY JOURNAL

SEPTEMBER, 1899.

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, BEARD BUILDING, 120 LIBERTY STREET.

BRANCH OFFICES:

CHICAGO.....Monadnock Block.
PHILADELPHIA.....929 Chestnut Street.
LONDON.....39 Victoria Street, Westminster.
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ST. PETERSBURG.....Alexander L. Lineff, Ligovka, 67-22.

Long Distance Telephone, "New York, 4044 Cortlandt."
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / 25/ / 31 fr

Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

NOTICE.

Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, accounting, finance and invention.

Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

Address all communications to

The Street Railway Publishing Co.,
Beard Building, 120 Liberty Street, New York.

The October (souvenir) issue of STREET RAILWAY JOURNAL will be a "World's Practice Number," in which will appear a series of papers prepared by leading engineers throughout the world, describing practice in electric railroading in countries where development has been greatest. American practice will be illustrated by several papers upon various branches of the work done in Chicago. Louis J. Magee, managing director of the Union Elektricitäts Gesellschaft, of Berlin, will contribute an extensive and very valuable article upon "Electric Railway Practice in Germany;" Prof. Sidney H. Short will embody the results of his recent close examination of electric railway practice in Great Britain by an article on that subject; and papers upon practice in Russia, Switzerland and Argentina will be contributed by able engineers in the respective countries. The financial characteristics of the large city railway systems of the world will be presented in tabular form, from late and accurate information obtained from original sources, and many other articles of the greatest present interest and value will appear in this number.

There appears to be a somewhat general impression among advocates of municipal ownership who have but superficially studied street railway statistics in our principal cities, that the large street railway systems of New York city are not paying their just burdens of taxation and that, in fact, they are paying almost nothing into the State and city treasury for the privileges which they enjoy. It is not uncommon even to learn from some of these ill advised and irresponsible moulders of public opinion that New York city franchises have been granted to their holders without any compensation whatever—that they have been free gifts to the corporations. The actual facts of the matter, however, as disclosed by a recent careful investigation of the tax records of New York city, are that one system alone is paying over $1,000,000 annually to city and State in the form of taxes upon earnings, real estate and personal property, licenses, etc., and this $1,000,000 amounts to over 8 per cent of the gross receipts. What would be thought if an income tax of 8 per cent was imposed upon the gross income of any citizen, or a tax of 16 per cent upon his net income?

The results of the tests of power brakes to be made this month on certain lines in New York city, under the auspices of the Board of Railroad Commissioners of the State of New York, will be looked forward to with great interest in the hope that a substantial and valuable contribution to existing data upon the braking of electric cars will be brought out. We understand that nearly fifty devices in all are to be tested, and manufacturers of air, electric and mechanical brakes of all kinds are taking great pains to comply with all requirements of the Board and to prepare their apparatus carefully to produce good results.

The coming two months are generally regarded by street railway managers as those in which the pressure in business is lightest upon them, and these months have therefore been generally selected for holding the various conventions. By this we do not mean that the lot of the railway manager is at any time an easy one, for he always has something to think about and worry over; but by the 1st of September the summer traffic has begun to wane, and until the end of October the immediate approach of winter and the holiday season, with their accompanying problems, are some distance off. For this reason the American Street Railway Association and many of the State associations have done wisely to select this time for holding their annual conventions. Of the State meetings, the two most numerously attended are those of New York and Pennsylvania; the former occurring at Ithaca, Sept. 12 and 13, and the latter at Lancaster, Oct. 4 and 5. To both a most cordial invitation by the respective officers has been extended, not only to the street railways of the State in which the convention is held, but to those of other States in case they may wish to attend, and also particularly to the representatives of manufacturers or the supply men engaged in

electric railway business. Both these associations have been most successful, and both have probably never been more prosperous or attained a larger membership than at present.

* * * * * *

It is not necessary at this time to dwell on the benefits which these organizations confer on the industry in general and on their own members. These benefits are too widely known and enjoyed to require further discussion here. There is one benefit, however, which can be derived from them that does not seem to be appreciated as much as it should be; and that is the opportunity which is given to individuals, among lesser known engineers, superintendents and other operating men in the business, particularly to the young men who have only recently engaged in the industry, to introduce themselves and their ideas to the "magnates" of the business. We know from personal experience that there are in the electric railway business, particularly among the small roads, a great many men whose ability warrants their holding more lucrative positions than they do at present. The owners and the responsible officials of the larger roads, on the other hand, are constantly on the lookout for assistants who can aid them in their enterprises. There is perhaps no business in which ideas and intelligence are more required than in that devoted to electric railroading, and none in which a possession of these qualities is more quickly appreciated by the important men in the business. The New York State Street Railway Association, in particular, established several years ago the practice of devoting the major part of its proceedings to short addresses and papers on timely topics. A long list of subjects, covering a wide field in the mechanical, electrical, operating and accounting branches, is published in advance of the meeting, and anyone who wishes to give his views on any of these topics is invited to do so, provided only they are to the point and not too long. In addition, however, it may not be generally known, but should be understood, that if anyone in the railway business has something to say upon any other topic connected with electric railways, not mentioned in the published list, the association would be glad to hear him, and an application to the president or secretary will insure the giving to him of the necessary time. If instead of presenting a paper he prefers to make his remarks orally the discussion is always open to him. What has been stated respecting the New York State Association is practically the same of all State associations which hold open meetings. We again urge, therefore, the bright men of the business to take advantage of the excellent opportunity thus offered to let their light shine before men, take an active part in the State associations to which their companies belong, and show the managers of the larger roads that they are capable of solving the problems which have come before them in the properties under their charge.

A peculiar incident in the testimony given at the investigation of the recent trolley accident near Stratford, Conn., was the evidence submitted by a man named Kelly. He stated that he was on the car at the time of the accident, and described graphically and with great detail his sensations when the car ran off the track, when it climbed the guard-rail, and when it took its final plunge over the bridge into the gorge below. He attributed his escape to the fact that during the descent he fell outside of the car and landed in some mud. During the first few days of the investigation he was regarded with a great deal of interest by the members of the jury and the attendants, including the newspaper reporters. Subsequent testimony, however, proved that he was not on the car at all, but that he witnessed the accident while driving a carriage in the neighborhood. When confronted with this evidence Mr. Kelly did not deny it, but stated that his imagination overcame him to such an extent, and that he had thought so much about what he had seen, that he came to believe he was on the car itself. While in itself trifling, the incident simply proves the proposition which many jurists have held for a long time, that direct testimony is not only not as good as circumstantial evidence, but very often extremely unreliable, especially of events which happen during moments of great excitement. Leaving out of consideration entirely the wish for notoriety, or the desire to participate in damage suits by means of perjured testimony, some people, after a crisis of this kind, are so constituted that they come to actually believe that they have participated in or seen things which never occurred, and the most graphic description of some of the incidents is drawn entirely from their imagination, without any real intention to deceive. This fact is worth remembering in accident cases, and there are many cases on record similar to that cited above.

During the trial of a recent suit for damages brought by a water company against an electric railway company for alleged injury to the pipes of the plaintiffs through electrolysis, the attorney for the water company stated that all of the alleged damages were limited to the territory within 2000 ft. of the railway power station. Soon after this statement, the attorney of the railroad company arose and asked his opponents if their clients would sign a contract releasing the railway company in the future from all claims for damages to the water pipes from electrolysis outside of this district, provided his clients would agree to repair all troubles due to electrolysis within the region specified, viz., that within 2000 ft. of the station. After consultation with the managers of the water company, the attorney of the latter stated that the water company would be perfectly willing to agree to this condition. Before the contract was signed, however, the managers of the railroad company good-naturedly decided to be generous to their opponents and advised them not to sign the contract. When asked why, the railway managers said that if it was signed, they would immediately *reverse their current*, thereby *transferring* any possible trouble from near the station to the suburbs.

Comparative Costs and Profits of Cable, Electric and Horse Traction in New York City

In November, 1898, we published, from the private cost sheets of the Metropolitan Street Railway Company, of New York City, a comparative exhibit of the receipts and expenses in detail of the cable lines, the electric (underground conduit) lines and the horse railway lines of that important system, for the year ending June 30, 1898. We are now able to present, in comparison with these figures, those of the corresponding financial year just ended. The comparison is the more valuable, inasmuch as the track

mileage of the system is the same this year as last, so that the results are not complicated by the purchase of new lines or the building of extensions, but the full effect of the change of motive power and the giving of greater facilities may be seen reflected in gross earnings, while the results of the ageing of electrical apparatus and of certain other influences affecting operation during the year are shown in the detailed operating expenses.

On June 30, 1899, the company had 25.3 miles of track in operation by the cable system, the construction dating from 1893 and 1895; 82.1 miles of track in operation with the underground electric system, nearly all of which was opened from Nov. 1, 1897, to Oct. 1, 1898; and 113.4 miles of horse railway track. It will thus be seen that in both years, the results of which are now presented, there was serious interruption to traffic because of construction, the company last year losing three complete months' traffic on two of its most heavily patronized lines.

The first lesson to be derived from these figures is the way in which the public responds to increased facilities. In the last year the company ran its cars over the same trackage nearly 42,000,000 miles, as against but 35,000,000 miles in the previous year, the new cars being, moreover, nearly double the capacity of the old. The passenger receipts jumped nearly 25 per cent as a consequence, while the receipts per car mile were actually increased from 29.7 cents to 30.7 cents, or about 3 per cent. The traffic of the cable lines fell off about 10 per cent, and of the horse lines about 30 per cent, while the electric lines carried three times as many passengers in 1899 as in 1898, and their receipts per car mile increased from 26.99 cents to 31.23 cents.

Taken as a whole, the Metropolitan system operated last year at 15.18 cents per car mile, as against 15.83 cents in the previous year, and the earnings from operation have become 15.50 cents, as against 13.87 cents for 1898. The electric lines have made all of this increased net earning power, and have, in addition, overcome a combined diminution on the horse and cable lines of 1.15 cents per car mile.

The percentages of operating expenses to passenger receipts of the three motive powers compare as follows:

	1898	1899
	Per cent	Per cent
Cable	47.8	50.8
Electric	37.9	38.3
Horse	65.3	69.8
Total	53.3	49.4

Coming now to detailed operating expenses, we find much to study in the comparisons, and some things which require explanation. The winter of 1898-9 was an extremely severe one, the most so that New York has known since the great blizzard of 1888. It was not only that there were two or three severe storms to contend with, but there was a long succession of stormy conditions, and the snow was not off the ground for weeks at a time. This had a serious influence, not only in the item of "removing snow and ice and street cleaning," which increased from $27,725 in 1898 to $67,322 in 1899, but also in "renewals of cable" for the cable system, "tube cleaning" for both cable and electric systems, "repairs of cars, vehicles and electrical and cable equipment," and in lost traffic, the latter a very material figure, inasmuch as the system was almost completely blocked for several days during the winter. During these heavy snow storms the cable lines were kept in almost continuous operation, but only at the expense of immense strain and wear upon the cables. During parts of the stormy period last winter a new cable on the Broadway line would last hardly more than a week.

As a result of these and other influences, including the ageing of apparatus, there has been a general increase in the cost of all three motive powers in the last year as compared with the previous one, and this increase is found in all of the main divisions of operating expenses with all three motive powers, except in "general expenses" for the cable system, and in "transportation" and "general expenses" in the horse system, which show slight decreases.

It will be noticed that in the power figures of the electric line appear a number of charges belonging to horse railroading, and it is again explained, as was done last year, that these are owing to a short crosstown horse railway line so joining a number of the electric lines as to make it impossible to consider it other than a part of the electric system. The cost of electric motive power proper, excluding these items, was 1.21 cents per car mile in 1898, and 1.57 cents per car mile in 1899. The company's new 70,000-h.p. power station was not in operation at all during the year, and is even now running but a single unit out of the ten to be installed, so that the advantage of economical power has not yet been obtained, but the company has been forced to use a number of temporary power stations with storage batteries, etc., and has been many times forced to work them above the economical limit, the demand for power at certain hours of the day severely taxing the station capacities.

In connection with these detailed figures of passenger operation pure and simple, which are the ones, of course, which will be of special interest to the street railway manager and engineer, it may be well to present a complete financial statement of the operation of the Metropolitan system for the last two years. In this statement the "receipts from all sources" include not only the passenger receipts, but those from advertising, dividends on stock of other companies held in the treasury, income from rental of offices in the power station buildings owned by the company, etc.; while the operating expenses of this statement are slightly larger than those in the accompanying table, by reason of items covering cost of caring for office buildings and a few other small charges. A complete statement follows:

	1898	1899
Receipts from all sources	$11,076,021	$13,525,524
All operating expenses	5,620,484	6,408,711
Earnings from operation	5,455,537	7,116,813
Per cent operating expenses to total receipts	50.7	47.4
Fixed charges	3,609,966	4,477,757
Dividends paid	1,500,000	2,471,675
Surplus over dividends	345,570	167,381

We cannot forbear to again speak of the generosity of the management of the Metropolitan Street Railway Company in freely giving to the engineering and street railway public valuable figures of this kind, thus throwing light upon the problems which both foreign and American cities are grappling with at the present time.

RECEIPTS AND EXPENSES OF THE METROPOLITAN STREET RAILWAY COMPANY, OF NEW YORK,

For the Years Ending June 30, 1898, and June 30, 1899,

SHOWING THE RELATIVE COSTS AND PROFITS OF CABLE, ELECTRIC AND HORSE RAILWAY OPERATION.

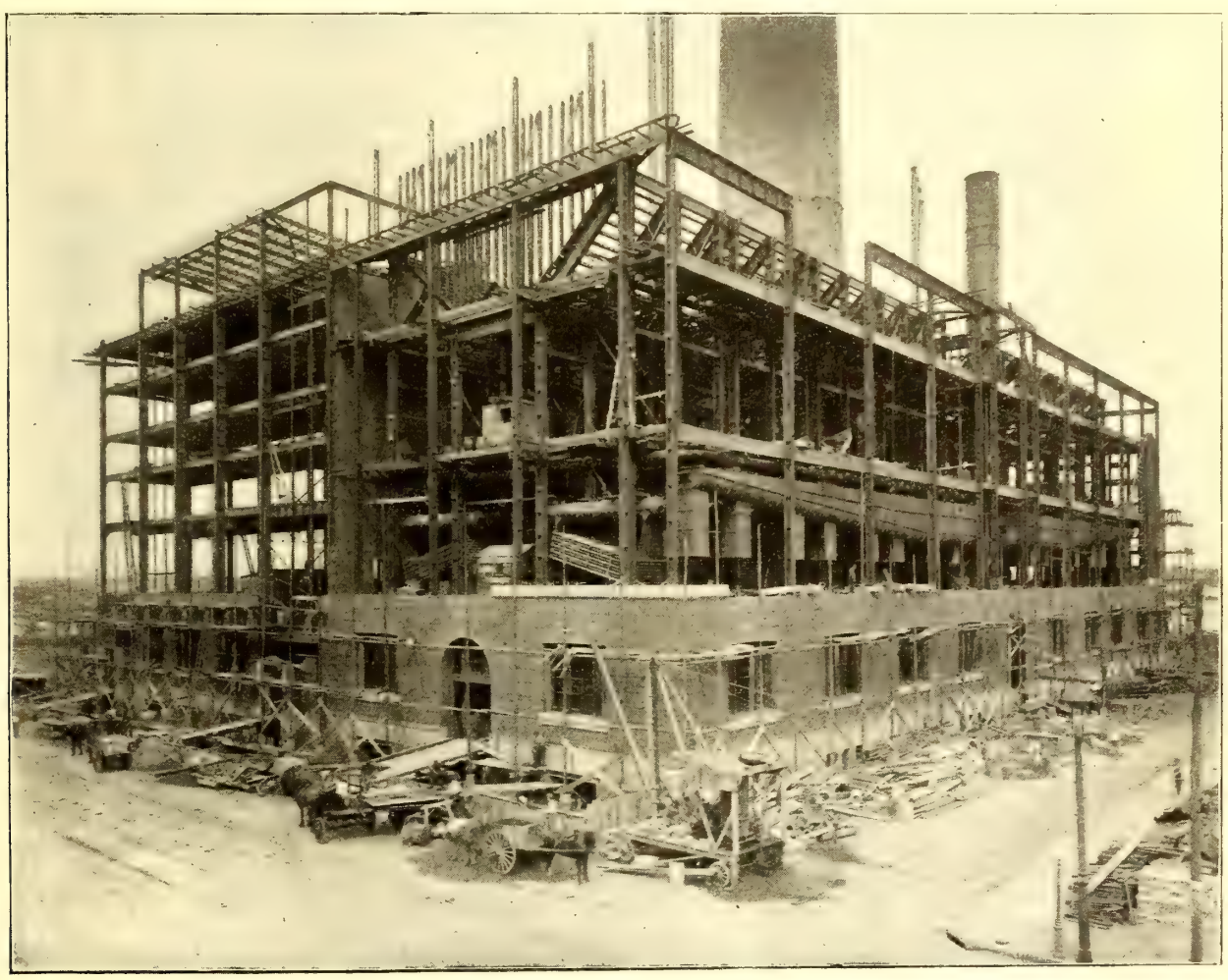
ITEMS.	Cable.				Electric.				Horse.				Total.			
	1898.		1899.		1898		1899.		1898.		1899.		1898		1899.	
	Amount.	Per Car Mile.	Amount.	Per Car Mile.	Amount.	Per Car Mile.	Amount.	Per Car Mile.	Amount.	Per Car Mile	Amount	Per Car Mile.	Amount.	Per Car Mile.	Amount	Per Car Mile
GENERAL EXHIBIT.																
Total passenger receipts	4,130,225	34.42	3,690,615	35.43	1,918,873	26.69	6,043,538	31.23	4,375,597	27.35	3,085,559	25.72	10,424,695	29.70	12,819,712	30.70
Passenger operating expenses	1,970,486	16.42	1,874,422	18.00	727,406	10.23	2,312,682	11.95	2,858,235	17.87	2,154,969	17.96	5,556,127	15.83	6,342,073	15.18
Earnings from passenger operation	2,159,739	18.00	1,816,193	17.43	1,191,467	16.76	3,730,856	19.28	1,517,362	9.48	930,590	7.76	4,868,568	13.87	6,477,639	15.50
OPERATING EXPENSES IN DETAIL.																
MAINTENANCE OF WAY.																
1 Repairs roadbed—track, labor	41,447	.35	44,894	.43	6,153	.09	25,796	.13	72,928	.46	58,810	.49	120,528	.34	129,499	.31
2 " " material	6,673	.06	4,685	.05	*105	.	4,223	.02	7,549	.05	14,462	.12	14,117	.04	23,370	.06
3 " " steel rails	200	..	375	..	954	.01	28	..	705	..	711	..	1,859	..	1,114	..
4 " " switches, cstgs., spikes, etc.	10,108	.08	17,227	.17	3,128	.04	10,083	.05	5,567	.03	4,936	.04	18,804	.05	32,247	.08
5 " " ties and timber	287	..	14	..	148	..	746	..	2,304	.01	1,093	.01	2,739	..	1,854	..
6 Repairs overhead and underground construction	80,787	.67	82,411	.79	5,779	.08	22,978	.13	165	..	.....	..	86,731	.25	105,389	.25
7 " " renewals of cable	189,391	1.58	239,481	2.30	.....	..	.....	..	.....	..	.....	..	189,391	.54	239,481	.57
8 " " tube cleaners	11,758	.10	11,824	.11	4,230	.06	30,818	.16	.....	..	.....	.	15 988	.05	42,642	.10
9 " " oilers	40,708	.34	41,511	.40	12	..	.....	..	.....	..	.....	..	40,720	.12	41,511	.10
10 " " gearsmen and splicers	21,240	.18	21,339	.20	.....	..	.....	..	.....	..	.....	..	21,240	.06	21,339	.05
11 Repairs of buildings	4,099	.03	7,783	.08	821	.01	11,853	.06	17,262	.10	13,695	.11	22,182	.06	33,331	.08
12 Removal of snow and ice, and street cleaning	15,328	.13	17,045	.16	2,731	.04	25,413	.13	9,666	.06	24,864	.21	27,725	.08	67,322	.16
Total	422,027	3.51	488,590	4.69	23,851	.33	131,938	00.68	116,145	.72	118,572	.99	562,024	1.60	739,099	1.77
MAINTENANCE OF EQUIPMENT.																
13 Repairs of cars and vehicles	68,768	.57	78,174	.75	28,687	.40	134,339	.69	61,449	.38	50,950	.42	158,904	.45	263,463	.63
14 " " electrical or cable equipment of cars	42,287	.35	37,380	.36	29,952	.42	90,320	.47	8	..	.....	..	72,247	.21	127,701	.31
17 " " tools and machinery	1,714	.01	1,974	.02	152	..	2,562	.01	328	..	74	..	2,195	..	4,610	.01
Total	112,770	.94	117,528	1.13	58,792	.83	227,222	01.17	61,784	.39	51,024	.42	233,345	.66	395,774	.95
POWER.																
15 Repairs of steam plant	15,147	.13	19.396	.19	2,042	.03	8,148	.04	9	..	.....	..	17,197	.05	27.543	.07
16 " " electrical or cable plant	12,395	.10	9,252	.09	824	.01	3,042	.02	3	..	.....	..	13,221	.04	12,293	.03
18 " " harness	458	..	219	..	584	..	1,057	..	15,361	.10	13,964	.12	16,404	.05	15,240	.04
19 Stable equipment, supplies, etc.	174	..	113	..	424	.	642	..	12,206	.08	8,594	.07	12,805	.04	9,349	.02
20 Renewals of horses	550	.	250	..	3,030	.04	750	..	62,440	.39	23,925	.20	66,020	19	24,925	.06
21 Horse shoeing	571	..	352	..	2,477	.03	3,175	.02	80,933	.51	62,737	.52	83,981	.24	66,264	.16
22 Cost of provender	3,432	.03	4,081	04	14,010	.20	15,575	.08	445,183	2.78	377,736	3.15	462,624	1.32	397,392	.95
23 " " feedmen—wages	92	..	270	..	1,687	.02	2,228	.01	40,419	.25	28,516	.24	42,198	12	31,014	.08
24 " " removing manure	60	..	75	..	*85	..	*137	..	7,109	.04	6,637	.06	7,084	.02	6,575	.01
27 Hostlers, hitchers and stable help	2,485	.02	3,033	.03	12,795	.18	15,847	.08	347,855	2.18	271,283	2.26	363,134	1.07	290,163	.70
28 Engineers, firemen and power service	65,262	.54	64,342	.62	20,662	.29	63,480	.33	240	..	.....		86,163	.25	127,822	.31
32 Fuel, power houses	104,912	.88	112,428	1.08	51,0 5	.72	188,455	.98	455	.	.....	..	156,381	.45	300,883	.72
33 Light and other supplies at power house	15,471	.13	16,383	.16	5,370	.08	13,414	.07	59	..	.....	..	20,900	.06	29,797	07
34 Water tax	21,775	.18	19,383	.19	5,842	.08	27,300	.14	11,138	.07	8,691	.07	38.754	.11	55,374	.13
Total	242,784	2.02	249,577	2.39	120,675	1.70	342,974	1.77	1,023,408	6.40	802,082	6.69	1,386,867	3 95	1,394,634	3.34
TRANSPORTATION.																
25 Conductors, drivers, gripmen and motormen	711,630	5.93	652,262	6.27	353,127	4.97	1,083,104	5.60	1,156,395	7.23	837,390	6.98	2,221,151	6.33	2,572,756	6.16
26 Inspectors, starters, switchmen, etc	143,512	1.20	142,125	1.36	50,292	.71	166,515	.86	119,400	.74	93.411	.78	313,204	.89	402,051	.96
29 Car house exp. watchmen, car cleaners, oilers, etc.	36,820	.31	37,848	.36	27,392	.39	93,205	.48	63,245	.40	44,829	.37	127,457	.36	175,882	.42
30 Car service—car lighting	39,227	.33	33,814	.33	1,142	.02	2,306	.01	11,690	.07	9,305	.08	52,059	.14	45,425	.11
31 " " " oil, waste, etc	12,932	.11	11,634	.11	5,158	.07	19,991	.10	7,191	.04	3,574	.03	25,281	.07	35,198	.08
Total	944,120	7.87	877,683	8.43	437,111	6.15	1,365,121	7.06	1,357.921	8.49	988,508	8.24	2,739,153	7.81	3,231,312	7.73
GENERAL EXPENSES.																
35 Salaries of officers and clerks	30,359	.25	28,123	.27	11,051	.16	35,831	.19	21,938	.26	29,308	.24	83,348	.24	93,262	.22
36-40 Injuries and damages	150,325	1.25	59,474	.57	43,829	.61	101,968	.53	79,076	.49	50,711	.42	273,229	.78	212,154	.51
41-48 Other general expenses	68,099	.57	53,446	.51	32,100	.45	107,628	.56	177,962	1.11	114,764	.96	278,162	.79	275,837	.66
Total	248,784	2.07	141,043	1.35	86,978	1.22	245,428	1.27	298,976	1.87	194,783	1.62	634,738	1.81	581,253	1.39
Total operating expenses	1,970,486	16.42	1,874,422	17.99	727 406	10.23	2,312,682	11.95	2,858,235	17.87	2,154,969	17.96	5,556,127	15.83	6,342,073	15.18
Car mileage run	11,991,404		10 416,079		7,110,090		19,347,978		15,994,912		11,996,799		35,096,406		41,760,856	

* Surplus account.

Power Station of Metropolitan Street Railway Company

The work on the main power station of the Metropolitan Street Railway Company, of New York, has been carried on continuously since the construction was decided upon about two years ago, and the building is now nearing completion. Frequent reference has been made in the STREET RAILWAY JOURNAL to the power station, and the fact that during the last month the first of the large engines which are now being installed was turned over by steam makes the present time a fitting one to publish a short description of the work which has already been performed, and to give a number of views showing the present condition of the work.

The station is located on the extreme eastern side of the city, between Ninety-fifth and Ninety-sixth Streets, and First Avenue and the East River. While somewhat outside of the center of distribution, it offers the best of facilities for the handling of fuel and ashes and for obtaining water for condensing purposes. As the alternating system of current distribution at high potential will be used, the losses in transmission, on account of the location of the station outside of the center of gravity, will be trifling compared with the other advantages secured at this point.

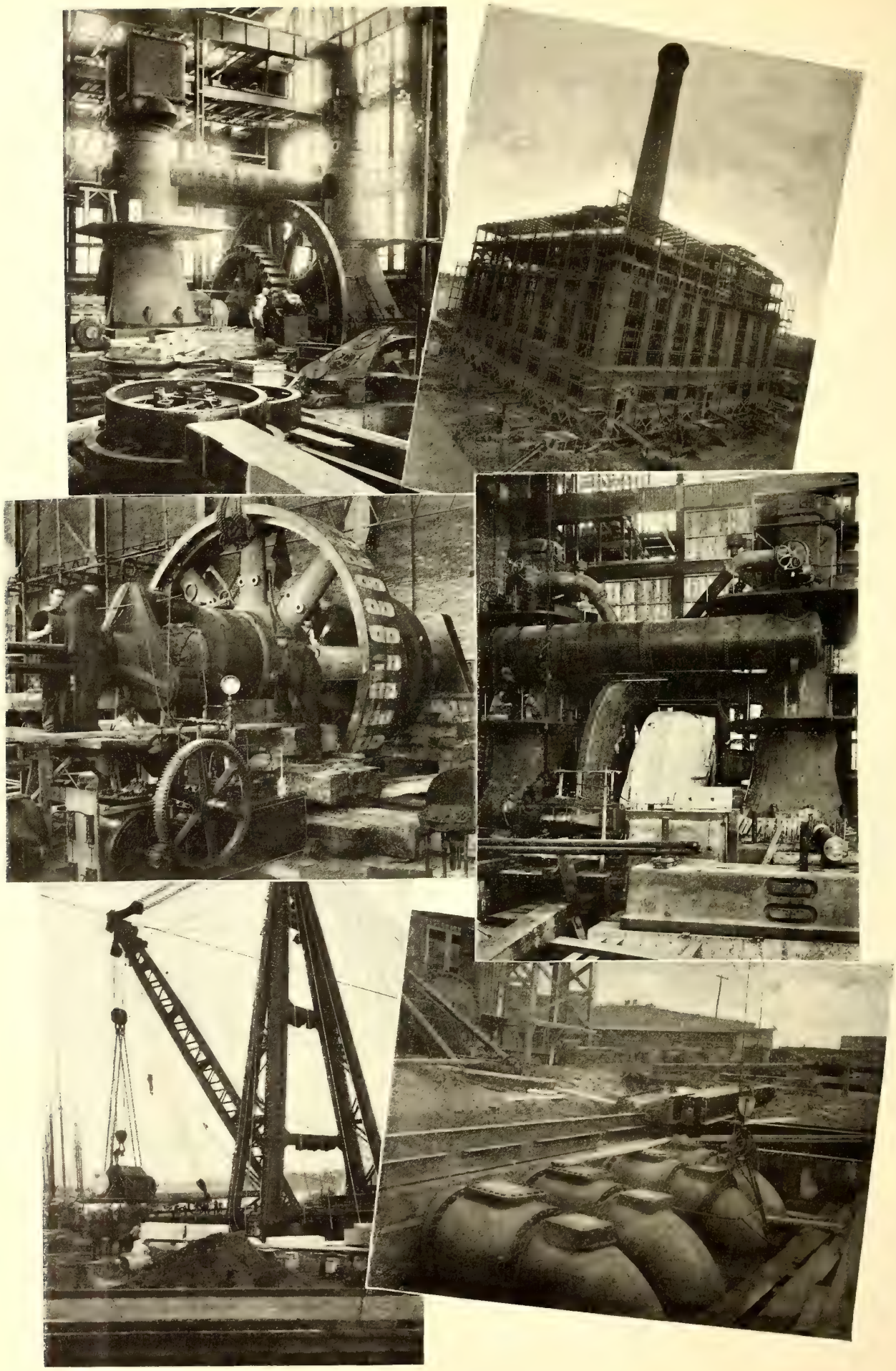


VIEW OF NEW MAIN POWER STATION, METROPOLITAN STREET RAILWAY COMPANY, NEW YORK

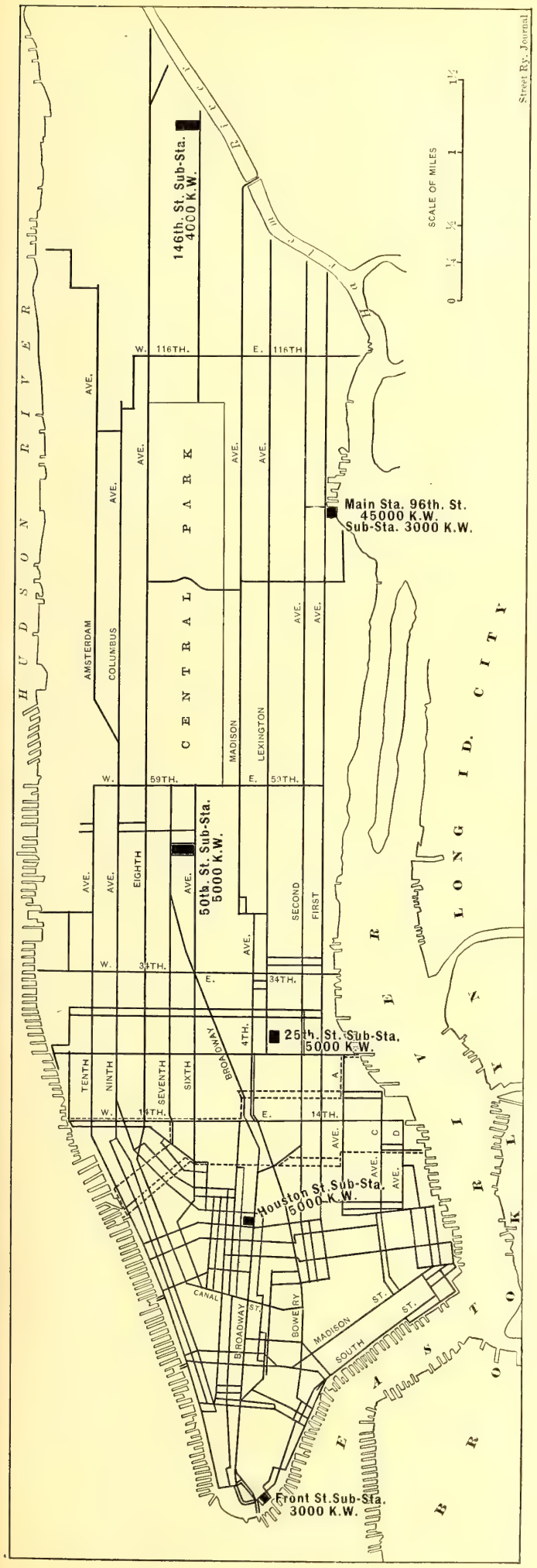
The building is of brick, with steel trusses and framing, and occupies a space of about 201 ft. by 279 ft. The engine room will occupy the northern end of the building, and will be about 110 ft wide and 200 ft. long on the short side. It will contain eleven vertical cross-compound condensing Allis engines,—the largest of any kind ever built in this country. The cylinders are 46 ins. x 86 ins. x 60-in. stroke, and the distance from the foundation to the top of the cylinder is about 38 ft. 3 ins. The shaft is hollow, being 37 ins. in diameter at the center, and having an opening 16 ins. in diameter extending the entire length. The journals are 34 ins. x 60 ins. The fly-wheels of these engines are 28 ft. in diameter, and are made up with a cast-steel rim 2 ft. 5 ins. deep and 2 ft. 4½ ins. wide, to which are riveted eighty 1⅛-in. steel plates at each side, making 160 plates in all. The engines can develop 4500 i.h.p. at greatest economical load, and will be able to work continuously at 6000 h.p. if required, and for a short time to work at 7000 h.p. Each engine is directly connected to a 3500-kw. General Electric generator. This machine has forty poles, and will have a frequency of twenty-five cycles at 6600 volts, and will operate at 75 r.p.m. At present the engine room contains three Ideal engines for operating exciters, and two 1200-h.p. engines supplied by the Pennsylvania Iron Works for temporary service.

The power room will contain eighty-seven Babcock & Wilcox water-tube boilers in three tiers of twenty-nine boilers each. Each boiler will have a rated capacity of 250 h.p., with (ultimate) capacity of 400 h.p. Over the boiler room, extending the entire length of the building, is a steel coal storage bin, with a capacity of about 9000 tons. The piping is extra heavy throughout, and was installed by the Walworth Manufacturing Company and Best, Fox & Company. The joints are of the Van Stone type, and Walworth valves are used throughout. A Mead coal conveyor is being installed and a Sellers' traveling crane operates the entire length of the engine room.

One of the interesting features of the station is the chimney, which is stated to be the largest in the world and the tallest on this continent. It is 353 ft. in height, with a 22-ft. core. The concrete foundations for this stack are 85 ft. square, and are carried down to a depth of 20 ft. be-



VIEWS SHOWING CONSTRUCTION OF NINETY-SIXTH STREET STATION



MAP OF NEW YORK CITY, SHOWING LINES AND STATIONS OF THE METROPOLITAN STREET RAILWAY COMPANY

low the level of the station. At this depth piles were driven, spaced 2 ft. 3 ins. and 2 ft. 6 ins. apart; 1345 piles altogether were driven in this space, after which the pit was filled with a mixture of one part cement, three parts sand and five parts broken stone, making a block of concrete 85 ft. square and 20 ft. in depth. The chimney, which is built upon this block, contains 3,600,000 bricks and weighs 8540 tons.

The accompanying map shows the location of the substations to be used in connection with the main station at Ninety-sixth Street. These stations run in sizes from 3000 to 6000 kw., as follows: 146th Street, 4000 kw.; Ninety-sixth Street, 3000 kw.; Fiftieth Street, 6000 kw.; Twenty-fifth Street, 5000 kw.; Front Street, 3000 kw., and Houston Street, 5000 kw. The main generating station, as stated, has a capacity of 45,000 kw. Two more stations will probably be located in the lower end of the city a little later, possibly on new plots to be purchased.

Storage batteries will be used extensively, thereby increasing the capacity of the stations, but the sizes of the batteries to be employed have not yet been fully determined.

Important Electric Railway Recently Opened in Switzerland

The first electric trunk line in Switzerland was put in operation recently. It extends between Burgdorf and Thun, and is, with exception of the Chavornay-Orbe Road, which is only 4 km. (2.6 miles) long, the first road in Switzerland to be operated by electricity under steam railroad conditions. Up to the station of Hasle it uses the track of the Emmenthal Railroad. From that point it branches off and enters the Biglen Valley, in which are located the villages Schafhausen, Bigenthal, Walkringen and Biglen, and meets the Berne-Lucerne branch of the Jura-Simplon Railroad at Konolfingen. The new road then follows the Kirsenbach River to Thun.

The electric power for the operation of the road is generated at Spiez, on the Thuner See, and is in the form of three-phase alternating current at a pressure of 15,000 volts. The current is led into Thun by lines strung on iron poles, and from Thun to Burgdorf, on wooden poles located adjacent to the roadbed. Fourteen transformer stations, with a maximum capacity of 450 kw., reduce the pressure from 15,000 volts to 750 volts alternating current, which is directly employed for the operation of the road. The trolley line consists of two hard drawn copper wires 8 mm. in diameter, and the rails form the third conductor.

The rolling stock of the road consists at present of six motor cars, weighing 32 tons, and a corresponding number of trailers. The motor cars will seat sixty-six persons. To each one of these cars an ordinary car seating fifty-five persons, of the second and third class, can be attached. The speed is 36 km. (22 miles) per hour. All cars are equipped with hand and Westinghouse brakes, and are electrically lighted. The motor cars are electrically heated, while the trailers are warmed either by electricity or steam.

For the freight traffic two electric locomotives are in service, each of which can transport 100 tons on the steepest grades (2.5 per cent). Each locomotive is equipped with two motors of 150 h.p. each, and can attain a speed of 18 or 36 km. (11—22 miles) per hour. The company also proposes to provide a small equipment of standard steam locomotives for emergencies and times of extra traffic. For this reason steam heating has been provided for in the trailers, besides the electrical method.

Between Burgdorf and Thun are thirteen way stations. As the line is 41 km. (25.4 miles) long, the average dis-

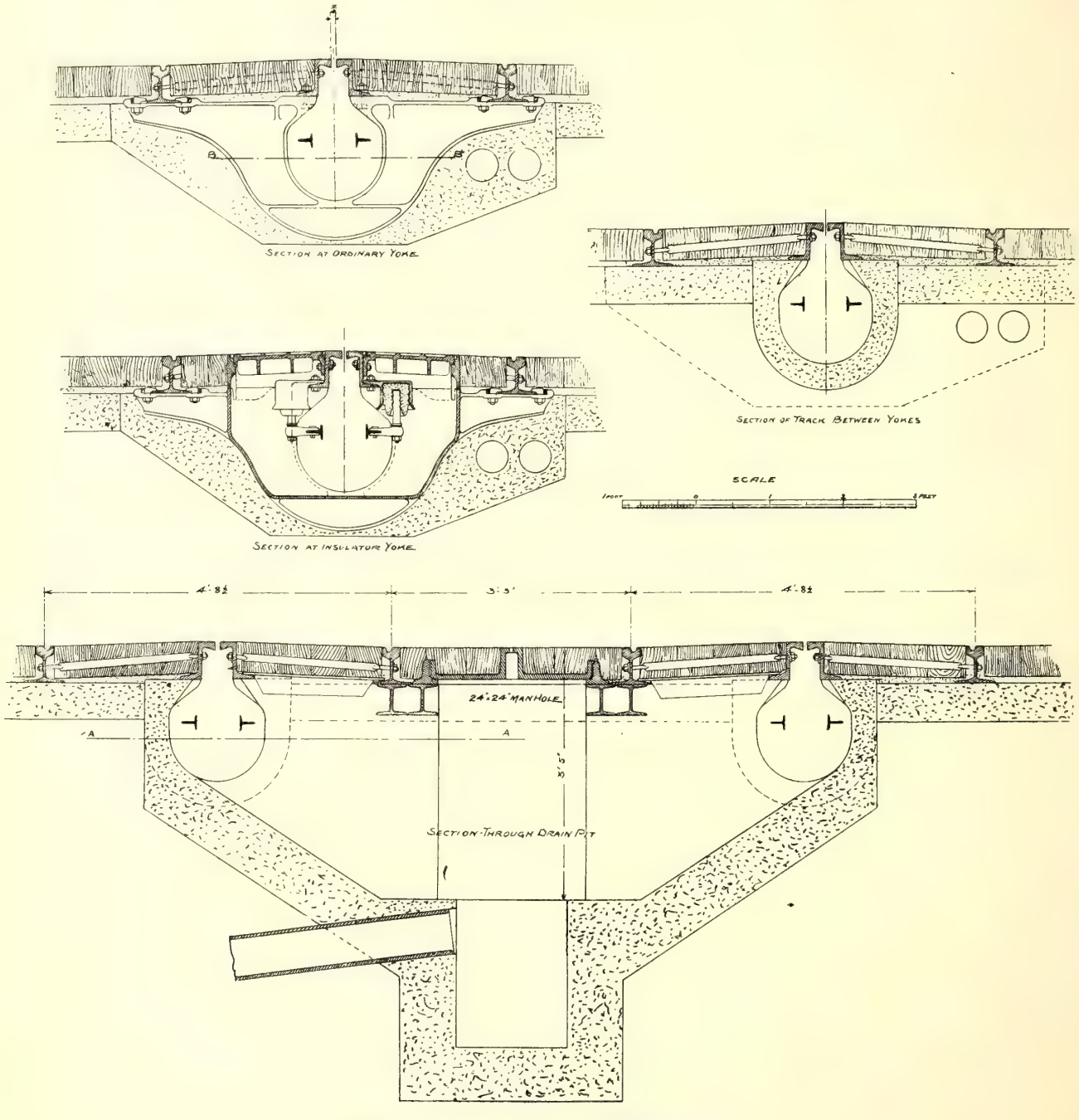
tance between the stations is 3 km. (1.8 miles), with a speed of 36 km. (22 miles) per hour. Stops are made about every five minutes. The depots are simple in construction, but are, nevertheless, handsome and practical. They are all lighted by electricity.

Wages at Hull, England

The City Council of Hull, England, has fixed upon the following scale of wages for its employees: The time required per week is seventy hours, which, however, includes the time allowed for meals. Inspectors receive 30s. ($7.20) per week, and for each year of service one additional shilling per week up to 40s. ($9.60). Motormen start with 28s. ($6.72) per week, and are raised to 35s. ($8.40). They also receive 6d. (12 cents) for each hour overtime. Conductors receive 18s. ($4.32) per week, and are raised to 25s. ($6). For overtime during the first three years they receive 4d. (8 cents) per hour, later 4½d. (9 cents). Barn hands receive 21s to 25s. ($5.04 to $6) per week; stove attendants, 28s. to 30s. ($6.72 to $7.20); laborers, 25s. to 27s. ($6 to $6.48) per week. The city furnishes the uniforms.

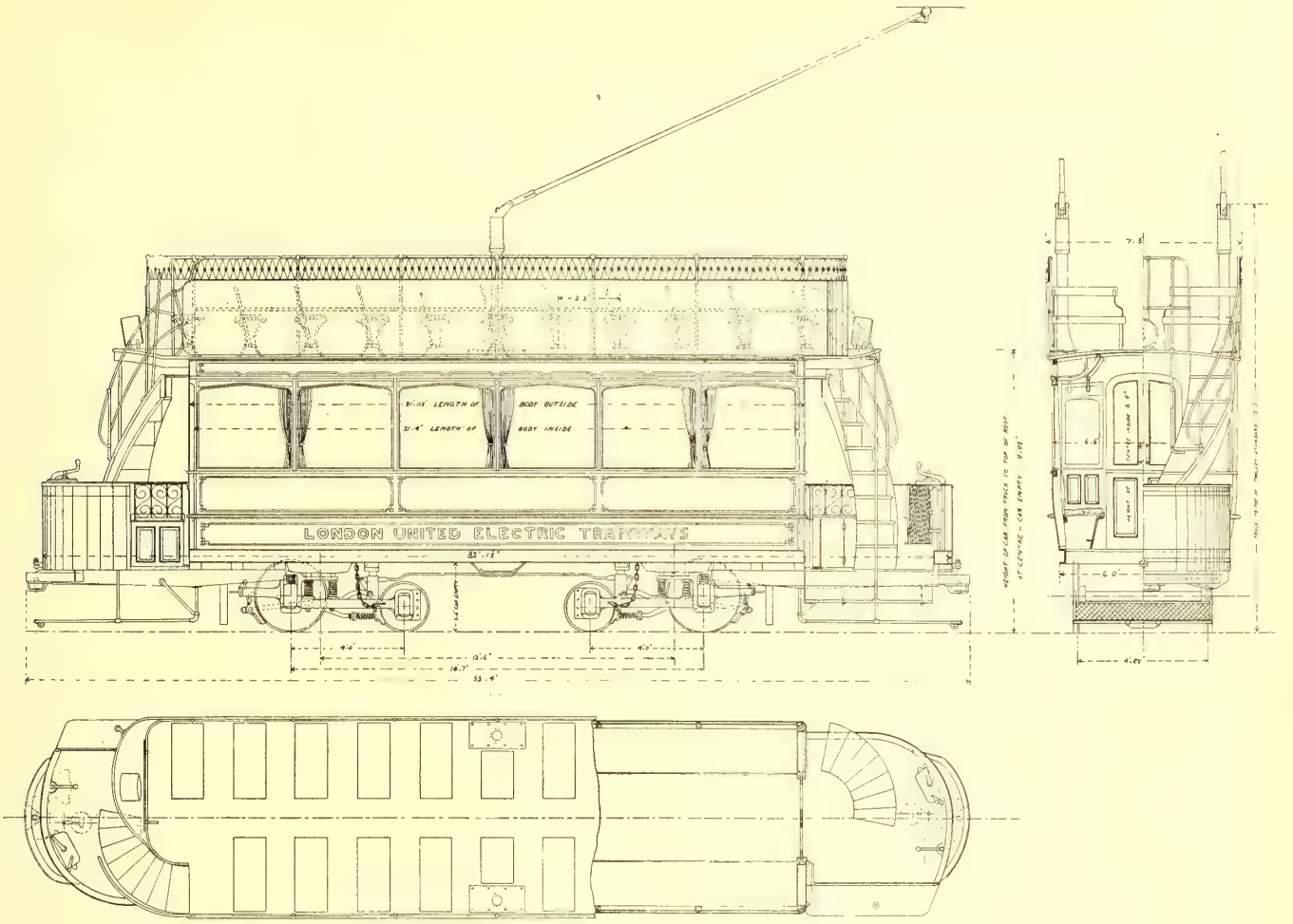
Plans of the London United Tramways Company

The most important tramway work now being projected in London is that of the London United Tramways Company, occupying the district extending from Hammersmith to Hounslow and Hamton Wick on the southern boundary of the city, and from the Central London Railway terminus at Shepard's Bush and Hanwell to Uxbridge on the north. With the junction line uniting these tramways this system amounts to about 75 miles of track, covering 39 miles of street. Of this about 27 miles are in operation by horses.

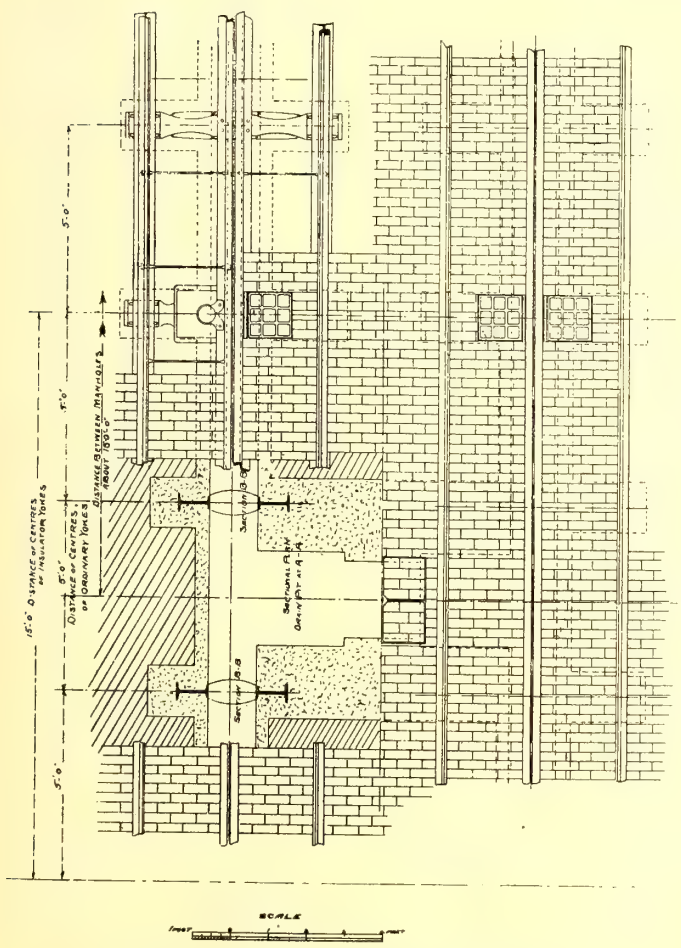


SECTIONS OF CONDUIT CONSTRUCTION

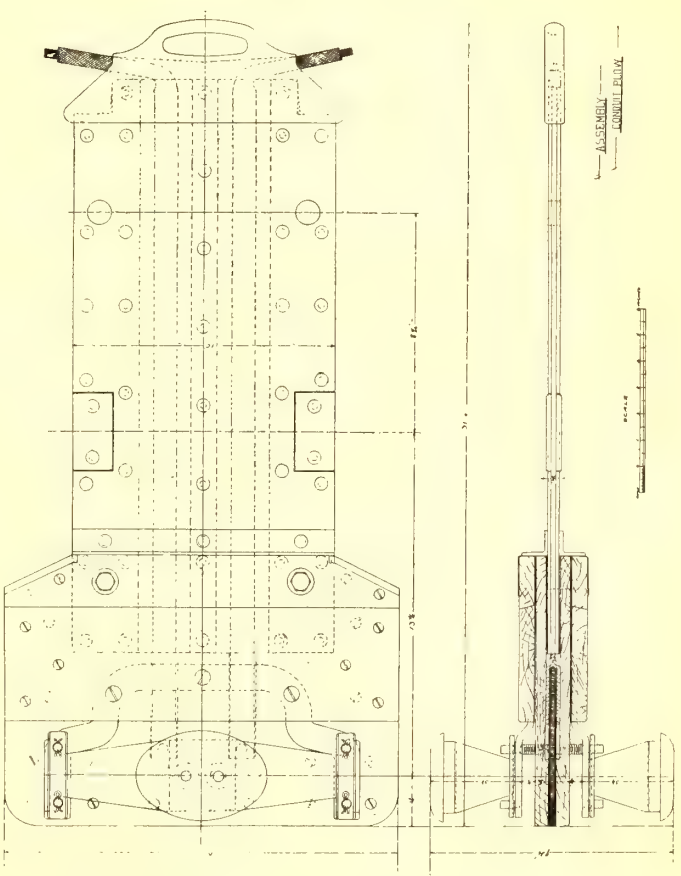
The plans of the company for electrical construction were described fully in an article in the Street Railway Journal for July, by J. Clifton Robinson, managing director of the company. Both the trolley and underground systems will be used. The former will cover about 20 miles, and is now under construction. It will be located, of course, in the suburban portion of the route. The road will be operated on the three-wire system, and two trolley wires will be carried over each track, making a complete metallic return. The two inside wires will be inter-connected, and will form the neutral pole of the system. The



PLAN, SECTION AND SIDE ELEVATION OF CAR



PLAN OF CONDUIT CONSTRUCTION



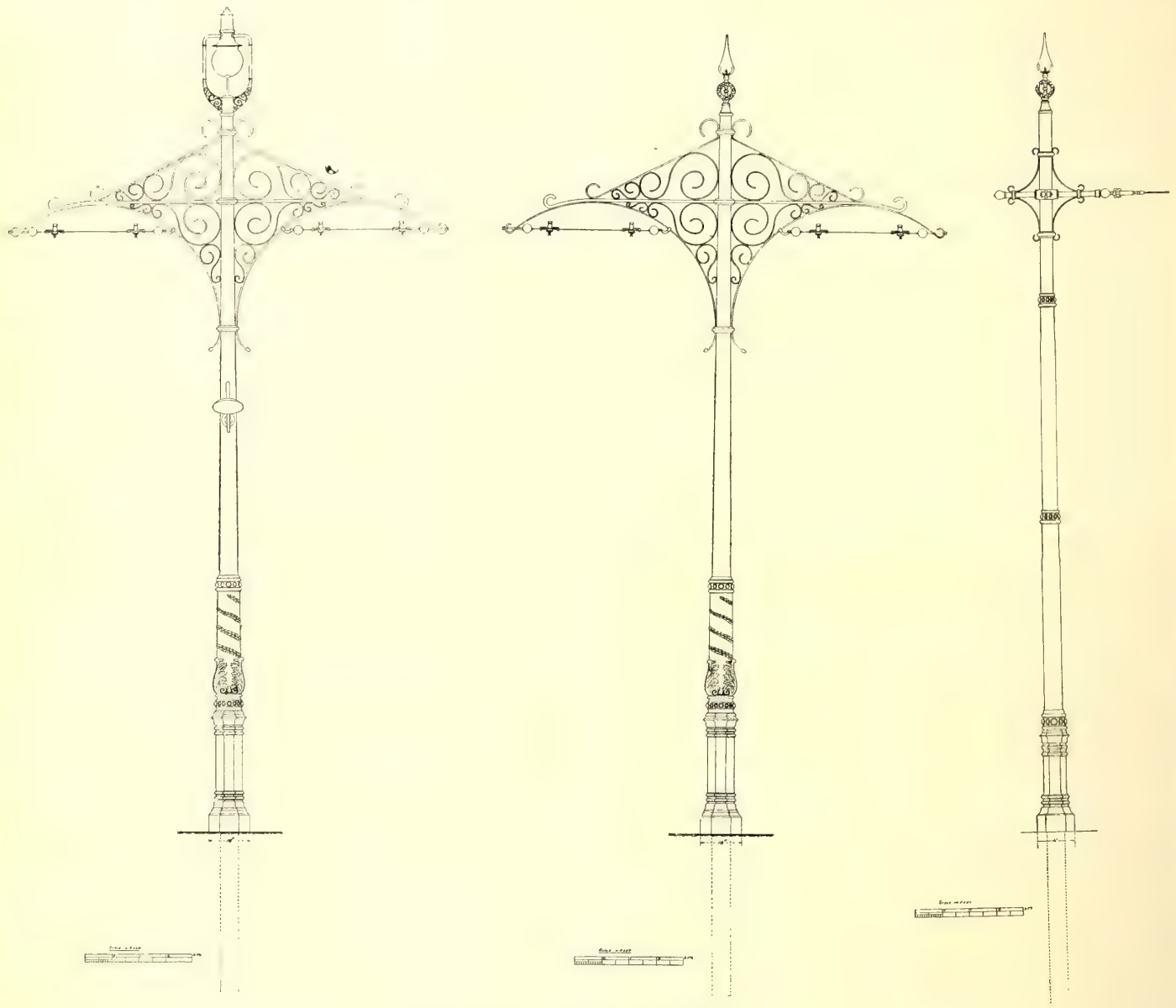
SIDE ELEVATION AND CROSS SECTION OF PLOW

overhead wires will be divided into half-mile sections, and, in order to meet the Board of Trade requirements, each 1½ miles of the line will be supplied by an independent feeder running direct to the power station. The neutral return will also be reinforced for each section of a mile and a half by a separate feeder.

The power station will be at High Road, Chiswick, and will have a capacity of 5000 h.p. The engine room will contain at present three 750-h.p. engines, each driving a 500-kw., three-phase 500-volt generator, with a frequency of 25 cycles per second. The section farthest from the center of the line, about 8 miles distant, will be operated by a sub-station, to which the alternating current will be carried by underground feeders. In this station will be seven transformers of 150 kw. each, and four rotary converters of 200 kw. each, which will deliver the current to the line at 550 volts. The converters will be electrically connected, so as to act both as converters and balancers. In case one side of the three-wire system is overloaded the converter will act on the opposite side as a motor, and thus assist the overloaded machine. The line poles will be extremely tasteful in design. As shown in the accompanying engravings, they will be of three types, one a span wire pole of three sizes, measuring respectively 16 ins., 18 ins. and 20 ins. at the base; and two bracket poles, one surmounted by an arc light.

The underground conduit system will be similar in general features to that used in New York, with cast iron yokes every 5 ft., and concrete sub-struction. Hand-holes will be located every 15 ft. and man-holes about every 150 ft., depending upon local conditions. The slots will be ¾ in. in width, and the conductors will be T irons, held in depending porcelain insulators similar to those employed in New York and Washington. The plow will provide a sliding contact by means of shoes held against the contact rails by spring pressure.

The cars will be double decked, mounted on maximum traction trucks. They will be 33 ft. 4 ins. over all, with length of body outside 21 ft. 11½ ins., and length of body inside 21 ft. 4 ins. The width of the car at belt rails will be 6 ft. 6 ins., and the height from the track to the top of the roof, when the car is empty, 9 ft. 9½ ins. From the track to the top of the trolley standard the height will be 15 ft. 2 ins. The cars will be equipped with cross-seats on the top and longitudinal seats inside. H. F. Parshall is consulting engineer for the company.



STANDARD BRACKET AND SPAN POLES

The economic and social results which are to follow from the development of the electrical street railway are only second in importance to those which have followed from the development of the steam railroad. From address at the Boston Convention, 1898.

Electric Rail Welding in Buffalo

The work of electric welding 7500 rail bonds in Buffalo for the International Traction Company, referred to in a recent issue, is now well under way, and about 2500 joints have been made up to date. The method employed is the improved system of the Lorain Steel Company, described fully in an article by Mr. Kleinschmidt in the May issue of the STREET RAILWAY JOURNAL.

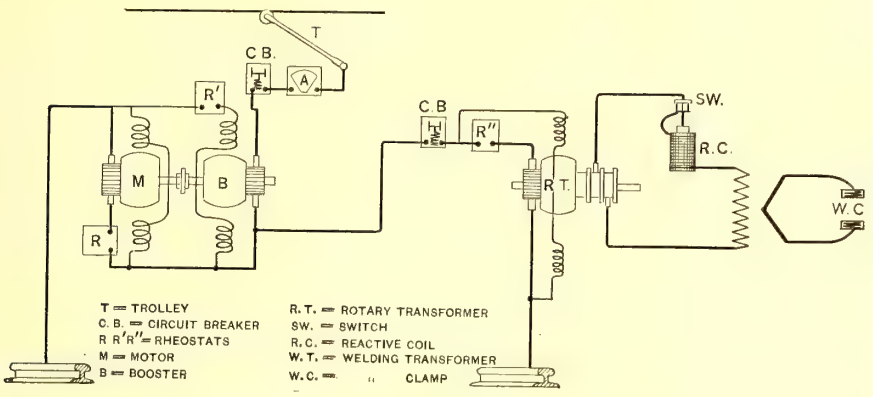
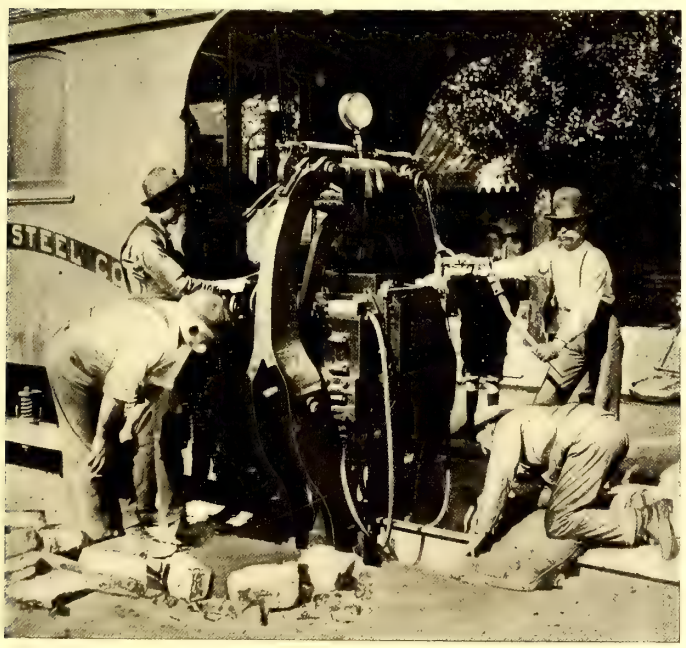


DIAGRAM OF CONNECTIONS FOR RAIL WELDER

The outfit in use in Buffalo consists of five cars, one of which is the welding car, the second a rotary transformer car, the third the booster or motor car, the fourth car is a sand and ballast car, which goes in advance of this train and prepares the joint for welding, and the fifth car, which



FRONT VIEW OF RAIL WELDING MACHINE

is equipped with a motor and emery wheels for grinding down any inequalities of the joints.

The connections of the apparatus used are shown in the accompanying diagram. The welding transformer primarily is run at 300 volts, and the voltage at the welding plant terminals is from 5 to 7 volts. The current used for the welding runs as high as 25,000 amperes. The use of the rheostat is to enable the attendant to raise the voltage of the machine by any amount desired to compensate for any lack of line voltage.

Method of Checking Fares on Interurban Railways

A most complete system of auditing railroad tickets, cash fare receipts, checks, etc., is employed by the Dayton & Western Traction Company. It is the invention of J. W. Lutz, cashier of the company, and seems to be well adapted to long electric lines, where a variety of fares is employed. It affords a complete check on conductors and agents, as by it no ticket can be a total loss to the company. Duplicates turned into the office do not need to be counted and placed consecutively, and no other record than the checking described is used.

A sheet of paper 17 ins. x 24 ins. is printed or stamped with sixty tables, each similar to that shown above.

00

Lutz's Universal Auditor No. 2.

1	11	21	31	41	51	61	71	81	91
2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9
10	20	30	40	50	60	70	80	90	100

FORM OF TABLE

Dayton & Western Traction Co.
CASH FARE RECEIPT

Good for One Continuous Ride between Stations where Fare Collected is Punched.

Fare Collected

5	30	55
10	35	60
15	40	65
20	45	70
25	50	75

Valentine Winters
Gen'l Mgr.

A 17304

HALF FARE

5 DAYTON — 10 SOLDIERS' HOME — 15 UNION ROAD — 20 NEW LEBANON — 25 JOHNSVILLE — 30 COUNTRY LINE — 35 WEST ALEXANDRIA — 40 BONTA'S FORD — 45 EATON

Dayton & Western Traction Co.
RETURN PASSAGE

Good for One Return Passage to Station Indicated by Double Punch Mark.

Fare Collected

55	30	5
60	35	10
65	40	15
70	45	20
75	50	25

Valentine Winters
Gen'l Mgr.

HALF FARE

A 17304

45 EATON — 40 BONTA'S FORD — 35 WEST ALEXANDRIA — 25 COUNTRY LINE — 20 JOHNSVILLE — 15 NEW LEBANON — 10 UNION ROAD — 5 SOLDIERS' HOME — DAYTON 45

FORM OF TICKET

These are numbered consecutively, and as each table represents 100 tickets, a sheet of the size mentioned represents 6000 tickets, or numbers. If 21,001 is the number of the ticket first to be checked then the first table would, of course, be numbered 210(00) and the sheet would then be ready for checking all tickets between 21,001 and 27,000

inclusive. It will also be noticed that the table has a blank line at the top. On this is entered the name of the conductor or agent to whom the 100 tickets represented by the table are issued. The Dayton & Western Traction Company has adopted a rule that where a ticket is not accounted for within a certain length of time, the person to whom it was issued pays for it just as if he had collected the fare for it. This makes conductors careful, cautious and accurate.

The form of ticket below shows the company's standard form of cash fare receipt and return trip tickets. It consists of two parts, as shown. Where a cash fare is paid, the points between which the ticket is issued are punched, together with the charge for a single fare. The left hand half is then given to the passenger and the right hand half is turned in to the company, hence it can never be used. Where a round trip ticket is purchased, the points between which the ticket is issued and price paid are punched, but the right hand half is given the passenger and the left hand half returned to the office. The portion given to the passenger is then good for a return trip, and is taken up by the conductor of the car by which the trip is made. Half fares are indicated by punching the space marked "half fare."

The auditing system is copyrighted, and the form of ticket shown has been patented by Mr. Lutz.

Electric Railway Construction in Buenos Ayres

The work on the construction of the Buenos Ayres & Belgrano Electric Tramway, which is being carried on under the instruction of Messrs. Kincaid, Waller & Manville, of London, is approaching completion. Six miles of this line are now open, and the financial results have been most satisfactory. Current is obtained from a French electric light company.





DOUBLE DECKED CARS AT BUENOS AYRES

Both single and double deck cars are used. They were supplied by Jackson & Sharp, The J. G. Brill Company and Barney & Smith, and are mounted on Peckham trucks.

The first engraving shows a view of one of these cars taken opposite the Hippodrome, where a long siding was installed to care for the extra traffic. As will be seen, double bracket poles are used, the bracket on one side extending across two tracks. The second engraving shows a car at Portones.

It is reported that the Westinghouse Company has received a large order for electric railway apparatus to be used at the Paris Exposition in 1900.

A German Definition of a Railroad

During a recent law suit in Germany for injuries sustained through a railroad accident the question arose as to the true definition of a railroad. The highest German court, the Imperial Court at Leipzig, has given the following:

"A railroad is an enterprise whose function is to transport persons and merchandise over comparatively long distances upon a metallic roadway, which, in view of its peculiar construction and ease of operation, can transfer great weights and permit a high rate of speed during this transportation by employing natural forces (such as steam, electricity, animal and human muscular power), including in some instances the weight of the operating agent, and, under certain circumstances, is able to render considerable service, as well as be dangerous to human life and health."

Stiffening a Stairway

Where room is at a premium, as it frequently is in car shops and barns, the spiral stairway is an economizer of space, but the problem arises how to make safe the railing necessary around such stair openings. A cheap and easily applied method is to put up a light fence of $\frac{7}{8}$-in. sheathing, using a 2-in. x 4-in. rail near the top of the boarding, and, perhaps a light cap on top, the bottom of the sheathing to be nailed to the floor with a quarter-round one on both sides. To strengthen this light construction, run a 1-in. pipe around inside the sheathing, the pipe being either put together with elbows, or, what is better, the corners bent in the smith's forge. Holes are drilled even 12 ins. or 15 ins., and common wood screws or carriage bolts used for fastening the pipe to the 2-in. x 4-in. rail above mentioned. In most cases, it will not be necessary to fasten the pipe to the wall or floor, as it stiffens the woodwork sufficiently without such fastening. But if desirable, the pipe may be fastened to the wall by means of a flange screwed directly to the end of the pipe or to the floor by means of an inserted T and a drop leg thereto.

The method of lubrication largely affects the life of brasses. After long tests with various lubricants the writer has discontinued entirely the use of grease on armature brasses, and in most cases on axle brasses, a good grade of engine oil, supplied through wicks, being more satisfactory and economical. From paper at the Boston Convention, 1898.

Plymouth Electric Tramways

(By Our Special Correspondent.)

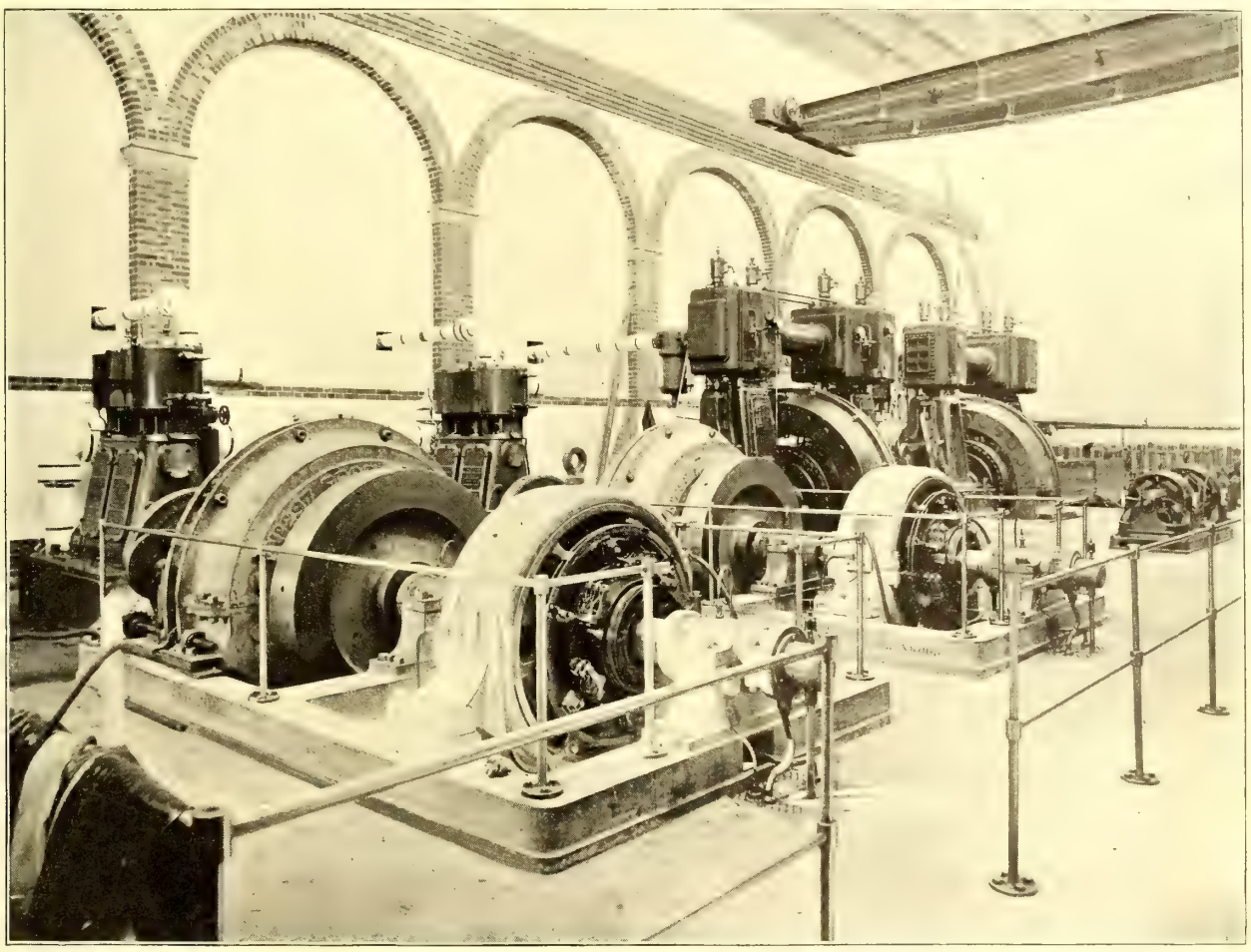
Plymouth, the first town in England to be incorporated by act of Parliament (so long ago as Nov. 12, 1439) is among the first of the great towns in England to adopt electric traction on its corporation tramways. The system will, I think, compare favorably with any now in operation.

Plymouth has an interesting municipal history. It possesses the oldest municipal water works, authorized by an act passed in 1585 through the influence of Sir Francis Drake, the celebrated navigator, who was then mayor. In 1892 the corporation acquired the tramways and in February, 1896, unanimously appointed J. Hall Rider, A. M. Inst. C. E., etc., its electrical engineer. Mr. Rider, upon his arrival at Plymouth, was at once called upon to prepare plans and specifications for the proposed electric supply works, and these, the first works in this country, designed primarily for running the tramways, combined with the lighting of the town, are now completed.

They have been built on corporation land, with rocky subsoil, at Prince Rock on the Cattewater, as the estuary of the river Plym is called, and immediately adjoining will be constructed a refuse destructor by contract with Goddard, Massey & Warner, who are guaranteeing 280 i.h.p. per hour. This destructor will be used for the tramways and the electricity committee will pay the works committee (who are responsible for the destructor) at the rate of ¼d. per kw. hour of electric energy produced. This arrangement will mean economy to both committees, as it will bring some £1560 to the credit of the destructor and is a much cheaper rate for the electricity committee than could be secured by independent action.

The accompanying map shows the existing electric lines in solid black, horse lines, authorized for conversion to electricity, in dashed lines, and proposed new electric extensions in dotted lines. Horse cars have been running for some time on the electrically equipped route from the Theatre Royal to Prince Rock. The length of this section is 3 1-10 miles of single track. The lines are double nearly all the way, and were laid by the corporation. The rails are grooved girder section, 92 lbs. to the yard and 30 ft. in length. Probably 60-ft. rails will be used in future extensions. Each joint is bonded with three No. 000 Chicago bonds 30 ins. long. The tests of the conductivity have given most satisfactory results.

The electrical equipment of the tramways was undertaken by the Westinghouse Company, who sublet the overhead construction to R. W. Blackwell & Co. The details were designed by Mr. Rider to suit the character of the road, and no fewer than five different methods of carrying the wires have been employed, viz: (1.) Side bracket arm, carrying both wires on one side of bracket. (2.) Side bracket arms on both sides of track, each carrying one wire. (3.) Span wire from pole to pole. (4.) Span wire from pole on one side of rosette fixed to building on other, and (5) span wire from rosette to rosette.



INTERIOR OF POWER STATION, PLYMOUTH, ENGLAND

Owing to the great number of telegraph and telephone wires, guard wires will be put up over more than half the route. This rather detracts from the exceptionally neat and workmanlike appearance of the overhead construction, which is helped, in no small degree, by the handsome bracket arms, the wrought iron scroll work of which is most effective. This scroll work was designed by E. G. Okell, Mr. Rider's chief assistant, who has been associated with him throughout the designing and construction of the works. He, Mr. Rider and W. T. Tester, the con-

tractor's resident engineer, are to be warmly congratulated on the successful results of their combined efforts.

The poles are three sectional, with S. S. S. joints, of 7 ins., 6 ins. and 5 ins. outside diameter, with heavier poles of 8 ins., 7 ins. and 6 ins. diameter at curves. There are a few single tube poles, 8 ins. in diameter for half way and then tapering to 6 ins. at top. These, as well as a large proportion of the sectional poles, were supplied by Russell & Sons, of Wednesbury. Arc lamps are fixed in a number of streets on the tops of alternate poles and, where possible, on alternate sides of streets, and a fiddle-bow suspension, between the ears holding the wires, has been fitted to take off the oscillation from the lamps.

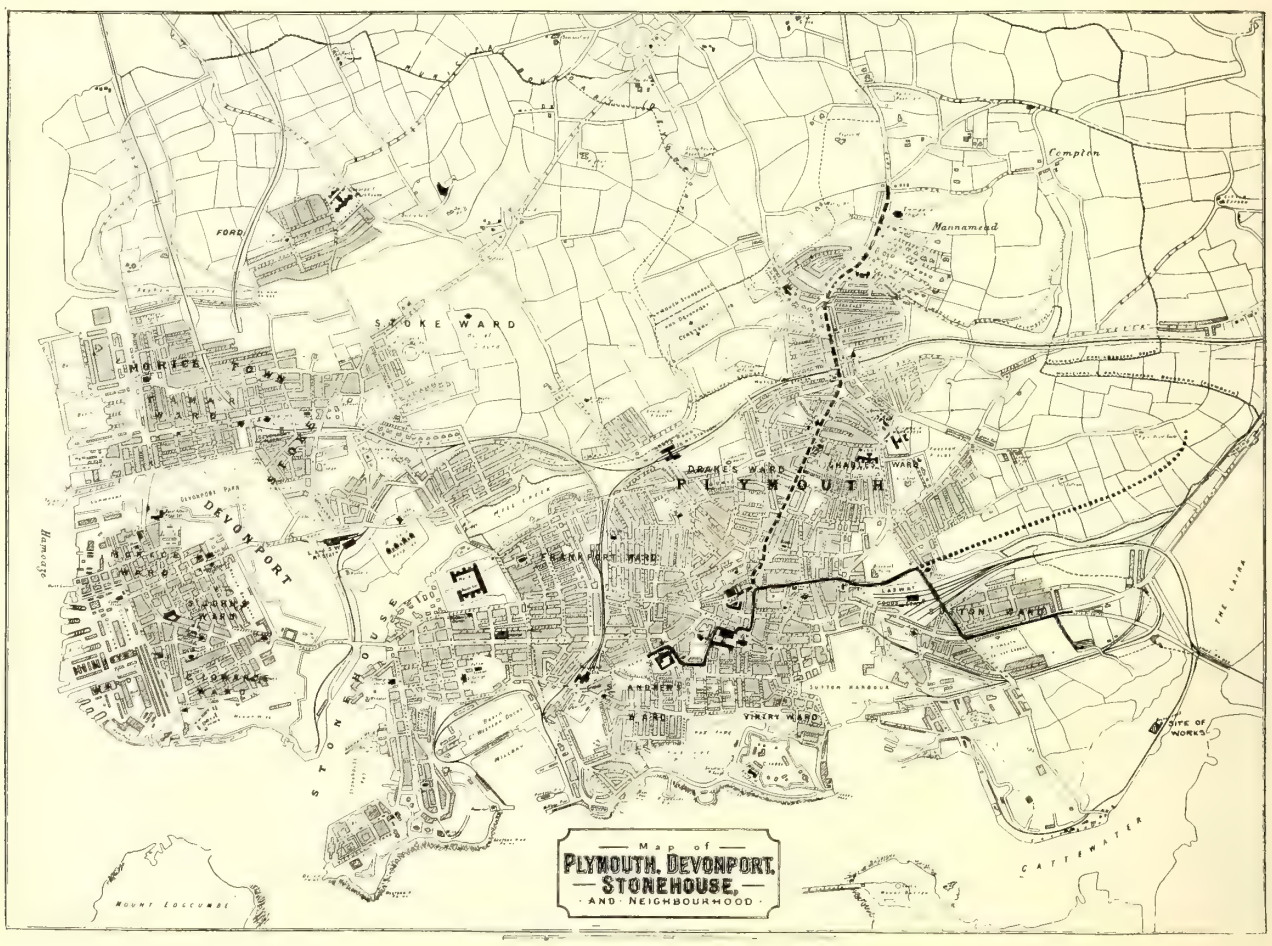
The line is divided into ½-mile sections, according to Board of Trade requirements, and insulated in the usual manner. Of the section boxes two have been very neatly disposed of, by being built into the walls of corporation buildings. They contain four switch fuses, lightning arrestor, telephone, wire terminals, etc.

The overhead equipment, the permanent way and the cars are provided by the tramways committee, while the electricity committee is responsible for all the underground cables and supplies the current to the section boxes, just as would be done in the case of a private consumer, charging the tramway committee 3½d. per unit up to 150,000 units, beyond which figure there will be a reduction in price. It is estimated that the price will be reduced to 2.3d. per unit as soon as contemplated extensions are completed, when some 600,000 units will probably be required.

At present there are six motor cars to seat twenty inside and twenty-two outside. They are mounted on Peckham standard cantilever extension trucks with 30-in. wheels, 3 ft. 6 ins gage, and a 5 ft. 6 ins. wheel base. The car bodies were built by Milnes & Company, of Birkenhead, and are 14 ft. long, 24 ft. 6 ins. over platforms, and 6 ft. wide. Each car is fitted with two Westinghouse No. 46 motors, giving 1000 lbs. tractive effort at 8 miles an hour. The cars are housed in a temporary car shed near the Prince Rock terminus, which will hold, in addition to the six motors cars, six trailers. These will be converted from the best of the horse cars now in use.

The controllers are of the Westinghouse series parallel type with a graded brake, and perfect control is kept over the car by putting the two motors in parallel and by connecting them by a variable resistance, if necessary, to the extent of short circuiting the motors. This brake has been working most satisfactorily throughout the trial trips.

The trolley is of the Blackwell side acting swiveling type. The standard, 6 ft. 6 ins. high, is placed in the center of the roof of cars, so that the arm can reach equally on either side. The arm is 15 ft. long.



MAP SHOWING PLYMOUTH ELECTRIC TRAMWAY SYSTEM

Sanction has been given for electrically equipping the line from the Market Place to Compton. This route will take 2¾ miles of single track and will tap the residential district of Mannamead. Six more motor cars will be required for this section, and another six for the section from Theatre Royal to Hyde Park at Mutley. The cars on this route will run from the theatre over the Prince Rock tracks as far as the market and then run up the Compton line, turning off to the terminus at Hyde Park. There will probably be a sub-station with a large battery of accumulator cells for the Compton route. The corporation is also applying for power to the Board of Trade to construct 2 miles of additional lines to the eastward of the town. This district is growing very rapidly and is peopled by the working classes.

The power station contains a lighting plant, distributing

an alternating current at 2000 volts pressure to sub-stations and a 500-volt to 550-volt continuous current tramway plant. In order to avoid having to run the engines at a light load during the day, a special combination plant has been designed by Mr. Rider. There are two sets in use; each consists of a Belliss high speed compound engine of 150 i.h.p. running at 275 r.p.m., direct coupled to a Ferranti alternator of 100 kw. and also to a Westinghouse generator of 100 kw. The engine is therefore capable of driving either machine at full load or both at half load. Between the engine and the machines is a special shaft coupling, so that the engine can be disengaged when required. A battery of 260 Tudor cells is kept in parallel with the generator. During the day the engine can be kept at practically full load, the alternator supplying what small amount of current is required for lighting, and the generator driving the cars. The battery, in parallel with the generator, takes up the inequalities of the tramway load, any current required above the output of the generator being supplied by the accumulators, and all under being taken in by the accumulator in the form of a charge. In this way a practically constant load can be kept on the generator and therefore on the engine, and the cells are continually charging and discharging according to the demands of the line.

As the lighting load increases during the evening, the load is gradually taken off the generator by the accumulator, leaving the engine free to drive the alternator at full load for the lighting. After midnight, when the cars have ceased running, the generator is driven at full load for charging the battery until 6 o'clock in the morning when the cars commence running.



SPAN POLE AND ROSETTE CONSTRUCTION

The use of the clutch enables the generator and alternator to be used independently of the engine when required; thus on Sundays, when the cars are not running, the generator will be run as a motor from the accumulator, driving the alternator for what lighting load there may be. Similarly the alternator can be run as a synchronous motor from either of the other alternators in the station and the generator used either for charging the battery or for tramway work with the battery in parallel.

It is not proposed to continue this type of combination right through the station when additional tramway machinery is put down, its great use being for a day load plant.



BRACKET POLE CONSTRUCTION

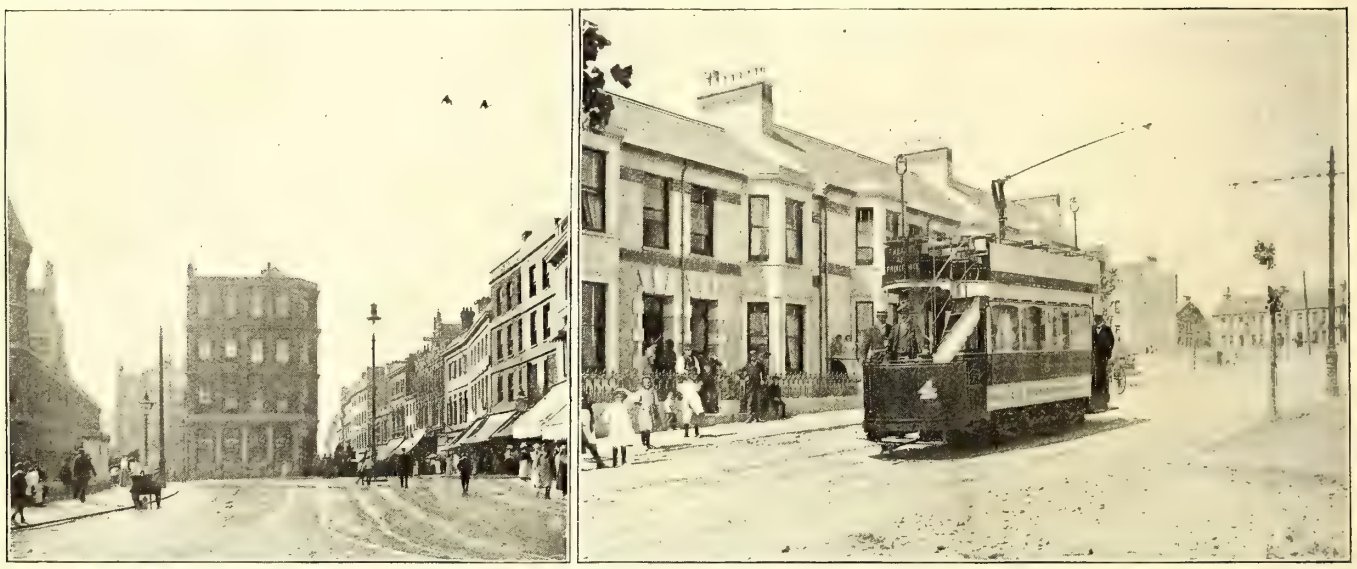
The battery consists of 260 Tudor cells of 600 amp. hours capacity; maximum discharge rate 200 amps. The battery is maintained by the Tudor Company under guarantee for ten years at a rate of 5 per cent on first cost. The terms of the contract are that at any time within twelve hours of being fully charged the battery must give its full specified capacity of 600 amp. hours without the voltage per cell falling below 1.85 volts. The rest of the plant comprises two 200-kw. Ferranti alternators for lighting, driven at 250 r.p.m. and a 20-kw. booster, motor driven and used in series with the generator for charging the accumulator so that the bus bar pressure need not be raised. The booster generator is compound wound so that the current can be sent round the fields if it is desired to use the booster when the cells are being discharged. When the line current is equal to the output of the generator the two windings will neutralize each other and the booster will give no pressure. Then the battery will neither charge nor discharge. When the line current is less than the output, the shunt winding will predominate and the booster pressure will be in the right direction for charging the cells. When the line current is greater than the output, the series winding will change the polarity of the booster so that it will add a pressure to the battery circuit and thus help it to discharge.

The probable additions to the plant will include a steam driven generator of from 450 kw. to 500 kw.

All the auxiliary plant, stoker gear, feed pumps are electrically driven by E. C. C. motors.

The three Lancashire boilers were supplied by J. Musgrave & Sons, of Bolton, and are rated at 350 h.p. each. One supplies the two Bellis engines and the other two the two Ferranti alternators. Welsh coal is brought by steamer to the wharf alongside and is distributed by a Vicars stoker.

There are three switchboards, one of the Westinghouse tramway type, one Ferranti type, and the third a Ferranti rectifier board. All of the regulating resistances are fixed in the room immediately under the switchboard recess. The cables were supplied by the British Insulated Wire Company and laid by the corporation.



SCENES IN PLYMOUTH, SHOWING ELECTRIC TRAMWAY

At present the tramways only pay expenses, the cost of 10d. per car mile preventing the formation of a sinking fund. With electric power the expenses are calculated at 5d. per car mile, and as owing to the increased speed a much more frequent service of cars will be run; it is not unreasonable to expect a handsome profit.

The Spree River Tunnel

The tunnel under the Spree River, intended for street railway traffic between Stralau and Treptow, near Berlin, has been completed and will be opened for public service in a very short time. The construction of this tunnel illustrates the increasing tendency in late years of the German corporations to follow American practice by selecting the shortest route, regardless of cost, and thereby meeting competition successfully. For a long time the park at Treptow, on the banks of the Spree, has been a much frequented resort for the residents of Berlin, because of its proximity to the city. This tunnel gives to the thickly populated section at the Silesian railway depot a new route by which the park may be reached in a shorter time. The most interesting part of the construction of this tunnel is the fact that it is the first that has ever been built curving under a river, by the Greathead system. To still further add to the complexity of construction quicksand was encountered along its entire length.

Its dimensions are as follows:

It is 453 m. long, and crosses the river nearly at right angles, the river being 200 m. wide at this point. Its lowest point is 10.7 m. below the average water level, the average depth of the river being 3.3 m., and the diameter of the tunnel 4 m.; this leaves 3.4 m. of solid earth above the tunnel.

The grade directly under the river is 1:600, while that near the mouths is 1:20. The total length, including the masonry at both ends, is 609 m.

A few details of construction may prove interesting:

The iron shell is composed of separate rings 650 mm. long, joined together by stiffening ribs 15 mm. in thickness. Each ring is composed of nine wrought iron flanged sections. The ribs project 50 mm. outside of the shell, and 15 mm. inside, the outer projections being utilized to hold a cement covering, while the inner serve for caulking, so as to insure water-tight joints. The cement is forced through holes in the shell, which are afterwards closed with iron or wooden plugs.

As extensive experiments before the construction of the tunnel and previous practical experience had proven that plates only 10 mm. in thickness were sufficiently strong, a great saving in cost was thereby effected.

To prevent the rusting of the interior and the exterior of the iron shell coatings of cement, from 80 to 100 mm. thick, were applied.

The tracks on the bottom of the tunnel, which are of the standard gage, are embedded in beton. A ditch collects all water, which is pumped out by means of an electrically driven pump.

The header used during the construction of the tunnel is patented, and is composed of an iron tube, the cutting end of which is beveled at an angle of 30 degs. to the base of the tunnel. A partition divides it into two compartments, the rear one always projecting over the forward end of the tunnel.

The breast wall of the tube is provided with openings, through which the sand is removed, also ball and socket stuffing boxes, through which drills may be passed to break up hard obstructions.

The header is moved forward by means of hydraulic jacks placed against the partition in the tube, and the end of the last section of the tunnel put in place. The total pressure amounts to 900 tons. The downward curve given to the tunnel is effected by an unequal location of jacks, in other words, by putting more pressure on the top than on the bottom of the partition in the tube.

Owing to the great difficulties encountered two and one-half years were occupied in the completion of this project. The daily advancement at the beginning amounted to 0.7m. to 1.00 m.; on some days a progress of 2 m. was made, and the general average being 1.5 m. per day.

LEGAL NOTES AND COMMENTS*

EDITED BY J. ASPINWALL HODGE, JR., OF THE NEW YORK BAR

CHARTERS, ORDINANCES, FRANCHISES, ETC.

ILLINOIS.—Removal of Causes—Electric Railroads—Condemnation of Land—Highways—Price—Consent of County Board—Instructions.

1. Two of several tenants in common, who are non-residents, and who have been joined with their resident co-tenants and the resident mortgagee of the interest of one of them, in condemnation proceedings, are not entitled to a removal of the proceedings to the United States Circuit Court when the aggregate of their claims exceeds the sum of $2,000, but the amount of their separate claims is less than that amount.

2. In condemnation proceedings for an electric railroad, evidence that the secretary of the company, seeking to condemn the land, called on one of several tenants in common, and made him an offer for the whole tract; that the tenant then said he would have to see his co-tenants, who were his sisters, about the matter, and requested two or three days to consider the matter; that at the end of such time the secretary called again, and that the offer was refused,—shows an inability to agree on a price for the tenant's separate share as well as that of the whole tract.

3. The County Board, and not the Township Commissioners of Highways, is the proper body from which to obtain consent to the construction of an electric railway on a public highway over which a turnpike company has an easement.

4. The giving of an instruction in condemnation proceedings, in regard to a matter not in issue, and which could not, one way or the other, affect the amount of compensation defendants were entitled to, is not error.

5. Refusal to give an instruction which leaves to the jury the construction of a deed is not error.

6. In condemnation proceedings by an electric railroad company against the owners of the fee, to secure the right to operate its line on a public highway over which a turnpike company has an easement, an instruction that, if the jury believed from the evidence that the turnpike company had abandoned that part of the road on which the railroad was to be constructed, the jury might take that fact into consideration, is properly refused, as it would still be a highway, and the amount of defendant's damages would not be affected. (Trotler vs. St. Louis B. & S. Ry. Co., 54 N. E. Rep., 487.)

MICHIGAN.—Municipal Corporations—Power to Operate Street Railroads—Constitutional Limitations—Internal Improvements.

1. Under Const. art. 14, sec. 9, providing that "the State shall not be a party to or interested in any work of internal improvement, nor engaged in carrying on any such work," works of internal improvement, which the State itself is prohibited from undertaking, it cannot authorize municipalities to undertake or become interested in.

2. The street railroads of Detroit, comprising over 140 miles of track, and valued, with their equipment, at from five to twenty million dollars, are works of internal improvement.

3. The act of the Legislature of Michigan authorizing the creation by the Common Council of the City of Detroit of a commission of three men, to be known as the "Detroit Street Railway Commission," and conferring on such commission, when appointed, the power, in their discretion, to purchase, lease, or otherwise acquire by conveyances to the city, any street railroad wholly or partly within the city, together with its property, rights, and privileges, and to extend and operate the same in behalf of the city by the carriage of passengers and freight for hire, is in violation of the provision of the State constitution prohibiting the State from becoming interested in any work of internal improvement, and is void. (Attorney General vs. Pingree et al., 79 N. W. Rep., 814.)

MISSOURI.—Authority to Amend Charter—Extension of Lines—Parallel Law—Repeal—Quo Warranto.

1. Rev. St. 1889, sec. 2779, authorizing a corporation to "extend its business to any other purposes authorized by this article," is not merely a permission to a corporation, organized for one of the eleven purposes allowed by sec. 2771, to extend its business so as to embrace another of the eleven purposes, but authorizes a street car company, whose termini were fixed by the original incorporation, to amend its charter so as to extend the original termini, and thereby carry the public a greater distance for the same fare, or so as to include the right to buy or lease a road already constructed.

2. Where a street railway company has, from time to time, by municipal authority, extended its lines beyond the termini stated in its original charter, and such grants are greater in extent and longer in mileage than the one challenged in the case at bar, but no one has ever questioned their legality, and relator expressly disclaims any desire to have the company ousted therefrom, the writ of quo warranto will be refused.

3. Act Jan. 16, 1860 ("Third Parallel Law"), provides that no street railroad shall hereafter be constructed in the city of St. Louis nearer to a parallel line than the third parallel street from any road now constructed, or which may thereafter be constructed, except the roads hereinbefore mentioned. At that time the Legislature alone had power to legislate as to the city of St. Louis. Acts 1865-66, pp. 279-287, amended the St. Louis charter, and gave the city sole power to grant the right "to construct street railroads in any street of said city, and to regulate and control the same and the use thereof." Const. 1875 expressely prohibited the Legislature from granting the right to construct or operate or transfer a street railway in any city of the State, without its consent, and gave the city of St. Louis the power to adopt a charter which should supersede all prior charters. The charter so adopted by the city gave it the sole right to grant the right to construct street railways and to regulate street car companies. *Held*, that Act 1860 was repealed by implication by Act 1866 and Const. 1875. (State ex rel. Crow, Attorney General vs. Lindell Ry. Co., 52 S. W. Rep., 248.)

NEW JERSEY.—Abandonment of Operation—Excuse for Non-performance—Mandamus—Parties.

1. A street railway company incorporated under the laws of this State, and the route of its road, and the location of its tracks, established by an ordinance of the municipality in the streets of which the company is to operate its road, such ordinance being accepted by such company, and its tracks laid in accordance therewith, and the road constructed and in operation, cannot, at its mere will and discretion, cease and abandon the operation thereof, or any portion thereof. It becomes the duty of the railway company, in the exercise of its rights, privileges, and franchises, for the benefit of the public to maintain and operate its road according to the terms of the ordinance, and in compliance with statutes which confer upon the company such rights, privileges and franchises.

2. An implied condition attaches itself to the grant of the franchise that it be held for public benefit, and the duty upon the railway company is to exercise it for such purpose, and, as a public agent, it cannot escape this duty.

3. The company, duly incorporated, which has the ownership of, and is in possession and control of, such street railway, its appliances and property, whether under a lease of or by sale from the original or other company incorporated to construct and operate such railway, or by sale under a decree of the Court of Chancery of this State upon foreclosure under the statute of the State concerning the sale of the property and franchises of certain corporations (P. L. 1897, p. 229, c. 127), has conferred upon it all the corporate rights, liberties, privileges and franchises of such original or other company, and upon it rests the same burden and duty to maintain and operate such street railway under the statutes and the ordinance of the municipality as was imposed upon the original company.

4. The fact that the located route of the railway is laid across a bridge over a stream, the construction, maintenance and control of which bridge is in the Board of Chosen Freeholders, which will not permit the tracks to be laid thereon unless upon proper and reasonable regulations for the safety of the bridge for the traveling public, furnishes no excuse why the road should not be operated upon its route through the streets of the municipality lying upon either side of such bridge. The acceptance of the ordinance being apart from the control of such bridge by the Board of Chosen Freeholders, and having no relation to it, or to its use, and there being an agreement between the railway company and the chosen freeholders in relation to the use of such bridge, the court will not enter upon the consideration of the reasons why the company has not performed such agreement, in order to excuse the company from the performance of its duty towards the municipality in the operation of its road.

5. Mandamus is the proper remedy to compel such street railway company to perform the duty of maintaining and operating such railway for the benefit of the public. The public duty imposed upon the company is always active, potential and imperative, and must be executed until lawfully surrendered, suspended or abandoned by the legally expressed consent of the State, and the performance of this duty can be lawfully enforced by mandamus.

6. The municipality in the streets of which the railway is located by the ordinance is a proper relator in a proceeding by mandamus

* Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

to enforce the duties of the company toward the public. (State ex rel. City of Bridgeton vs. Bridgeton & M. Traction Co., 43 Atl. Rep., 715.)

NEW YORK.—1. Electric Street Railway—Grant of Certificate.—The grant of a right to build a street surface elevated railroad, connecting several localities of considerable importance, between which there is no direct railroad communication, in territory for the most part within the city of New York, is proper, though the proposed road would in some instances nearly parallel a steam railroad, where it would furnish means of local transportation which were not, and could not well be, furnished by such steam railroad.

2. Same—Grant.—Under Railroad Law, sec. 59, authorizing the Board of Railroad Commissioners, before granting a certificate for the construction of the road, to permit errors, omissions, or defects to be supplied and corrected, a change in the route of an electric railway, not affecting substantially its character, and made to obviate objections of the local authorities, is such a defect as could be corrected under the powers given under said section; and such change could be disregarded or approved, if made after the filing of the articles, and before the application to the board. (People ex rel. Long Island Ry. Co. vs. Board of R. R. Com'rs of New York, 59 N. Y. Suppl., 144.)

OHIO.—Change of Venue—Suit Against Corporation—Constitutional Law—Sufficiency of Affidavit—Presumption of Credibility—Rule as to Evidence—Order Overruling Application—Error Waived.

1. Sec. 5033 of the Revised Statutes, which provides for a change of venue "when a corporation having more than fifty stockholders is a party in an action pending in any county in which the corporation keeps its principal office or transacts its principal business, if the opposite party make affidavit that he cannot, as he believes, have a fair and impartial trial in that county, and his application is sustained by the several affidavits of five credible persons residing in the county," is not in conflict with the State or Federal Constitution.

2. It is not necessary, to entitle the applicant to the benefit of the statute in a case for which it provides, that his affidavit shall state the grounds of his belief that he cannot have a fair and impartial trial in the county in which the action is pending, nor that the sustaining affiants shall state the grounds of their belief. It is sufficient that the affidavit of the applicant state that he cannot, "as he believes," have a fair and impartial trial in that county. And his application is "sustained," within the purview of the statute, when there is filed the several affidavits of five credible persons residing in the county, stating that they entertain the same belief. When so complied with, the statute is mandatory.

3. Unless the character of an affiant for truth is attacked, he will be presumed to be a credible person, and evidence in his support is not required nor admissible; but, if attacked, it becomes a question for the court to determine whether he is a credible person, and unless found to be so, the application may be denied.

4. Whether the action is one in which a corporation having more than fifty stockholders is a party, or is pending in the county where the corporation keeps its principal office or transacts its principal business, are questions for the determination of the court in which the application is made; and, if the statement of these facts in the affidavit is denied, the burden is on the applicant to establish them.

5. An order overruling an application for a change of venue is not an order made in a special proceeding, which may be made the foundation of an independent proceeding in error, but is properly reviewable on error prosecuted to the final judgment in the action. The error is not waived by proceeding to a trial of the action without objection by the applicant. (Snell vs. Cincinnati St. Ry Co., 54 N. E. Rep., 270.)

UNITED STATES COURTS (OHIO)

1.—Constitutional Law—Impairment of Contracts—Ordinances Granting Street Railroad Franchises.

City ordinances making grants of franchises to street railroad companies on specified conditions, when accepted by the companies, constitute contracts, which cannot be annulled or amended except by consent of both parties, and which are protected from impairment by the fourteenth constitutional amendment.

2.—Equity Jurisdiction—Restraining Enforcement of Unconstitutional Ordinance.

A federal court of equity may grant relief by injunction against a city ordinance which impairs the contract rights of complainant or deprives him of his property without due process of law.

3.—Right of Municipality to Fix Rates of Fares.

The statutes of Ohio confer power upon municipalities to determine the conditions of the grant of a franchise to a street railroad company, including the rates of fare to be charged, but no power to thereafter prescribe rates of fare; and where the grant itself fixes the rate of fare a reserved right of regulation does not authorize the municipality to thereafter change it during the life of the grant.

4.—Constitutional Law—Impairment of Obligation of Contracts—Ordinance Changing Rates of Fare on Street Railroads.

A city, in granting franchises to two certain street railroad companies, fixed the rates of fare to be charged, reserving the right to increase or diminish such rates, as it might deem justifiable and expedient. Afterwards, by different ordinances, it granted additional franchises to each company, expiring with the original franchise, to build extensions, lay additional tracks, or to change the motive power. It imposed conditions to each of such additional grants, which were accepted by the respective companies, in the way of requiring street paving and repairing, or the furnishing of increased car service, to which the companies were not before subject. Such ordinances also made changes in the rates of fare by providing that but a single fare, at the rate then charged, should be charged for passage between any two points on either the original lines or their extensions, and by requiring the companies to sell tickets at a reduced rate. As to one of the companies, which, under the ordinance containing the reservation, had the right to, and did, charge two fares for passage over the entire length of its line, a subsequent ordinance granting it the right to lay a double track, and to maintain it during the life of its original franchise, required the carriage of passengers over the entire line for a single fare at the rate then charged, and such company was subsequently granted the right to change its motive power from horses to electricity, which it did, at a large expense. Each of said companies subsequently consolidated with a number of other companies, as to whom no power to change the rates of fare had been reserved by the city, their original lines, to which the reservation in regard to changing rates of fare applied, thus becoming parts of two several consolidated systems, each containing many miles of road, operated together. These consolidations were consented to by the city, the consents containing provisos, accepted by the consolidated companies, requiring transfers to be given, or through cars run, so that a single rate of fare or ticket at the rate then charged should entitle a passenger to ride over the lines of any two of the constituent companies, whereas they were before entitled to charge separate fares over each line. None of such legislation of the city subsequent to that granting the two original franchises mentioned contained any reservation of the right to make future changes in rates of fare. *Held*, that such subsequent legislation, and its acceptance by the companies, operated as a repeal of the provisions of the original grants reserving the right to change the rates of fare on the original lines of the two companies to which they applied, or constituted new contracts with such companies and their successors, which the city could not impair during the life of their franchises; and that an ordinance passed by the city requiring the consolidated companies to reduce the rates of fare on such original lines, aside from being impracticable in operation, since each of such lines had become a part of a larger system, operated together as a whole, was unconstitutional and void as an impairment of the contracts made by such subsequent ordinances.

5.—Same—Modification of Grant by City—Validity Under Ohio Statute.

Rev. St. Ohio, sec. 2502, providing that, after a grant or renewal of a grant is made by a municipal corporation, it shall not, during the term of such grant or renewal, release the grantee from any obligation or liability imposed by the terms of such grant or renewal, does not prohibit a city making a grant of a franchise to a street railroad company, in which it reserves the right to change the rates of fare to be charged, from thereafter modifying such contract on sufficient consideration. (Cleveland City Ry. Co. vs. City of Cleveland. Cleveland Electric Ry. Co. vs. Same, 94 Fed. Rep., 385.)

LIABILITY FOR NEGLIGENCE

ALABAMA.—Passengers — Personal Injuries — Complaint — Street Cars—Operation Without Conductor—Plea—Rules of Carrier—Negligence of Passenger—Death—Proximate Cause.

1. A complaint averring that plaintiff's intestate was a passenger on one of defendant's street cars, and that defendant then and there so negligently conducted said business that by reason of such negligence plaintiff's intestate received personal injuries, which caused his death, sufficiently alleges the negligence of defendant.

2. A complaint in an action for personal injuries to passenger, causing death, alleging that "deceased gave the usual signal to stop the car, whereupon the motorman * * * slowed up and stopped, or so nearly so as to render it reasonably safe for deceased to proceed to alight, whereupon deceased proceeded to alight, placing himself in a standing position on the platform or running board alongside the car for that purpose, * * * whereupon the motorman, negligently failing to look and see whether deceased

was in a place of danger, * * * started the car with a sudden motion, * * * thereby throwing deceased violently from said car," is not objectionable, in that it does not show whether he was injured by reason of attempting to get off the car after it had stopped, or while it was moving, and that it does not show that the motorman was informed of his desire to get off the car.

3. It is not necessary to allege the name of the carrier's employee whose negligence caused the injury.

4. Where a complaint alleges several negligent acts or omissions of a carrier, and that, combined together, they produced the result complained of, it is error to strike out the words charging one of the acts or omissions.

5. Whether the operation by a street railroad company of its cars without a conductor constitutes negligence is a question for the jury.

6. In an action for personal injuries to passenger, a plea that the car was equipped with bell and cord attached so that passengers could notify the motorman when they wished the car stopped should be stricken out, in the absence of an averment that the passenger did not pull the cord or ring the bell.

7. A rule of a street car company that passengers must not leave its cars while they are in motion is a reasonable one.

8. A passenger cannot be charged with negligence in violating a rule of the carrier, unless he knew the rule.

9. Whether a passenger was guilty of negligence in going upon the running board of the car preparatory to alighting, while it was in motion, was a question for the jury.

10. Negligence resulting in an injury to decedent's finger, which produced blood poisoning, causing his death, is the proximate cause of such death. (Armstrong vs. Montgomery St. Ry. Co., 26 So. Rep., 349.)

ARKANSAS.—Carriers—Personal Injuries — Evidence — Conclusions of Fact—Admissibility—Relevancy—Res Gestæ—Declarations After Injury—Trial—Prejudicial Instruction—Street Railroads—Trespassers—Degree of Care.

1. In an action to recover for injuries sustained while attempting to board a moving street car, the question, "what difficulty would you have had in getting on if it had remained going as it was when you started on it?" is inadmissible, as calling for the decision of a question which is within the exclusive province of the jury to determine.

2. Testimony of a witness in an action against a street railway company for damages for personal injuries, to the effect that he did not think it was dangerous to get on certain cars by the front platform, when they were running slowly, is inadmissible as determining a question within the exclusive province of the jury.

3. In an action by plaintiff, a boy 10 years of age, against a street car company for damages for personal injuries, evidence that boys had ridden on defendant's cars at different times without permission and at other times by invitation, and without paying fare, is incompetent, as not tending to prove that plaintiff was entitled to ride on the car he attempted to board at the time he was injured.

4. A statement by the motorman of the defendant company that it was due to his (the motorman's) own carelessness that plaintiff got hurt, made after the injury was complete, and plaintiff had been removed from where he had fallen, and was sitting in the car, and made with the obvious purpose of showing that the motorman was guilty of no intentional wrong, is no part of the res gestæ, and is inadmissible.

5. Testimony by a witness to the effect that he could not repeat the exact words used by plaintiff after the injury had occurred, but the impression left on his mind was that it was plaintiff's own fault, is properly excluded.

6. Where one of the defenses to an action against a street railway company was that the injury was due to plaintiff's own negligence, and not to any negligence on the part of defendant, and evidence was adduced to support this defense, and instructions were given upon it, an instruction that the only valid defense in the action was based on the theory that defendant's motorman had not invited plaintiff to ride, and for the jury to exclude from their consideration and decision the question whether, admitting the invitation to have been given, the plaintiff was guilty of such contributory negligence as would defeat his recovery, is highly prejudicial to the defendant.

7. Employees of a street railway company are under no obligation to keep a lookout to prevent boys, endeavoring to ride without permission and paying fare, from entering its cars while in motion, and owe them no duty save not to injure them wantonly.

8. A boy ten years of age, riding upon a street car without paying fare, by invitation of a motorman in charge of the same, who has authority to receive and let off passengers, is not a trespasser.

9. An invitation of a motorman to a boy to ride on the car is an act within the scope of his employment, for which he is responsible to his master, and if the boy accepts it innocently he is no trespasser, and it is the duty of the company to extend to him the diligence due to passengers of his age and discretion.

10. In entering, riding upon, and leaving street cars a boy ten years of age or over is bound to exercise prudence equal to his care, knowledge, and experience, and to that extent is held responsible in law for acts or omissions contributing to his own injury. (Little Rock Traction & Elec. Co. vs. Nelson, 52 S. W. Rep., 7.)

ILLINOIS.—Peremptory Instructions—Waiver—Injuries to Passengers—Instructions—Questions for Jury.

1. A motion made at the close of plaintiff's evidence to find for defendant is waived where it is not renewed at the close of the evidence, except as it is included in a series of instructions asked by defendant.

2. An instruction that a railroad company should exercise the highest degree of care, consistent with the practical operation of the road, to provide for the safety of passengers, is applicable in an action by a passenger of a grip car for injuries sustained by the sudden flying back of a brake lever, where there was evidence that the brake was in bad order.

3. In an action by a passenger on a grip car for injuries caused by a sudden flying back of a brake lever, his failure to obey the gripman's request to stand back was not negligence per se, where the car was crowded, and he was not informed of the danger. (West Chicago St. Ry. Co. vs. Johnson, 54 N. E. Rep., 334.)

ILLINOIS.—Action for Negligence—Personal Injury—Instructions.

1. In an action for personal injuries, an instruction authorizing a verdict for plaintiff on condition that she was injured because of defendant's negligence, "without negligence or fault on her part," is equivalent to requiring proof that she was in the exercise of ordinary care.

2. An instruction that the jury may disregard the entire testimony of a witness, when it is palpable that he has intentionally testified falsely as to some material matter, and is not corroborated by other evidence, could not mislead them to suppose that they should not disregard the testimony of a witness intentionally falsifying if there were others of the same kind who testified in the same way.

3. The jury were told that they were to consider all the testimony; that it was plaintiff's duty to establish her case by a preponderance of the evidence, and a verdict for defendant was directed if the evidence was equally balanced, if it preponderated for defendant, or if they were in doubt as to the preponderance; that the burden of proof was not on defendant, and, if the preponderance did not show an act alleged essential to recovery, their verdict should be for defendant. They were also told to consider all the evidence, and if it preponderated for defendant, or if they were unable to decide, they should find for defendant. *Held*, that the jury could not have understood an instruction that a "preponderance of the evidence" does not necessarily mean the greater number of witnesses, but that such evidence as produces conviction in the minds of the jury will constitute such preponderance, to mean that they might disregard the evidence for defendant.

4. From an instruction to a jury, in relation to estimating damages for pain and suffering due to a personal injury, and the future consequences reasonably certain to result, that they might "themselves make such estimate from the facts and circumstances in proof, by considering them in connection with their knowledge, observation, and experience in the business affairs of life," it could not be inferred that they might consider injuries outside the evidence, of which they might individually know. (North Chicago St. Ry. Co. vs. Fitzgibbons, 54 N. E. Rep., 483.)

LOUISIANA.—Injury to Person on Track.

The plaintiff in a suit for damages against a railroad company for injuries caused by defendant's car running over him, shown to have been alongside or in a position close to the track, with his legs across the nearest rail, and in that condition receiving his injuries, must, in order to recover, show with reasonable certainty that, notwithstanding his gross imprudence in thus exposing himself to peril, the defendant's motorman could, by the exercise of ordinary care, have averted the accident. 2 Thomp. Neg. p. 1105, sec. 1; Id. pp. 1157, 1158; Pierce, R. R. p. 330; Patt. Ry. Acc. Law, pp. 51, 55, 61; Railway Co. vs. Ives, 12 Sup. Ct. 679, 144 U. S. 429, and line of authorities there cited; McGuire vs. Railroad Co., 16 South. 457, 46 La. Ann. 1543. (Kramer vs. New Orleans City & L. R. Co., 26 So. Rep., 411.)

MARYLAND.—Master and Servant—Liability of Master for Torts of Servant—Willful and Wanton Acts—Instructions.

1. A master may be held liable for an act of his servant, though willfully or wantonly committed, when it was within the scope of his employment, and done in the performance of the master's business.

2. Whether an act of a servant was within the scope of his employment, and done in the course of his service, and for the master's benefit, is usually a question of fact for the jury.

3. The mere fact that a plaintiff suing for a personal injury resulting from the alleged negligent act of defendant's servant testifies that, in his opinion, the servant acted willfully and maliciously, or even feloniously, does not entitle the defendant to an instruction directing a verdict in his favor.

4. Where no reference is made to the pleadings in the prayers for instructions, the correctness of such prayers must be determined solely by the evidence. (Baltimore Consol. Ry. Co. vs. Pierce, 43 Atl. Rep., 940.)

MARYLAND.—Crossing Track—Failure to Stop and Look—Instructions—Contributory Negligence—Duty of Motorman.

1. The failure of a pedestrian to stop and look before crossing the tracks of a street railway will not, under all circumstances, constitute such contributory negligence as will prevent recovery.

2. Negligence on the part of plaintiff will not defeat his right to recover, unless it is such that but for it the misfortune could not have happened; nor if the defendant, by the exercise of care on his part, could have avoided the consequences of such negligence.

3. The court may modify a request of defendant to charge that plaintiff cannot recover if she contributed to the injury, by adding, "unless the motorman saw, or could reasonably have seen, the peril of the plaintiff, and failed to exercise ordinary care to avoid the accident."

4. The question of negligence, in cases of personal injuries from street railroads, is primarily one for the jury; and it is only when the facts are undisputed, or where but one reasonable inference can be drawn from them, that the question becomes one for the court.

5. Where a track occupies nearly the entire bed of the street, leaving only six feet between it and the curb, so that one, in crossing the street, would reach the tracks in a few steps after he came into the view of the motorman, and plaintiff is injured, while crossing, by a car approaching at the rate of ten or eleven miles an hour,—so fast that the motorman was unable to stop the car after discovering her,—she may recover, although negligent, if the jury find that the motorman should have slackened his speed and had his car well under control in approaching the crossing, and kept a sharp lookout for persons about to cross the track. (Baltimore Consol. Ry. Co. vs. Rifcowitz et al., 43 Atl., 762.)

MASSACHUSETTS.—Defective Roads—Evidence—Notice of Injury.

1. In an action against a street railway company for personal injuries caused by defendant's failure to construct its road to the road commissioner's satisfaction, as required by Pub. St. c. 113, sec. 32, the testimony of an assistant commissioner who had charge of the locality where the accident happened, that he saw the work and was satisfied, is admissible to show that the work was done to the commissioner's satisfaction.

2. Pub. St. c. 52, sec. 19, requiring notice of an injury in a highway to be given within thirty days to persons by law obliged to keep the highway in repair, is applicable where an injury is occasioned by a street railroad company's failure to keep its road in repair as required by chapter 113, sec. 32. (Maloney vs. Natick & C. St. Ry. Co., 54 N. E. Rep., 350.)

NEW JERSEY.—Frightening Teams.

Where an electric car, running upon and along a public highway at the ordinary and usual rate of speed, and without lessening the same, runs into and through a pool of water on the tracks of the railway, thereby throwing the water up, out, and in front of the car, and up, out, and upon the front and sides thereof, and causing, by so running through such water, an unusual, loud, roaring, and hissing noise, by reason of the water being gathered and hurled around and through the trucks and wheels of the car, and throwing therefrom, and so causing a horse driven by the plaintiff along the highway to become frightened and uncontrollable and to run away, throwing the plaintiff from his carriage and injuring him, a case is presented which requires its submission to the jury, upon the question whether the railway company, by its servants operating such car, has exercised reasonable care to protect the plaintiff from injury in his use of the highway. The case of McCann vs. Traction Co., 36 Atl. 888, 59 N. J. Law, 481, followed, and the principles established applied. (Ayars vs. Camden & S. Ry. Co., 43 Atl. Rep., 678.)

Indorsement of Standard System of Accounting

At the eleventh annual convention of State Railroad Commissioners, held in Denver, Aug. 10, the committee on classification of construction and operating expenses of electric railways made the following report:

To the Eleventh Annual Convention of Railroad Commissioners:

At the ninth annual convention of Railroad Commissioners, held in St. Louis in May, 1897, the following resolution was passed:

Resolved, That a special committee of three be appointed by this convention to prepare a form of classification of the construction expenses and operating expenses of electric roads, to correspond as far as practicable with the forms approved by this convention, and adopted by the Inter-State Commerce Commission for steam roads, and that said committee be authorized to invite the co-operation and assistance of the Association of American Railway Accounting Officers; also of the National Street Railway Association, or any other persons possessing expert knowledge appertaining to the subject, and to report the result of their proceedings to the next annual convention of this body.

The persons appointed to carry out the purposes of this resolution were: William O. Seymour, of Connecticut; Ashley W. Cole, of New York, and R. S. Kayler, of Ohio. The committee apponted by the Association of American Railway Accounting Officers to co-operate with the foregoing committee were:

H. M. Kochersperger, Comptroller of the New York, New Haven & Hartford Railroad Company; M. Riebenack, Assistant Comptroller of the Pennsylvania Railroad Company; H. D. Bulkley, Comptroller of the Baltimore & Ohio Railroad Company. The committee as thus constituted, met in New York City in April, 1898, and mapped out its work, closely modeled after the forms of the classification of the construction and operating expenses of steam roads, but the items chargeable under each head of the various accounts were not completed, and we found it impossible to perfect it in time to present to the tenth annual convention, held in Washington in May, 1898. We therefore reported progress, and asked for an extension of time for the completion of the work, which the convention readily granted. At the time of this meeting in New York City it was learned that an organization was in existence known as "The Street Railway Accountants' Association of America," which had been engaged for two years preparing such a classification as we had been instructed to prepare. In accordance with the terms of the resolution appointing us, we sought and obtained the co-operation and assistance of this organization, to which we are indebted for the form herewith presented for your consideration and adoption. It was found that the form prepared by the street railway accountants was so much more advanced in its preparation, so complete and full in its details, and so well adapted for its purpose, owing to the familiarity of those who prepared it with street railway accounting, that we deemed it wise to abandon the work which we had commenced and advise the indorsement and adoption of the form prepared by them. Several slight modifications in the form have been made at the suggestion of the railway accounting officers, and as it is now presented it is unanimously approved and recommended to this convention by your committee and the railway accounting officers associated with us. Emanating from their own accounting officers, the form is more likely to be universally adopted and used by the street railway companies than if prepared and submitted by those entirely outside of their organization, especially if they are assured by our action that it will be accepted and approved by the various State Commissions to which they are required to make annual reports. Your committee desire to publicly express their sincere thanks to the committee of the Street Railway Accountants' Association of America, who are the authors of this classification, and whose names, positions and addresses are prefixed to this report, for the cordial and generous manner in which they have contributed the results of their laborious and extended deliberations for our consideration and adoption; also for the valuable assistance rendered by J. D. Green, auditor of disbursements of the Pennsylvania Railroad, who represented Mr. Riebenack upon the committee; to Col. N. H. Heft, superintendent of electric construction on the New York, New Haven & Hartford Railroad Company, who kindly gave us the benefit of his expert knowledge of electrical matters; to Col. Charles R. DeFreest, recently clerk of the railroad commissioners of New York, whose assistance and advice were much appreciated; to Henry F. Billings, clerk of the railroad commission of Connecticut, who kindly consented to officiate as stenographer of the committee; and, finally, to the committee of the Association of American Railway Accounting Officers, who were associated with us, without whose advice and assistance no good thing can be accomplished in devising correct methods of railway accounting.

Respectfully submitted for the committee,

Wm. O. Seymour, Chairman.

This indorsement was the result of the meeting held by the committee in New York on July 11, and reported in the last issue on page 536. To the report was appended the standard system of accounting of the Street Railway Accountants' Association of America, with the slight changes mentioned in the August issue.

Seventeenth Annual Convention of the New York State Street Railway Association

The New York State Street Railway Association will hold its seventeenth annual meeting at Ithaca, N. Y., on Tuesday and Wednesday, Sept. 12 and 13. A most attractive programme has been arranged for the meeting, and a large attendance of both street railway managers and representatives of manufacturing companies is assured. Ithaca is well fitted for a convention city. It possesses good hotel accommodations and an excellent meeting place, while Cornell University offers an interesting field of study to those interested in electrical development and scientific matters in general. The faculty of that institution have expressed much interest in the coming convention, and the programme of the entertainment includes an inspection of the college buildings and the several departments, with a short description of each department by the professor in charge.

The entertainment of the delegates will also include a trolley ride to the picturesque environs of Ithaca, including a trip on Cayuga Lake, with luncheon served on the boat, a special entertainment and band concert at Renwick Park, and the customary banquet on the evening of the first day.

Ithaca possesses unusual scenic attractions, some of the natural beauties in the immediate vicinity rivaling anything found elsewhere in the East. Ithaca Gorge in itself draws hundreds of visitors each year, its many water falls and glens presenting a panorama seldom equaled. A few of the falls easily reached from the city are Triphammer Falls, the upper fall of the gorge; Ithaca Falls, 140 ft. high and nearly 200 ft. wide; Enfield or Lucifer Falls, 150 ft. high, and Taughhannock Falls, 215 ft. high, this being the highest fall in the State. From this flow of water are obtained the water powers of Cornell University and the Ithica Street Railway Company.

Cayuga Lake is a beautiful body of water and is as changeable in its moods as the ocean, at times being smooth as glass, again rippled with tiny waves, and at times, during high winds and heavy storms, its shores are lashed with white caps and breakers. At its head the street railway company has laid out and developed Renwick Park, now one of the most popular resorts of its kind in the State.

These natural attractions, together with the University buildings and grounds, are well worth in themselves a trip to Ithaca, and viewed as they will be under the thoughtful guidance of the reception committee, the delegates to the Ithaca meeting will long remember with pleasure, this occasion.

But the entertainment features of the convention will not be permitted to interfere with the business side. The officers of the association are very anxious that the meeting shall be of the greatest possible practical value, and to this end have sent the following list of every-day subjects to every street railway company in the State with the request that a representative make a selection therefrom and prepare a paper thereon. Should any subject of interest not embodied in the list suggest itself, any company is invited to adopt the same and send a paper upon that topic. The list suggested is as follows:

Rail Welding.
Track Bonding.
The Third Rail.
Storage Battery.
The Repair Shop.
Induction Motors.
Care of Dynamos.
Car Mileage Record.
Indemnity Insurance.
Municipal Ownership.
"The Metallic Circuit."
The Three-Phase System.
Street Railroads vs. State.
Loss of Current in Returns.
General Track Construction.
Inspection of Car Equipment.
Transfers, Their Use and Abuse.
"Receipts from Other Sources."
Street Railways vs. Automobiles.
Points on Overhead Construction.
Long Distance Power Transmission.
Impracticability of Reduction of Fare.
Suggestions on Financial Organization.
Maintenance and Repair of Car Bodies.
Pleasure Resorts as Traffic Stimulators.
Signal Systems for Single Track Roads.
Air and Power Brakes for Electric Cars.
Care and Inspection of Wheels and Axles.
Local Railway Employees' Benefit Associations.
Fuel Economy of Railroad Engines. (Allotted.)
The Power Station, from an Economic Standpoint.
How Can We Increase the Efficiency of Employees?
The Proper Instruction of Motormen and Conductors.
Compressed and Liquid Air for Street Car Operation.
Fenders and Other Means for Prevention of Accidents.
Experiments on Resistance of Rail Bonds. (Allotted.)
Freight and Express Service on Interurban Electric Lines.
The Mutual Relations of Municipalities and Street Railroads.
Statistics of Street Railway Construction and Operation. (Allotted.)
Polyphase Equipment Used in Cornell University; Illustrated by Polyphase Apparatus. (Allotted.)

The presentation and discussion of brief and concise papers (limited to twelve minutes) upon practical subjects like these, will be a highly instructive and prominent feature of the meeting.

In addition, four members of Cornell faculty have consented to contribute papers to be read, as follows:

"Statistics of Street Railway Construction and Operation." Harris J. Ryan, professor of electrical engineering.

"Experiments on Resistance of Rail Bonds." Professor H. H. Norris, electrical engineering department.

"Fuel Economy of Railroad Engines." R. C. Carpenter, professor of experimental engineering.

"Polyphase Equipment Used in Cornell University." (Illustrated by practical exhibit of polyphase apparatus.) Professor H. J. Hotchkiss.

President Rogers has sent to all roads in the State a letter urging upon them the benefit, importance and necessity of having one or more of the practical men from each company in attendance at the convention. He also says:

"It is earnestly hoped that the smaller roads of the State will actively participate in the proceedings of the meeting, particularly in the preparation of papers and the ensuing discussion, also that non-member street railroads will send representatives authorized to join the association."

Mr. Rogers has also extended a very cordial invitation to representatives of all manufacturers and dealers in street railway supplies and apparatus, to participate in the benefits and pleasures of the convention, and urges such concerns to send one or more delegates. Ample space in close proximity to the place of meeting, for the exhibit of supplies, models, etc., will be furnished free of expense to those who desire to avail themselves of the privilege.

Preparations for the Chicago Convention

A meeting of the general committee having in charge the arrangements for the coming convention at Chicago, of the American Street Railway Association, was held on the 14th of August at the office of J. M. Roach, general manager of the Union Traction Company, at 444 North Clark Street, Chicago. The meeting was attended by the chairmen of all the various committees and was called to order by T. C. Penington, secretary of the association, when, on motion, J. M. Roach was elected permanent chairman. The first business transacted was the filling of the vacant chairmanships of the various committees. The two committees on hotels and entertainments were consolidated and J. M. Roach was elected chairman in place of the late M. K. Bowen. The plans for entertainment and excursions were outlined and approved by all present. The programme includes a reception and dance at the hotel, a visit by rail to the drainage canal, a tally-ho trip to the parks on the South Side, and to the museum in Jackson Park, a visit by trolley cars to the stock yards, and the regular banquet. For the entertainment of the ladies of the association during the forenoon of each day's session, several carriage drives about the city and a visit in a body to some of the leading department stores, as well as to the public library and art institute on the lake front, will be arranged.

The committee on information and direction was authorized to prepare a book giving a map of the street railway lines of the city, with directions as to how to reach any of the parks or other important places in and about the city, together with a directory of local committees. Sufficient money was pledged by the representatives of the street railway companies present to carry out the programme and to meet all incidental expenses. The committee on space reported that all the space in the Tattersall Building had been engaged by exhibitors and a plan was outlined for securing additional space from the city in the neighboring streets and alleys.

All the committees are at work on their various assignments, and it is the intention of all that the Chicago convention will in its

attendance and interest, as well as in the matter of entertainment, eclipse any conventions that have previously been held.

The Tattersall's Building is 355 ft. x 146 ft. and the interior arrangement is shown in the illustration herewith. The partitions that now cut off the main floor from the floor under the gallery, however, will be taken down, so the entire floor will be open and no exhibit will be hid away from view.

In sending goods to the convention for exhibition purposes, manufacturers should remember the following directions:

All goods should be marked with the consignor's name, and directed to Tattersall's, Chicago, care of H. W. Smith, successor to Anderson Transfer Company, 1618 State Street. Bill of lading or advice that goods have been shipped in his care should be sent to Mr. Smith, giving particulars in regard to shipment. Goods will be delivered to the proper assigned space in the exhibition hall. All goods should be shipped early to insure delivery in time and all charges prepaid. All articles intended for the exhibition must be delivered at the building by the agent or owner, and at his expense, but the local committee has made arrangements with H. W. Smith (successor to Anderson Transfer Company) to haul and deliver all shipments to and from the building at low rates if directed in his care. All electrical connections for power and extra lights must be made at the expense of the exhibitor. The committee on exhibits will make contracts with carpenters, electrical workers and laborers at regular prices, so the exhibitors will not be overcharged for lumber, labor, etc.

Friday, the 20th, has been set apart by the executive committee for the examination of exhibits. No session of the association will be held on that day and no entertainments of any kind will be given by the local committee, so all delegates will have ample time to examine the displays made by the supply-men.



INTERIOR OF CONVENTION HALL, CHICAGO

Four Cent Fare Proposition in Milwaukee

On July 31 the City Council of Milwaukee appointed a special committee to confer with the officers of the Milwaukee Electric Railway & Light Company with a view of obtaining, if possible, a reduction in the rates of fare charged, and of bringing about a better understanding and more harmonious relations between the city and the company. To this committee the company has signified its desire to do all in its power to secure these desired results, and offers the following concessions on both sides as a basis of agreement.

The concessions which the company is willing to make are:

1. A gradual and increasing reduction in the rates of fare, until a 4-cent rate is secured by the sale of commutation tickets.
2. The permanent establishment of the transfer system.
3. The extension of the railway lines to the city limits at points necessary for the convenience of the people in the several localities interested.
4. The company is willing, in case the city desires, and has the power to purchase the railways and physical property of the company within the city, to grant an option to purchase on terms to be agreed upon, or, determined by arbitration.

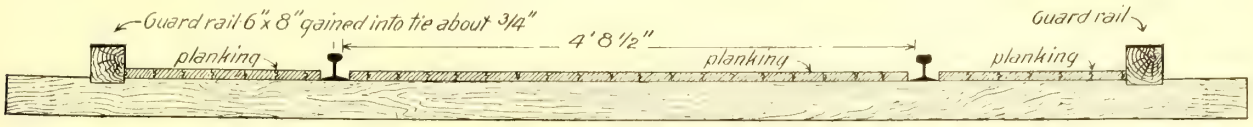
For these concessions the company holds the city should grant the following:

1. Franchises upon certain streets which will enable the service to the public to be improved, and the railway system perfected.
2. An extension of the railway franchises for ten years.

The London County Council will install about 10 miles of underground conduit electric railway.

Trolley Accident Near Stratford, Conn.

What will probably prove to be the most disastrous accident which has ever happened on an electric road occurred near Stratford, Conn., on Aug. 6, when a car on the Shelton Street Railway, filled with passengers, jumped the track near the south end of a long bridge that crosses a deep ravine about 1½ miles from Stratford. The accident occurred about 3 o'clock in the afternoon, and the car fell about 50 ft. to the valley below. It turned completely over in its descent, and the weight of the motors and truck drove the floor against the top of the car, crushing many passengers. About twenty-eight passengers perished, while several others were severely injured. The Shelton Street Railway is a new line, recently opened between Shelton and Stratford. It is about 9 miles in length, runs along the western shore of the Housatonic River, and connects at Stratford with the systems of the Bridgeport Traction Company and the Milford Street Railway Company. The car to which the accident occurred was No. 2, of the Milford Street Railway.



SECTION OF TRACK CONSTRUCTION ON BRIDGE

From Stratford the tracks follow the highway in a northerly direction, until just before the ravine is reached at which the accident occurred. They then leave the highway and descend a grade of about 3 per cent a distance of some 700 ft. until the southern end of the bridge is reached. The latter crosses what in winter is an ice pond, but which, in summer, during dry weather, is a sort of morass. The track is laid with 4 in. T-rails, with flat head and sides; and 12 ins. outside of each T-rail is the usual wooden guard rail, 6 ins. x 8 ins. This guard is bolted to the ties, but is gained somewhat to fit into the ties, so that its effective height is reduced about an inch. The space between the rails and between the guard rails and the rails is planked for the greater part of the length of the bridge, including the part at which the car ran off the track. The company had ordered steel guard rails, to be laid inside the service rails, but they had not arrived.

The car was a 9-bench open car, mounted on a single truck, with a wheel base of about 7 ft. The depth of wheel flange was about three-quarters of an inch.

The testimony given before the Coroner's Jury seems to indicate that the motorman descended the grade leading to the bridge at a high rate of speed, and that the car commenced to oscillate and sway badly just before it reached the bridge, the cause being either the springing of the track on the embankment, owing to its having been recently built, or to the sudden change from a descending grade to the horizontal track, on the bridge, or both. The wheels jumped the track after the car had run about 40 ft. on the bridge. The car then ran about 30 ft. on the planking, climbed over the guard-rail, and left the bridge about 60 ft. beyond the point where it had left the rails. The evidence showed that when the car left the rails the current was turned off and the brakes set.

The decision of the Coroner's Jury was to find the motorman criminally negligent in running the car at a dangerous rate of speed; also that the company was negligent in allowing an imperfect condition of its track on the day of the accident, and in not enforcing the rule as to speed in approaching the bridge. The following recommendations were also made:

"First, that all cars be required to stop before crossing the bridge at Peck's Mill, 30 ft. distant from the bridge, at either end.

"Second, that all trolley bridges have inside guard rails and that the outside guard rail be not less than 8 ins. high and be lined with iron.

"Third, that no man be allowed to act as motorman for a trolley car until he shall have qualified before some competent board of examiners and be licensed therefor.

"Fourth, that the number of working hours of motormen and conductors be reduced, and that they be allowed a reasonable time for their meals.

"Fifth, that the Governor convene the Legislature at the earliest possible date, for the purpose of creating a commission with ample power, whose duty shall be to supervise the construction and operation of trolley lines."





VIEWS OF WRECKED CAR TAKEN ON THE DAY FOLLOWING THE ACCIDENT

Combination of Special Work Manufacturers

The names of the constitutent companies of the American Switch Company recently incorporated with $11,000,000 capital were announced last week. They are as follows: Weir Frog Company, Morden Frog & Crossing Works, Johnson R. R. Frog & Crossing Company, Eliot Frog & Switch Company, New York Frog & Crossing Company, Ramapo Iron Works, Cleveland Frog & Crossing Company, Carlisle Manufacturing Company, Paige Iron Works and Pettibone, Mulliken & Co.

The capital is divided equally into 6 per cent preferred stock and common stock. The company, it is said, will have a working capital of $1,600,000 in cash, and in addition has pig iron and manufactured goods on hand worth $700,000. Two new plants are to be constructed at once out of the capital on hand, after which, it is stated, there will still be a liberal working capital in the treasury.

Three Cent Fare Ordinance in Detroit

The Common Council of Detroit passed, and on Aug. 16, the Mayor signed, an ordinance providing that all street railway companies in that city shall charge no higher rate of fare than eight tickets for a quarter. The city holds that whereby under the old ordinances the companies are authorized to charge "not to exceed 5 cents," the city retains the privilege of regulating the amount charged to a "reasonable rate."

On the same day the new resolution was passed the Detroit Citizens' Street Railway Company obtained from the United States

District Court an order restraining the city from enforcing or attempting to enforce the new ordinance. The restraining order is returnable Sept. 4, when a permanent injunction will be asked for.

Consolidation of Albany and Troy Systems

Anthony N. Brady is authority for the statement that a consolidation of the street railway systems of Albany and Troy, N. Y., will be perfected within a few days. It is further stated that the consolidation of the Albany and Troy systems will be followed by the absorption of the Troy & New England Railroad Company, and also street railways in Saratoga, Rensselaer, Washington and Warren Counties, and in Vermont, which will give the consolidated company a monopoly of street car traffic from Albany to Lake George, on one side of the Hudson, and from Albany and Troy to Sand Lake, New York, and Bennington, Vt., on the other. It means, too, that the new company will be a powerful rival for the local business, so long enjoyed by the New York Central and Delaware & Hudson Canal Company's systems, which has made what is known as the Albany and Troy Belt Line one of the best, if not the best paying piece of steam railroad properties in the country.

The Albany Railway Company controls and operates all the street railroads in the Capital City, and its road to Troy has been particularly profitable. The Troy City Railway owns all the street railways in Troy, with lines to Green Island, Cohoes, Waterford, Lansingburg and Albia. The Troy & New England Railroad is a continuation of the Albia branch and runs to Sand Lake and Averill Park, two summer resorts largely patronized by residents of Albany and Rensselaer Counties. Ex-United States Senator Murphy and Anthony N. Brady are largely interested in the Troy and Albany roads, and they and their friends control the Troy & New England.

The Troy City Railway is capitalized at $4,000,000, of which $2,000,000 is in 5 per cent gold-bearing bonds. The Albany Railway has $2,000,000 in 5 per cent bonds, and $1,750,000 in common stock. The Troy & New England Company is capitalized at $500,000.

End of Street Railway Contests in Atlanta in Sight

The bitter fight over franchises in Atlanta, Ga., and its development into proposed municipal ownership, seems about to reach a settlement.

The electric railway committee of the City Council, after giving a hearing, which lasted several weeks, to the rival claimants—the Collins Park & Belt Railroad Company, and the Atlanta Railway & Power Company, has recommended an ordinance which will be far-reaching in its effects. This ordinance, which was passed by the City Council on August 21, after a long and heated session, proposes to regulate and govern the street railways, in a manner that has never before been attempted in Atlanta. It also looks to the leasing of all the lines of the Atlanta Railway & Power system after the expiration of its franchises in 1921, at a rental of 5 per cent of the gross receipts, and also the payment of the same tax by any other system then in existence. By their acceptance of the franchises just granted the two companies they become amenable to the new law.

The principal features of the law are as follows:

Section 4. The City of Atlanta reserves the right to regulate the location of tracks, wires, poles and conduits, and their construction.

Section 5. Any part of the lines of all street railway companies, not exceeding five blocks at any one point, may be used by any other street railway company, upon payment of just compensation.

Section 6. After the expiration of the original grants to the Atlanta Consolidated Street Railway Company all companies shall pay (beginning May 20, 1921) a percentage of their gross receipts, not exceeding 5 per cent per annum.

Section 8. The rate of fare for one continuous trip from 5 A. M. to 12 P. M. shall not be more than 5 cents, and from 12 P. M. to 5 A. M. not more than 10 cents.

The section 6 is the direct outcome of the voluntary offer of the Atlanta Railway & Power Company to pay a part of their net receipts to the city. This offer was declined, as its acceptance entailed a refusal from the city to grant franchises to competing lines.

During the hearing the accusation was made that the application for franchises by the Collins Park & Belt Railroad Company was for speculative purposes, and made in order to sell their electric light plant to the Atlanta Railway & Power Company. The Collins Park road is required, on its acceptance of franchises granted them, to give the city a bond for $40,000 that work will begin in four months, and the system completed in twelve months. Their offer of $50,000 toward the construction of a new bridge was accepted.

One of the most interesting features of the new law is an amendment made to section 6, with the object of preventing the two systems from consolidating. Its substance is as follows:

"Should the two systems now competing consolidate, unite or by any means direct or indirect, have the same or reciprocal management, or any understanding as to the operation of the two systems in unison, the 5 per cent tax on gross receipts shall at once become effective on both roads." It is provided, however, that a reciprocal use of transfers between the two lines may be permitted without subjecting the companies to the tax, until 1921.

Consolidation of Machine and Tool Manufacturing Interests

A new company, formed by the consolidation of the Niles Tool Works of Hamilton, Ohio; the Pond Machine Tool Company, of Plainfield, N. J.; Bement, Miles & Company, of Philadelphia, and the Philadelphia Engineering Works, was incorporated at Trenton on Aug. 14. The company is known as the "Niles-Bement-Pond Company," and has a capital stock of $8,000,000, $5,000,000 of which is common and $3,000,000 6 per cent cumulative preferred. The four companies included practically control the heavy machine tool trade, including the manufacture of gun carriages, in this country, employing together over 3000 men. The temporary offices of the company are with the Corporation Trust Company in Jersey City, and the New York offices will probably be at 136 Liberty Street.

The directors of the new concern are: Alexander Gordon, president of the Niles Tool Works Company; Charles A. Moore, of Manning, Maxwell & Moore; Clarence S. Bement and Frederick B. Miles, of Bement, Miles & Company; Gordon Shillito, Thomas T. Gaff and Daniel H. Holmes, of Cincinnati; Frederick W. Gordon, of Philadelphia; George T. Reiss and James P. Cullen, of the Niles Tool Works Company; E. C. Burke, of Cleveland, Ohio; Walter L. Clark, of the Niles Tool Works Company; A. C. Stebbins, of the Pond Machine Tool Company; W. S. McKinney, of Pittsburgh, and Robert C. McKinney. Officers—President, R. C. McKinney; first vice-president, James P. Cullen; second vice-president, A. C. Stebbins; third vice-president, Walter L. Clarke; treasurer, Charles L. Cornell, of the Niles Company; secretary, E. N. C. Davis.

Trolley Contact Spring Case

On Aug. 1, the General Electric Company secured in the United States Circuit Court, District of New Jersey, a decision against the Rahway Electric Light & Power Company, of Rahway, N. J., in its suit for alleged infringement of the Anderson patent, No. 412,155. This patent covers an invention for the arrangement of certain metallic conducting brushes intervening between the end of a trolley wheel and the frame or fork in which the wheel is journaled, for the purpose of maintaining a good electric connection against them in the ordinary system of overhead underrunning trolley.

The defense made by the defendant was, lack of invention, a complete anticipation, lack of patentable novelty in view of the prior art, and entire lack of infringement on the defendant's part. The court, after very fully reviewing the case, decided that the Anderson patent, now owned by the General Electric Company, and dated Oct. 1, 1889, antedates other patents granted for spring contact devices on underrunning trolleys, and therefore gave judgment for the complainants.

Consolidation of Electrical Directories

It is announced that the E. L. Powers Company, of New York, has secured control of the "Electric Railroad List of the World," formerly published by the "Railroad Gazette," and has consolidated this list with the "American Street Railway Directory." By means of this combination the new publication will have the combined circulation of both directories, its scope enlarged, and the data improved in point of accuracy and completeness.

NEWS OF THE MONTH

A recent compilation shows that the tramway companies of Great Britain are using on roads now in operation, and have ordered for roads constructing, from 2500 to 3000 American electric motors, and nearly or quite 40,000 h.p. of American electric railway generators.

The American Mica Company, which has a capital stock of $3,500,000, and which will control the output of mica in the United States, has been incorporated under the laws of New Jersey.

C. B. Wisner, secretary of the Sills Mica Company, of Chicago, when asked regarding the new corporation, stated that besides his own company the Eugene Munsell Company, of New York, and the American Mica Company, of Boston, are interested.

The Twenty-eighth and Twenty-ninth Street Cross Town line of the Metropolitan Street Railway Company is now being operated entirely by compressed air cars from the power station at the foot of West Twenty-fourth Street.

A cablegram from Glasgow announces that the Glasgow Tramway Committee on Aug. 15 accepted the tender of the Edward P. Allis Company, of Milwaukee, for the engines for its new power plant. It is said the order amounts to £114,544.

At a meeting on Aug. 16, the directors of the Brooklyn Rapid Transit Company passed resolutions complimenting President Rossiter upon his able management of the road and the masterly way in which he handled and suppressed the recent strike.

A newspaper special dispatch from Chicago reads as follows: "John M. Roach, who has been president of the Chicago Consolidated Traction Company and also general manager of the Chicago Union Traction Company, has resigned his position as president of the Consolidated Company and Charles T. Yerkes takes his place. It is said Mr. Yerkes intends to give his active attention to the Chicago Consolidated Traction Company. He has also taken into the board with him John R. Walsh, president of the Chicago National Bank, and Harvey T. Weeks, a retired capitalist and active politician, who during the days of the elder Carter Harrison was the right-hand man of the Mayor." It is stated in addition that Warren F. Furbeck, vice-president of the Consolidated Company, has also resigned and has been succeeded by L. S. Owsley.

Albert L. Johnson has given out the following interview:

"We hope to get a franchise soon to build and operate a conduit electric road from the heart of London to Brighton. Our surveys and specifications are about completed, and by the latter part of September everything will be in shape to lay before the controlling powers of London. We shall offer the people of the British metropolis very great inducements to give us the franchise we seek. There is nothing like the American sub-trolley service there, and we propose to build and equip a road in first-class style and carry passengers from London to Brighton for sixpence, which is twelve and one-half cents of our money. The present rate of fare between those two points is equivalent to $1.50 of American money."

The distance from the city limit of London to Brighton is 45 miles. From the city limits to the heart of London is about 7 miles more, so that the American syndicate offers to carry passengers 52 miles for sixpence.

The Board of Railroad Commissioners has made arrangements for a test of brakes for street surface railroad cars. Twenty-two permits have been issued for that purpose, and each person or company receiving a permit is allowed to equip with brakes one of the cars of the Metropolitan Street Railway Company, and the tests will be made, three or four on one day at Lenox Avenue and 146st Street, New York City. The first series of tests were made on Tuesday, Aug. 29, and Wednesday, Aug. 30, between the hours of 9 A. M. and 5 P. M. On these days from five to seven brakes were tested. Notice of the dates of tests to follow will be given in the daily newspapers and in the street railway publications. An invitation to be present is extended to those who are interested in the operation of street surface railroads.

An illustration of the way in which the investing public is rapidly absorbing street railway and electric lighting securities may be obtained from the fact that the United Electric Securities Company, of Boston, has, under date of Aug. 1, called for redemption at 103 and accrued interest over $600,000 of its collateral trust 5 per cent bonds outstanding. These bonds have been secured by underlaying 6 per cent first mortgage bonds of electric railway and lighting companies, which have now been sold at a substantial advance over the prices at which they were rated as collateral, and the proceeds of these sales are to be used to retire the bonds as above stated.

It is semi-officially announced that Charles P. Clark, president of the New York, New Haven & Hartford Railroad, may, on account of poor health, find it necessary to retire from that office, and his resignation is expected at the October meeting. This announcement will be received with no less regret in electric railway circles than in the steam railroad world, for it is largely due to Mr. Clark's interest and faith in the application of electricity to heavy passenger transportation problems that the experiments with the third rail and overhead systems, which have resulted in so many valuable developments, have been carried out on the N. Y., N. H. & H. R. R. It is stated, however, that Mr. Clark will still retain his position as a director of the road.

It is further announced that John M. Hall, the present vice-president of the system, will be elected to the presidency on the retirement of Mr. Clark.

The Birmingham Railway & Electric Company has voluntarily increased the wages of its conductors from 15 to 17½ cents an hour, and motormen from 12 to 15 cents an hour. The increase applies only to those who have been in the employ of the company one year or over.

The Birmingham Traction Company has voluntarily increased the wages of its employees. New motormen will receive 13 cents an hour for the first six months' service, 14 cents for the second and 15 cents thereafter. In the same manner the conductors will get 14, 15 and 16 cents per hour, according to the length of service. Heretofore motormen have been receiving 13 cents and conductors 14 cents. The company has also posted a notice that a ten-day vacation on full pay will be given in October to the motormen and conductor who shall have made the best record before that time. A second prize will also be offered.

The Little Rock Traction & Electric Company has increased the wages of motormen and conductors, who have been in the company's employ two years or more, 3 cents an hour.

The Denver Tramway Company, on Aug. 12, gave the women of the Old Ladies' Home of that city a free ride about the city. The ladies were taken to the City Park, where the company had provided luncheon for its guests.

The Derby Street Railway Company has notified its motormen and conductors who have been in the company's employ not less than five years that they will receive $2.50 a month increase; when they have been in the service ten years there will be another increase of $2.50, and then an increase of the same amount for each succeeding five years.

Corporation Counsel Robertson, of Hartford, on Aug. 8, rendered an opinion that street railways may sub-lease their lines for a freight business provided they own the cars used and that they are run by their motormen. He states that all street railways have a right to carry freight, but as to sub-letting their property, unless their charter gives them permission, they cannot do it except under the conditions named.

The trolley express between Manchester and Hartford was boycotted so persistently by the merchants of the former place that it has been discontinued.

One of the buildings of the electric light plant of the Washington Traction & Electric Company was recently destroyed by fire. The loss is estimated at $50,000. The building was used for the storage of electrical appliances, and for stable and office purposes.

The Indianapolis Street Railway Company will erect a large car plant and repair shops on West Washington street. The new buildings will be 200 ft. x 200 ft., and will be fully equipped with the necessary machinery and facilities for building street cars complete, with the execption of motors and trucks. Life guards and other supplies will be manufactured. It is understood these shops will be able to fill orders from outside companies as soon as the needs of the Indianapolis Street Railway Company have been supplied. In addition to the new plant the company has let contracts for a new car barn 100 ft. x 180 ft., on Louisiana Street. This will have storage capacity for fifty cars.

The Mayor of New Albany has appealed to the Supreme Court to compel the operation of the New Albany Railway, which was recently discontinued.

Flint & Hanlon, contractors, have commenced the work of lowering the elevated street railway of Sioux City, now the property of the Sioux City Traction Company. About 1500 ft. of this structure will be taken down at this time. The remainder will be lowered some time next year, and the material will be used in the construction of steel bridges.

The Cedar Rapids & Marion City Railway Company has put in effect a new scale of wages. All conductors who have been on a regular run for one year have been given an increase of 20 cents a day; motormen who have been on a regular run for two years receive an increase of $1 a month, and motormen having regular runs for five years past receive an increase of $2.50 per month.

The Detroit Electric Railway Company has refused the demand of the executive board of the railway employees for an increase of 4 cents per hour in wages. There has been a call for a meeting of the employees, and a strike is threatened.

Judge Lillibridge, of the Circuit Court, July 27, delivered a decision permanently enjoining the street railway companies of Detroit from carrying freight over their lines within the city. Hitherto the cars have carried freight over the city lines, although there has been no specific authority for so doing.

The report of the various street railway companies operating in St. Louis, for the second quarter ending June 30, as to the number of trips made and passengers carried is as follows:

	Trips.	Passengers.
Lindell Railway	284,856	6,470,246
St. Louis & Suburban	41,669	3,244,924
Union Depot	201,024	7,071,668
Citizens' Railway	78,970	2,375,986
Cass Avenue	153,534	2,611,273
Jefferson Avenue	36,916	382,496
Missouri	181,204	4,164,153
Southern Electric	50,346	1,688,771
St. Louis Railroad	247,140	3,274,000
Peoples' (April 1 to 11, inclusive)	6,349	97,350
St. Louis Traction Co., Peoples' Div., April 12 to June 30	44,329	766,877
Total	1,326,337	32,227,686

The officials of the Wellston, Creve Coeur Lake & St. Charles Railroad Company, of St. Louis, celebrated the completion of the line to the company's grove at St. Charles Rock and Lucas Lane, by giving an entertainment at the grove, Aug. 12.

The Metropolitan Street Railway Company, of Kansas City, is planning to build large shops for the purpose of manufacturing many of its own supplies including iron poles, fenders, etc.

The electric light companies of Hoboken, Elizabeth and the People's Light and Power Company, controlling the electric light plants in Newark, the Oranges, Montclair, Jersey City, Bergen Point and neighboring towns and villages, have beeen consolidated. The new company will be known as the United Electric Company of New Jersey. The consolidation of the electric light properties is looked upon as a step in the ultimate consolidation of the electric railway interests with the gas and eletric light companies in that section of the State. Bernard Shanley, John D. Crimmins and the Widener-Elkins syndicate are interested in the consolidation.

The Plainfield Street Railway Company and the Brunswick Traction Company have entered into an agreement for issuing transfers to each other's lines at Dunellen.

The South Orange Avenue car barn of the North Jersey Street Railway Company, of Newark, was destroyed by fire recently. Two parlor cars were destroyed, together with five snow sweepers, seven new cars for its Orange and Passaic line and sixty-two other cars. The loss is estimated at $140,000. The fire is supposed to have been caused by lightning entering the building on the trolley wires. The power house escaped serious damage.

The Canandaigua Lake Transportation Company and the Canandaigua Electric Light & Railroad Company have arranged a special feature known as "Bargain Days." On Monday and Thursday afternoons of each week the companies have arranged to carry passengers on both boat and railway at a greatly reduced price. The privilege of stopovers is also allowed.

The Augusta Railway & Electric Company will construct a park at Summerville. The proposed park will be a spacious affair of fifteen acres, situated on the Wrightsville Road in the vicinity of the old Camp Mackenzie. It will be laid off in grass plots interspersed with fountains and beds of various flowers, and the walks to be lined with shade trees. A large two-story pavilion will also be provided. The lower, or ground story of this pavilion, will be used as a car house, where will be kept an extra supply of cars, so that large crowds can easily be handled. The upper portion will be fitted up as a first-class dance pavilion of the latest design. The construction of the park is expected to begin at an early date.

The Lewiston, Brunswick & Bath Street Railway Company, of Lewiston, and the Maine Central Railroad are engaged in a rate war. The Maine Central has reduced its rates so as to conform with those of the electric railway, and an interesting war will probably be the result. The electric railway rates will probably be again cut.

The New Orleans Traction Company recently donated the receipts of one night at West End to the Charity Sewing Room of New Orleans.

President Vreeland, of the Metropolitan Street Railway Company, of New York, has granted a three days' vacation with full pay to all the conductors and motormen of the system who remained loyal during the attempted strike on July 19-20. This privilege is equivalent to a gift of from $20,000 to $25,000 from the company to the men.

The Brooklyn Rapid Transit Company has fixed the rate of pay of motormen in its employ as follows: Motormen on surface cars, $2 per day; bridge train motormen, $2.25 per day, and regular elevated motormen $2.50. The elevated motormen are composed chiefly of locomotive engineers, who accepted positions as motormen when the Fifth Avenue branch was equipped with electricity. These men suffer a decrease of $1 per day in wages.

Owing to the failure of the employees and the officials of the Chippewa Valley Electric Railroad Company, of Eau Claire, to come to an agreement on a scale of wages, the men went out on strike, and on Aug. 6 the company was forced to discontinue the operation of its cars. Many obstructions were placed on the tracks and mobs threatened the street railway property in various parts of the city.

The Milwaukee Electric Railway & Light Company has voluntarily increased the wages of employees in the company's service five years from 19 to 20 cents an hour.

The question of municipal ownership of street railways and conduits bids fair to become one of the vital issues before the Council of Richmond. It is stated the following resolution will soon be introduced: "Be it resolved by the Council of the City of Richmond, That the committee on charter changes is hereby instructed to report to this body amendments to the charter of the city of Richmond, as follows: 1. Granting power to the city to construct, or acquire by purchase, maintain and operate street railways for the carriage of passengers and freight for hire and reward, and in furtherance of such powers to issue bonds and secure the same upon such franchise, trackage, rolling stock, &c. 2. Granting power to the city to construct, maintain rent or lease underground conduits within the city of Richmond for the conduct of telephone, telegraph and other electrical conductors, and in furtherance of such powers to issue bonds and secure the same upon such conduits."

The Memphis Street Railway Company has increased the wages of motormen and conductors who have been in the company's employ one year or over from 14 to 15 cents an hour.

One of the cars of the Nashville Street Railway, while passing over the Cumberland River bridge, was thrown into the river, a distance of twenty-five feet, by a span in the bridge giving away. Fortunately very few people were injured and the car and equipment suffered little damage, considering the severity of the accident.

A daring robbery took place shortly after midnight, July 31, at the car barn of the Newport & Fall River Street Railway Company, in Portsmouth. Five masked men entered the barn, subdued and robbed the employees who were there, and then entered the office, emptying the money locker and making two unsuccessful attempts to blow open the safe. One of the employees, who was bound, after several hours succeeded in freeing himself and tried to telephone for assistance, but found that the wires had been cut. It was found necessary to dispatch cars to Newport and Fall River before the authorities could be notified. It is said that the robbers secured about $500.

The Allentown & Lehigh Valley Traction Company has decided to comply with the request of its motormen and conductors for an increase in wages. The most cordial relations exist between the men and the management, and the decision to increase the wage scale was largely influenced by the respectful manner in which the request was made. The old rate was 15 cents an hour for both mortormen and conductors. The new scale gives 15 cents an hour for the first year, 16 for for the second and 17 thereafter. This places the employees of this company among the best paid street railway men in Pennsylvania.

New Company for the Manufacture of Heavy Electrical Apparatus

A meeting of the stockholders of the Scott-Janney Electric Company, recently incorporated at Trenton, with a capital of $30,000,000, was held in Philadelphia, Aug. 21. This company is organized for the purpose of manufacturing, on a large scale, electrical apparatus and supplies, including alternating and direct current apparatus, motors, dynamos, etc., up to 2000 volts capacity, arc lamps and transformers, under patents granted to Gordon J. Scott, and will come into direct competition with the General Electric Company and the Westinghouse Company. The company has in operation a large manufacturing plant at Twenty-second Street and Washington Avenue, Philadelphia.

The Scott direct current railway system differs materially from the ordinary systems, and for it the following claims are made:

First.—It can be applied to any of the existing railway motors.

Second.—When so applied will enable the existing motors to do more efficient work.

Third.—It will enable present motors to start and accelerate a car or train of cars to maximum running speed from 30 to 40 per cent faster than at present without taking any more current, or will start them as fast with from 20 to 30 per cent less current.

Fourth.—This system does away with all jerking of cars or trains even while starting very quickly.

Fifth.—This system when used in connection with Scott railway motors, which are of a new type and very light, efficient and powerful for the size, will return 20 to 30 per cent more work at the car wheels than any other motors.

Sixth.—It makes no difference whether one or one hundred cars are in one train, as all motors in such train can be controlled from any car by fractions of a revolution, or by fractions of a pound at periphery of car wheels.

Seventh.—Any trolley system, overhead, underground, surface contact or third rail, will need only 65 to 70 per cent of the copper necessary with existing railway systems, or those which will use any other system of driving and control.

A. Langstaff Johnston, consulting engineer, has examined the workings of the system in detail, and has reported most favorably upon its merits.

The Scott-Janney Company also proposes to introduce what it calls a gaso-electric system, which it is announced contains all the advantages of an independent and self-contained motive power, secured by compressed air or storage batteries without their attendant dead weight and complicated machinery, and at greatly reduced cost for installation and maintenance.

The following officers for the year were elected: Frank Le Bar, Philadelphia; Henry A. Sage, Ogdensburg, N. Y., president of the Ogdensburg Heat, Light & Power Company; Gordon J. Scott, Philadelphia; General Frank Reeder, Easton, Pa.; Robert Alexander, Philadelphia; William B. Hill, director of the People's Trust Company, New York; Edward A. Abbott, Concord, N. H.; J. F. Tapley, New York; James B. Dill, director of the Trust Company of America, New York, and the Federal Steel Company; W. H. Wolverton, treasurer of the Bell Telephone Company, New York; Charles W. Drake, former vice-president of the Missouri Pacific Railway Company and a director of the American Trust Company, New York; Allen D. Laney, of the banking firm of Lathrop R. Bacon & Company, New York; T. Quincy Brown, president Atlantic National Bank, Boston; Daniel O'Day, of the Standard Oil Company, New York; Charles Watson, chief engineer American Sugar Refineries Company, New York; C. W. Ogden, New York; Frank R. Hansen, New Jersey; George H. B. Martin, New Jersey; William S. Janney, R. F. Lopez and Charles F. Walter, Philadelphia.

Recent Electric Roads in England

It is reported that the projected Isle of Thanet electric road will soon be built. This new line, which will be 10 miles long, will pass through Ramsgate, Margate and Broadstairs, three of the most popular English seaside resorts. The contract will probably be worth £30,000. Orders have just been sent the Edward P. Allis Company, of Milwaukee, for two 300-h.p. engines. Additional orders will also be placed with this concern.

Among English trolley lines equipped with American electric appliances is the Staffordshire Tramways Company. The Potteries Electric Traction Company, which is an extension of that line, is now nearing completion. The electrical part of the contract is worth about $100,000. The American Tube Works and Morris Tasker, of Philadelphia, supplied 1450 tubular steel poles.

Three horizontal compound condensing engines of 350 h.p. each were furnished by the McIntosh, Seymour & Company, of Auburn, N. Y. The General Electric Company made the generators. The motor trucks came from the Peckham Motor Truck and Wheel Company, of Kingston, N. Y. The insulators were ordered from the Albert & J. M. Anderson Manufacturing Company, of Boston, and all the copper was supplied by the Washburn & Moen Manufacturing Company, of Worcester, Mass.

The August issue of "Cassier's Magazine" is a special number devoted exclusively to electric railways. It contains about eighteen long articles on live street railway questions, written by as many different engineers, each an expert on the particular subject treated in his paper. Among the topics discussed are: "The Latest Developments in Electric Conduit Railways," by F. S. Pearson; "Electric Tramways in Great Britain," by Robert W. Blackwell; "Building an Electric Railway," by Lemuel W. Serrell; "Overhead Construction," by J. G. White; "The Development of the Tram Car," by John A. Brill; "Rails and Rail Joints," by M. K. Bowen; "Light Electric Railways," by Dr. Louis Bell; "The Multiple Unit System for Electric Railways," by Frank J. Sprague; "The Selection of Rolling Stock," by C. F. Uebelacker; "Storage Batteries and Electric Railways," by Herbert Lloyd; "Electric Railways in America," by W. J. Clark, etc.

Pennsylvania Street Railway Association

At a meeting of the Executive Committee of the Pennsylvania Street Railway Association, held recently, it was decided to postpone the eighth annual meeting of the association from the first week in September to Wednesday and Thursday, Oct. 4 and 5.

The meeting will be held at the Stevens House, in the City of Lancaster. Papers and addresses of interest to members of the association will be read and delivered at the first day's session, while the second day will be occupied with a series of entertainments of interest and attraction to members and visitors in attendance at the meeting.

Foreign Exports From America

The official figures of the foreign trade movement for the fiscal year ending June 30, 1899, have just been completed by the Treasury Bureau of Statistics, and show a very satisfactory improvement, both in gross and in detail. The total exports for the year amounted to $338,667,794, as against $290,697,354 in 1899. The greater part of this large increase is shown in the classes of manufactured iron and steel, which increased from $70,406,885 in 1898 to $93,715,951 in 1899. The differences in certain of the important detailed classifications appear in the following table:

	1898.	1899.
Cars and carriages	$3,424,419	$4,106,284
Copper ingots	31,075,636	34,476,343
Electrical and scientific apparatus	2,770,803	3,309,180
Steel rails	4,613,376	5,298,125
Steel wire	2,593,306	3,891,180
Builders' hardware and tools	6,428,332	7,842,372
Electrical machinery	2,052,564	2,736,110
Metal working machinery	4,618,683	6,491,586
Pumps and pumping machinery	2,023,034	2,710,654
Locomotive engines	3,883,719	4,728,748
Miscellaneous machinery	13,336,930	18,722,251
Iron pipes and fittings	3,092,016	5,874,228

Annual Report of Brooklyn Rapid Transit Company

President Rossiter, under date of Aug. 21, has transmitted to the stockholders of the Brooklyn Rapid Transit Company the annual report of the company for the year ending June 30, 1899. Mr. Rossiter fully reviews the growth of the system, and after giving the cost of consolidation of the different properties now included and the results expected to be obtained from these consolidations, he says in part:

"It can now be said of the Brooklyn Rapid Transit system that in mileage of track it is the largest street railway system in the world, comprising 504 miles, or more than twice the trackage of the Metropolitan Street Railway Company, of New York, nearly 400 miles more than the Manhattan Elevated Railway Company, of New York, 60 miles more than the Union Traction Company, of Philadelphia, and 173 miles more than the Boston Elevated Railway Company, including the old West End Company. In amount of passenger earnings it surpasses every street railroad system in the world with the exception of the Metropolitan Street Railway Company, of New York."

The combined reports of all the companies now included in the Brooklyn Rapid Transit Company (comprising the Brooklyn Heights, Brooklyn City, Brooklyn, Queens County & Suburban, Brooklyn Union Elevated, Nassau Electric, Kings County Elevated, Brooklyn & Brighton Beach, Sea View Railroad and Prospect Park & Coney Island), give for the

Year ending June 30,	1897.	1898.	1899.
Receipts from passengers	$9,343,261	$9,877,001	$11,035,216

The table given below gives the operating statement of the Brooklyn Heights Company during the year ending June 30, 1899. The figures do not include the figures of the acquired companies prior to the time of acquisition. The method of operation is to have all the companies leased to the Brooklyn Heights Railroad Company, which is the operating company, and the income of the Brooklyn Rapid Transit Company consists of the surplus profits of the Brooklyn Heights Company, and such moneys as it may receive from the stocks and bonds held by it. The figures given below include the reports of the Brooklyn Heights, the Brooklyn City, Brooklyn, Queens County & Suburban, and the Sea Beach Railway for the entire year, and the Brooklyn Union Elevated and the Nassau Electric for three months only of the fiscal year. For purposes of better comparison the figures of the leased companies for the corresponding period of the preceding year are combined with those of the Heights Company, although they were not at that time, of course, a part of the Brooklyn Rapid Transit system.

OPERATING STATEMENT, BROOKLYN HEIGHTS RAILROAD COMPANY

Year ending June 30,	1898.	1899.
Gross earnings	$6,616,361	$7,412,435
Operating expenses	4,232,206	4,669,371
Net earnings	2,384,155	2,743,064
Income from other sources	*185,459	13
Gross income	2,569,614	2,743,077
Fixed charges	2,482,349	2,289,909
Surplus	$87,265	$453,167
Per cent operating expenses to gross earnings	63.9	62.9

*Includes income from guarantee fund ($181,370), which in the succeeding year was paid directly to Brooklyn Rapid Transit Company, and did not pass through operating company's account.

INCOME ACCOUNT, BROOKLYN RAPID TRANSIT COMPANY

Year ending June 30, 1899.

Receipts.		
From interest on bonds and loans	$188,395	
From profit on bonds sold	182,001	
From miscellaneous	425	
From Brooklyn Heights R. R. Co.'s surplus	471,555	
		$842,375
Expenses.		
For interest	$338,261	
For taxes and miscellaneous expenses	41,565	
		379,826
Surplus for year		$462,549
Accumulated surplus prior to June 30, 1898		215,579
Total surplus June 30, 1899		$678,128
Deductions from Surplus.		
For new equipment and construction on railroad properties	$300,482	
For extinguishing old deficiencies of B., Q. C. & S. R. R. Co. accrued prior to its acquisition by B. R. T. Co.	321,174	
Direct to profit and loss	1,931	
		623,587
Surplus carried forward		$54,541

Plant for the Manufacture of Electric Brakes

The Hubbard Brake Company is the name of a new concern formed for the purpose of manufacturing and introducing throughout the United States an electric brake of new design, patented by M. G. Hubbard, whose mechanical ability is well known through his connection with the McGuire Manufacturing Company, of Chicago, as engineer. He was the inventor of several of the McGuire specialties, including a snow sweeper, truck, etc. The officers of the new company are: M. G. Hubbard, president and general manager; George E. Pratt, vice-president; Charles Gilpin, secretary and treasurer. Mr. Pratt has handled high-grade street railway supplies for many years, and is well known throughout the trade. Mr. Gilpin is secretary and treasurer of the Andover Iron Company, and is interested in other iron and railroad enterprises.

The company's works are located in Chester, Pa., near the freight station of the P. W. & B. Railroad, on Sixth Street. Machinery is being installed, and it is expected the works will be in operation by September 1. The company is well backed financially, and it begins operations with a number of orders on hand.

The electric brake to be manufactured has been thoroughly tested under practical conditions, and has shown excellent results. It is claimed for the device that stops can be made easily and quickly without jerking or jarring; it will prevent flat wheels; its first cost is not high, and the maintenance charges are very small; it can be operated by any motorman and from either end of the car, a small controller handle being provided for the purpose; there is no undue strain on car body or truck, as in some air brake systems, and no extra strain on the car axles, as in some disk or axle brakes.

The Hubbard Brake Company is equipping cars at Spring City, Pa., with this brake.

Street Railways in Foreign Cities

An interesting investigation upon the operating conditions of street railways in different foreign cities has recently been conducted by the Royal Trust Company, of Chicago. The information was secured by direct correspondence during the last three months with the United States Consuls, resident in the different cities, so that it can be relied upon as being up to date.

Of thirty-seven cities in various parts of the world about which information was obtained eight own and operate the transportation lines, four own the lines and lease them to companies which operate them, and in three others provision is made for municipal ownership at some future date. In eight cities passengers are permitted to stand in the aisles; in the others it is forbidden.

In a few cities, Cork, Prague and Marseilles, there is a uniform 2-cent fare, but in most cases the fare varies with distance traveled. Where information regarding franchises could be obtained an interesting variety of terms will be noticed. The data are grouped under the cities as follows:

Basle, Switzerland, electric transit. All lines built, owned and operated by the city. Fare, 2 cents for short and 4 cents for longer distances. Passengers allowed to stand in aisles and on platforms.

Belfast, Ireland, horse cars. Fare, 2 cents a mile. Standing in aisles or on platforms not allowed. Company has fourteen-year franchise and pays no bonus, but has to pave and repair middle of streets traversed by its lines.

Berlin, Germany, electric, steam and horse cars, also elevated (steam) belt line. Fare, 2½ cents for two miles and 1 cent for every additional mile. No passengers allowed in aisles, but a designated number are allowed on each platform. Companies have to pave and repair streets through which their lines run and pay a substantial bonus to the city.

Berne, Switzerland, steam and compressed air traction. Fare, 2 cents a mile. No one is allowed to stand in the aisles. Fixed numbers are allowed on platforms. City is negotiating for purchase of the company's lines.

Brussels, Belgium, electric—underground and overhead trolley—horse and steam traction. Fares from 2 to 12 cents, according to distance. No one is allowed to stand in the aisles. Cars generally divided into two compartments—first and second class.

Buenos Ayres, Argentine, electric, steam and horse traction. Underground electric line being constructed. Lines owned by British companies. Fares, 10 and 20 cents (paper). Two postmen and one policeman allowed on front platform (free); three passengers allowed on rear platform. Companies pay 6 per cent of gross receipts to city.

Calcutta, India, horse cars, but to be changed to electric cars soon. Fares, 2½ to 4½ cents. No passengers taken on after seats are occupied. Franchise runs twenty-five years; company pays a fixed amount per mile per annum and keeps middle of street in repair.

Cape Town, South Africa, electric trolley cars. Fare, 6 cents for three miles. Passengers stand on front and rear platforms, but not in aisles. Cars are "double-deckers," made by Brill, Philadelphia. Company has twenty-five years franchise; cannot learn that it cost anything.

China, there is not a street car in all China.

Christiania, Norway, one electric line (five miles) and one horse car line (four miles). Other lines under construction. City intends to buy the lines as soon as franchises expire. The city is now building a short line as a public enterprise. Fares, 2¾ cents. Fixed numbers allowed to stand on platforms, but none in aisles. Companies made no direct payment for their franchises, which expire in 1924, but pay taxes on their property like other corporations. Cars are "double-deckers."

Copenhagen, Denmark, horse and electric traction. Fare is 2¾ cents for any distance. When all seats are taken no more passengers are taken on, and conductors are heavily fined if they exceed the licensed number. Amalgamated Company pays the city a certain percentage of gross earnings.

Cork, Ireland, electric lines. Fare, 2 cents for any distance. Passengers not allowed in aisles or on platforms. Company's franchise is unlimited; it pays nothing directly, but paves the middle of the street and furnishes electric light to city at reduced rates.

Dublin, Ireland, electric traction. Fare, 1 cent a mile; minimum fare, 2 cents. Cars are "double-deckers." Passengers not allowed in aisles except in rainy weather. Company pays city $2500 a year per mile of its line for right of way and also has to pave between its tracks and one foot on either side. Franchise runs forty years, with provision that city may buy the line after twenty years, paying actual market value of machinery and plant. In case of disagreement on price, the board of trade is to be the referee.

Edinburgh, Scotland, horse and cable cars. In six months the entire system will be cable. City owns entire system, which is operated by a lessee company. Fare, 2 cents a mile, except certain popular routes, for which the fare is 2 cents, although longer than a mile. Workmen's tickets between the hours of 5 and 7 A. M. and 5 and 7 P. M. daily, and Saturdays from 1 to 3 P. M., at 2 cents for two miles and 1 cent for each additional mile. No passengers taken on after all seats are occupied.

Florence, Italy, electric and horse traction. City owns the lines and leases them to private companies. Fares, 2 cents from outskirts to center of city and 3 cents across city. Passengers allowed on platforms, but not in aisles. Lessee company has a fifty-year franchise and guarantees the city at least $12,000 a year revenue, besides contributing $400 a year to a provident institution for street car employees and $300 to a cabmen's society. Profits over 7 per cent are shared by the company and the city.

Frankfort-on-the-Main, entire system being changed to electric traction. Fares, 2½ to 5 cents, according to distance. The city recently bought the entire system, paying $550,000 down and $75,000 annually for seventeen years. There are twenty miles of lines. Fixed number allowed on platforms; no one in aisles. Considerably reduced rates given to pupils going to school or to private instructors, to swimming baths, to conservatories of music, art schools, etc. Family tickets at greatly reduced rates are issued, provided the husband's income is not over $25 a month or the wife's not over $15, and provided there is no son over twenty-one years of age.

Germany, there are still a number of cities, of 15,000 to 50,000 population, which have no street railways of any kind—Pforzheim, Trier, Ratisbon, Colmar, Jena, Kaiserslautern, Worms and others.

Ghent, Belgium, electric traction. Fares, 3 cents first-class; 2 cents second-class. Passengers allowed in aisles and on platforms. Franchise runs fifty years from Jan. 1, 1898. Company pays city 17 per cent of gross receipts annually, but not less than $3860 (which amount the company deposits each 1st day of January in advance). Franchise provides for purchase of lines by the city before twenty years or after twenty years. Franchise also fixes minimum wages of conductors and mortormen at 78 cents a day, and of workmen at 68 cents, and a maximum day's work in summer at fourteen and one-half hours and thirteen and one-half hours in winter, with an interruption of one and one-half hours for meals.

Glasgow, Scotland, has thirty-seven miles horse car service and three miles electric street railway. City owns and operates entire system. Fares, 1 cent for first half mile, 2 cents for two miles, and 1 cent for each additional mile up to six miles (longest route). No transfers given. Rule that no more passengers are to be taken on after seats inside and on top are taken, but rule is not kept. Entire system is to be made electric by 1901.

Havre, France, trolley cars (Thomson-Houston). Fares, 3 cents first-class, 2 cents second. Passengers on front platform pay second-class fare and those on rear platform pay first-class. Transfers, 1 cent extra. No one allowed in aisles. Franchise runs fifty years from 1893. Company pays city 2½ per cent on its gross receipts, but not less than $3500.

Kingston, Jamaica, electric traction. Fare, 4 cents within any section—city is divided into three sections. Fare through three sections is 12 cents. Three front seats in each car are reserved as first-class, and fare is 6 cents instead of 4 cents. Tickets sold at reduced rates. Franchise runs thirty years. Company pays government 4 per cent of gross earnings and maintains streets it occupies to eighteen inches on each side of tracks. Passengers allowed in aisles and on platforms. Market cars run before 9 A. M. and after 5 P. M. for country people carrying produce—fare, 3 cents.

Liverpool, England, electric and horse cars, also lines of omnibuses. City owns all the transit lines. Fares, 2 cents for each "stage" or zone and 4 cents for entire three stages, four miles. Passengers allowed to stand in aisles and on platforms.

Lyons, France, electric, steam and horse traction. On steam lines locomotive draws trains of three long cars. Fares, for first-class (cushioned seats), 4 cents; second-class, 2 cents. Fourteen persons allowed on front platform and same number on rear. Nobody allowed to stand in aisles. Only one door in car for both entrance and exit. General tramway company pays $16,000 fixed annual tax and also 10 per cent on all receipts in excess of $2,000,000. Franchise provides for purchase by city after forty years.

Maracaibo, Venezuela, horse cars. Three companies. Oldest one pays 3½ per cent a month profit on its capital. Fare, 5 cents. Rule against passengers standing, but not heeded. Companies paid nothing, directly or indirectly, for their franchises, which have five years yet to run.

Marseilles, France, overhead trolley system being installed on all lines. Uniform fare of 2 cents. Company paves between

tracks and fourteen inches each side; also pays city small annual fee of $19,300; and when gross receipts aggregate $1,400,000 a further fee will be paid, as follows: For the next $200,000, $7720; for the following $200,000, $9650; for the subsequent $200,000, $11,580; and $12,000 for every additional $200,000. Electric trains are limited to four cars, not exceeding 118 feet, and speed is limited to twelve and one-half miles an hour. Franchise expires in 1950, when the State becomes owner of the company's tracks and other property located on the public domain. During the last five years of the concession, should it appear that the operating company fails to maintain the property in good condition, the State reserves the right to seize all the company's revenues, for the purpose of keeping up the same. The State will have the right to take all rolling stock, tools and similar movable property at a valuation fixed by experts, but will be under no obligation to buy more than suits its purposes or wishes. Upon the termination of the concession, should the State deem it useless to continue the operation of certain lines, the concessionaires will be required to remove their tracks and restore the streets to their original condition. The State reserves the right to purchase its concession at any time. The price, in such event, will be fixed by the net annual revenue of the seven preceding years, including the fees paid to the city. From the total thus obtained will be deducted the net revenue of the two last profitable years, and the average of the five remaining years will stand as the amount of an annuity, to be paid to the concessionaires during each unexpired year of the revoked concession.

Mexico (City), Mexico, cars drawn by mules. Suburban cars are larger and are drawn to outskirts by mules and thence to their destination by small American dummy engines (steam). Company is preparing to substitute electric for animal traction, but will retain the steam lines. Managers of company are Americans. Fares for city are 5 and 6 cents according to distance. Suburban fares are 12 to 30 cents. Passengers are allowed in aisles and on rear platform, but not on front platform.

Munich, Germany, electric, steam and horse cars. All lines are owned by the city. Fares, 2½ to 6 cents on horse cars, according to distance. Passengers not allowed to stand in aisles, but limited number allowed on both platforms.

Naples, Italy, horse cars and electric trolley cars. Fare, 2 cents on two back seats and 3 cents on cushioned seats; 2 cents to stand on front platform, 3 cents on rear platform. Company has fifty-year franchise; pays percentage of net profits to the city. Electric cars made in Schenectady, N. Y.

Paris, France, thirty-three lines of omnibuses drawn by two horses (with twenty-six to thirty places), fourteen lines of omnibuses drawn by three horses (with forty places), three lines of steam tramways, twenty-three lines of horse tramways, four lines of compressed air and electricity. All of the lines are controlled by one company, which has an exclusive franchise dated 1860 and expiring 1910. In 1896 the omnibus lines carried 129,000,000 passengers out of a total of 240,000,000 for all lines. Cars and omnibuses are "double-deckers." Inside fare, 6 cents (entitles passenger to transfer ticket); fare on top and on platforms, 3 cents. Passengers not allowed in aisles.

Prague, Austria, electric and horse cars. Lines all owned by the city. Fare, 2 cents. Passengers allowed in aisles and on platforms.

Rheims, France, horse cars; but change to electric traction is in progress. Fares, 3 cents for first-class and 2 cents for second-class. One cent extra for a transfer. Number of passengers on a car fixed by law. Franchise expires in 1945, and provides that from the net profits each year the company is entitled first to receive 5 per cent upon its invested capital, while the city is entitled to 25 per cent of any surplus above the 5 per cent. The remaining surplus goes to the company, except that after the company has carried three millions of passengers the city is to receive $1.15 for every additional thousand passengers carried.

St. Petersburg, Russia, horse cars, single track. Principal line bought by city last September, and being operated by city at a profit. The city has suits pending to obtain permission of other lines, when electric traction will be installed. Cars are "double-deckers." Fares, 2½ and 3 cents. A dozen different lines but no transfers. Passengers allowed in aisles and platforms. Cars slow down but seldom stop for passengers to get on or off.

Stockholm, Sweden, horse and steam traction. Fare, 2¾ cents. Five persons allowed on front platform, six on rear and ten inside. Company's franchise runs forty years from 1876. Company is taxed 5 per cent on its income.

Stuttgart, Germany, electric traction. Power furnished by a separate electric lighting company. Fares, 2 1-3 to 6 cents, according to distance. Cars are limited to a fixed number of passengers, but exceptions are made in case of storm, after theater, last night car, etc. Company pays city 2½ per cent of gross receipts.

Sydney, Australia, electric, steam and cable traction. All lines owned and operated by the government of New South Wales. Fare, 2 cents a mile. Laws against overcrowding are disregarded.

Tegucigalpa, Honduras, no street car in the country and only one railroad, fifty miles long.

Toronto, Canada, electric traction. Fares, 5 cents; after midnight, 10 cents. Tickets, six for 25 cents, or twenty-five for $1. Also tickets good from 6 to 8:30 A. M. and 5 to 6:30 P. M., eight for twenty-five cents. Sunday tickets, seven for 25 cents. School children's tickets, ten for 25 cents. Children under nine years, (not in arms), half fare. Passengers allowed in aisles and on platforms. Company's franchise given for twenty years with a renewal of ten years. Company pays city $800 a year for every mile of single track; also pays 8 per cent of gross receipts up to $1,000,000 and 10 per cent above $1,000,000. Company is also taxed upon its plant, poles, etc., except track.

Victoria, British Columbia, electric trolley cars. Fare, 5 cents. Passengers allowed to stand in aisles and on platforms. Franchise given for fifty years, for which the company pays nothing, either in the way of taxes or bonus.

Winnipeg, Manitoba, electric trolley line. Fare, 5 cents. Passengers taken on regardless of seating capacity. Franchise granted 1893 for thirty-five years without bonus or conditions, except that after eleven years the company must pay the city 5 per cent of its gross earnings and pave its track (8 ft.) uniform with pavement laid by the city.

Westinghouse Electric Company Abroad

The plans for the erection of a large factory for the construction of electrical machinery in England by Mr. Westinghouse, as outlined in the Street Railway Journal last month, seems to have attracted the liveliest sort of interest among English manufacturing circles. London "Engineering" publishes a long editorial on the subject, in which it advises the English manufacturer to consider well the growing competition of American manufacturers, which competition has increased owing to the readiness with which the American manufacturer introduces improved methods and tools to facilitate his work. It regards the establishment of the proposed works in England by Mr. Westinghouse as a most important step in the history of manufacturing in England, and as beneficial to the English manufacturer in that he will be able to study American methods close at hand. The adoption of these methods is regarded as essential to the maintenance of English prestige.

In a recent interview with Mr. Carnegie on the subject, published in the London "Daily News," that prominent operator says that, if permitted by the British workman to introduce American methods, the success of Mr. Westinghouse in his Manchester establishment will be undoubted. He also adds, apropos of the increasing use of electric power, that at the Carnegie works in Pittsburgh all kinds of motive power are being discarded in favor of electricity.

Company for Making Veneer

The Seguine-Axford Veneer Company is the name of a new corporation organized to manufacture veneer for street car and railroad car ceilings, sides, backs, ends and seats, and in fact all the articles for which veneer can be used. The manufacture of veneer for car use will form a very large proportion of the company's business, and it will make a specialty of this class of work.

The general manager of the company is W. P. Seguine, who for many years was connected with the Frost Veneer Seating Company, and who is a well-known expert on the subject of the manufacture and use of veneer. Associated with Mr. Seguine are E. K. Seguine and William Baldwin Axford. The company's factory and office are located on Pacific Avenue, Jersey City, N. J., and its cutting mills are at Harriman, Tenn. The company will also make a specialty of the manufacture of wood tiling.

The Hipwood-Barrett Car & Vehicle Fender Company, of New York, has just recently opened in Chicago, a branch office in the Marquette Building, room 449. All the western business will be handled from this office, which is under the management of George E. Weiler. The office has already had credited to its efforts orders from the Montreal Park & Island Railway Company, of Montreal, and also from the Metropolitan Street Railroad Company, of Kansas City.

Large Power Station in Colorado

One of the latest power plants to be placed in operation in the West is now running at La Bella, Col., and will be used to operate the Florence & Cripple Creek and Golden Circle railroads, and to supply power, water and light to the mines, mills, samplers, etc., of the Cripple Creek District. The building proper covers a space of about 10,000 sq. ft. and is 50 ft. high.

In the boiler room are to be found six large boilers of the Babcock & Wilcox type, arranged in three batteries. These are of 3000 h.p. capacity under normal conditions, and should the service require, they can deliver, readily, steam for 4500 h.p. The boilers are arranged in a very novel manner, for instead of being constructed directly upon masonry foundations, as would ordinarily be done, they are mounted on elevated steel beams and a space is thus left underneath all of them. Instead of carrying the smoke and gases to the stack over the boilers, in the usual way, they are carried downward into this basement space left beneath, and thus taken to the stack. The space above the boilers is thus left perfectly clear and nothing is visible in the boiler room to indicate the presence of a flue. The heat and the obstruction of the large flue is thus done away with in the boiler room. The space above the boilers is entirely clear for the steam pipes and valves and these are readily accessible. A further use is made of the basement under the boilers in the handling of ashes. Instead of drawing the ashes from the fires into the room, they are dropped into the basement to an ash conveyor and are carried directly to the cars on the track on the outside of the building. The stokers are of the Babcock & Wilcox type, having an endless chain grate.

Extending the full length of the building and adjoining both the boiler room and the pump room is the engine room, this room is 110 ft. long and 45 ft. wide and contains a large compressor and three large engines, driving electrical generators. The combined engine capacity is 3000 h.p. Over the entire engine room spans a powerful traveling crane; by a novel design this crane is made to extend out of the building and overhang the railroad track and wagon road so that any piece of machinery is readily transferred to any portion of the engine room. One of the conspicuous features of the engine room is the large compressor, this is of the Ingersoll-Sargent make and is driven by an Allis Corliss engine. The compressing cylinders and the steam cylinders are both compound and the steam cylinders are condensing. The high pressure air cylinder has a diameter of 22 ins., while the low pressure cylinder has a diameter of 40 ins., both having a stroke of 48 ins. The capacity of the compressor being some 5000 ft. of free air per minute, fifty drills could be operated, and even at the high altitude of 10,000 ft. above sea level, thirty-five drills can be operated.

Adjoining the compressor are the large engines coupled to the huge generators of electricity. The electric power will be used to operate the Florence & Cripple Creek Railroad from Alta Vista to Cripple Creek and the Golden Circle Railroad from Victor to Cripple Creek via Vista Grande. The surplus power will be used to operate the hoists, pumps, compressors, crushers, etc., in mines, mills, samplers, etc., throughout the district. The engines are of the horizontal compound condensing type and were built by McIntosh, Seymour & Company, of Auburn, N. Y. The normal capacity of each engine is 750 h.p.; they are, however, capable of supplying 1100 h.p. each when occasion demands. The main shaft of the engines carries the electric generators, this shaft being 16 ins. in diameter. The generators were built by the General Electric Company, of Schenectady, N. Y. These machines are of the latest type and generate a three-phase alternating current of 6600 volts at 3600 alternations per minute. This is reduced to 440 volts by transformers.

Test of Kinetic Motors

A test of a new double truck motor car, recently built by the Kinetic Power Company, was made Aug. 17, on a 7½-mile branch of the Long Island Railroad, near Babylon, N. Y. The trial was witnessed by a number of foreign consuls, who had expressed an interest in the system, together with the representatives of several of the technical papers. The road upon which it was conducted is part of the "Garden City extension" of the Long Island Railroad, formerly operated by steam locomotives, but now operated by the Kinetic motor car mentioned, which makes several trips daily.

The car was recently built by the Jackson & Sharp Company, and one truck is equipped with two 8 in. x 12 in. cylinders, while the other truck is an idle one. The reservoir, or boiler, is carried under the car body between the trucks, and is stored with hot water at a pressure of about 160 lbs., from a stationary boiler before starting. A small fire is carried to make up for the heat lost by radiation, and the steam is exhausted into a condenser, located on the roof. The steam pressure is reduced to about 30 lbs. before being admitted to the cylinders. On trial the car ran the length of the route, 7½ miles, in fifteen minutes, though faster time than this has been made.

After the trial the visitors were afforded an opportunity of riding over the local street railway system in Babylon, which is also operated by Kinetic motor cars.

Stillwater-Mechanicville Street Railroad Company

The Westinghouse Electric & Manufacturing Company has completed the electrical equipment of the Stillwater-Mechanicville Street Railroad Company. The power house is at the northern end of the line at Stillwater, whence the tracks are run southward, following the Hudson River 9 miles through Mechanicville to Waterford, forming a junction with the Troy City and Albany lines. The railroad passes through an extremely picturesque country, attracting much traffic from the lovers of nature, and is a favorite route for excursion and pleasure parties from Albany and Troy. The track is mainly level, the maximum grade being 7 per cent for 400 yds. The roadbed is first-class, 90-lb. girder rails being used in the town sections, and 75-lb. T rails on the country roads.

Power is obtained from the Hudson River. A wooden dam at Stillwater gives a 7-ft. head, the water being piped to the power house to operate two 250-h.p. Leffel turbines, which run at 500 r.p.m. The turbines are both geared to the same shaft, revolving the shaft at about 160 r.p.m. Under this shaft is direct connected a 250-kw. Westinghouse direct current "engine type" generator, 550 volts. At the other end of the shaft is a friction clutch, which, when occasion requires, direct connects the generator to a 250-h.p. steam engine. The steam power is for use when the flow of water in the Hudson is insufficient to operate the turbines. A booster is installed to raise the voltage at the southern end of the line. All the cars have Westinghouse electric motors, the smaller cars have two 25-h.p. motors. There have recently been added four open and three closed cars to carry eighty passengers; these larger cars are equipped with two 35-h.p. Westinghouse motors.

Electric Railway Contracts in England

A contract has been signed with the British Thomson-Houston Company, Ltd., covering the electrical equipment, engines, cars, trucks, etc., for that portion of the London United Tramways upon which it has been resolved to introduce electric traction, in Hammersmith, Chiswick, etc. The contract includes six 250-kw. 550-volt direct-current traction generators and one 500-kw. 94-r.p.m. 5000-volt three-phase generator, driven by vertical Corliss engines; thirteen 75-kw. 5000 volts primary, 330 volts secondary, static oil-cooled transformers; four 200-kw. 500-r.p.m. 550-volt rotary converters; one motor generator set, consisting of a 500-kw. three-phase synchronous motor, direct coupled to two 250-kw. direct-current generators on combination bed plate; two 75-kw. 400-r.p.m. 525-volt direct-current generators for lighting purposes; also complete switchboards for the whole plant, and 100 cars of top-seat pattern, each mounted on two trucks and equipped with two G. E.-58 motors. Series-parallel controllers and magnetic brakes are also included in the contract.

It is intended to have the new service in operation next June.

The Bristol Tramway Company has also recently signed a contract with the British Thomson-Houston Company, Ltd., for four 500-kw. tramway generators coupled direct to vertical cross compound engines of the Corliss type, together with three 30-kw. motor generators, and two 50-kw. lighting machines; also a complete switchboard for this machinery, 150 single-truck double-deck cars complete, each of which will be equipped with two G. E.-52 motor, series-parallel controllers and magnetic brakes.

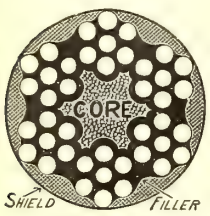
Other recent orders include thirty G. E.-52 double motor equipments, with electric brakes, for the Sheffield corporation; eight cars with Peckham trucks, G. E.-52 double motor equipment and electric brakes, for the Ashton-Under-Line; eleven cars, with Peckham trucks, G. E.-52 double motor equipments and K-10 emergency stop controllers, and the complete equipment of the Isle of Thanet Electric Railway. This will include about 1000 kw. in generator capacity.

The business of the Vulcanite Fibre Company, of Wilmington, Del., has grown to such an extent that the management has been compelled to add to its already large works. The new building will be a three-story brick addition to the old factory, and will be 135 ft. x 30 ft. Frank Taylor, of this concern, reports that they were never so busy in the history of the company as at present.

Protection of Wire Ropes

Wire rope for operative purposes is used in so many widely different ways, and is subjected to so many varying conditions, that the preparation of an exterior protective coating for ropes of this nature has presented a serious problem. A dry atmosphere, tending to speedy oxidation, brittleness and consequent peeling off of the coating, presents itself in one location; while in another, a moist atmosphere, or possibly a continuous subjection to water, sometimes impregnated with acid, prevails. In addition, most exposed wire ropes are subject to the extremes of winter and summer.

The illustration herewith presented shows the application of a special coating termed "Wire Rope Shield," which, it is claimed, possesses the requisites of a satisfactory coating, in being tenacious, pliable, lubricating and water and acid proof. The high points of the strands are protected from abrasion by a lubricating film deposit, and a like deposit prevents the chafing of the wires. The satisfactory use of this shield on wire ropes leading from an office building to an extremely wet mine, strongly impregnated with acid, and to dredging machinery constantly subjected to water, indicates its efficiency. The "filler" shown in the illustration is a flexible, cushioned lubricant, protecting the strands from abrasive wear, and reinforcing the work of the shield, in effectually sealing the rope against water soaking, acid or gaseous attacks. The Ironsides Company, of Columbus, Ohio, manufactures this shield and filler.



SECTION OF ROPE

Drawings of Electrical Apparatus

The "Electrical World and Engineer," of New York, announces that at the request of the German publisher, it will accept American subscriptions at the German price (20 marks, or $5, for each portfolio) for Prof. E. Arnold's two portfolios of working drawings of electrical apparatus.

The portfolios are sold separate. One contains sixty-four sheets 16 ins. x 21 ins. in size, of dimensioned drawings of direct-current dynamos and motors; and the other forty-eight sheets of the same size, giving dimensioned drawings of single and polyphase alternating current machines and transformers. The drawings show the machines of the leading manufacturers of Europe, more than twenty firms being represented.

Subscriptions will be received until Sept. 15. The portfolios will be delivered within a month later.

The Victoria Hotel

In the Victoria Hotel delegates to the convention will find a pleasant home during their stay in Chicago. It is adjacent to convention headquarters and centrally located on Michigan Avenue facing the Lake Front Park, where a fine view and a cool lake breeze add to the attractions of its rooms. The cuisine and service throughout are unexcelled.

The Victoria is conducted on both the American and European plans and makes special rates for delegates.

Elastic Self Locking Steel Nut

Numerous ingenious arrangements for securing a self-locking nut for bolts have been suggested, but few of these have been successful in procuring the desired results under all conditions of strain and vibration. The National Elastic Nut Company, of Milwaukee, Wis., however, is now placing on the market what it calls an "elastic" nut, and which it claims will positively lock itself on the bolt wherever placed, and never work loose.


SELF-LOCKING NUT

This result is obtained, it is stated, by the peculiar construction of the nut, which, instead of being punched from a solid bar, as is usually done, is made by bending a flat thin bar around into a ring, and then pressing this ring into the form of a nut, which is done by special machinery. The nut is tapped, or threaded slightly smaller than the bolt, so that when put on with a wrench it is distended a little, and the joint formed by the coming together of the two ends of the ring opens slightly (about 1-64-in.), developing a constant grip on the bolt which prevents it from unscrewing.

Recent Work of the Falk Company

The Falk Company, of Milwaukee, Wis., reports that its construction department has been extremely busy this season. Some of the work done has been the completing of the Oshkosh & Neenah Railway, owned by the Citizens Traction Company, of Oshkosh. The line embraces 17 miles of track and overhead work. The Falk Company had the contract for the complete construction, including grading, power house, etc., and the furnishing of all material and machinery. George Kobush, of the St. Louis Car Company, is president of this company. The Falk Company also laid the greater part of the existing track in Oshkosh. In Kansas City, Mo., this company has completed laying the 2 miles of track in Grand Avenue, where a 9-in. rail is laid in concrete beam and with asphalt pavement. It has also nearly completed the construction of the Northeast Electric line in Kansas City, which is 8 miles long and is partly laid with concrete beam and partly with tie construction, and asphalt paving.

The company has also recently secured a contract for track construction of the Third Street line in Kansas City, Kan., 2¾ miles in length. All of the track mentioned in the two cities is cast-welded. In addition contracts have been secured and work will be commenced soon on the welding of 7 miles of track for the new East Side Electric Railway in Kansas City, Mo.

The special work department of the Falk Company was crippled by its recent fire. However, the new buildings upon which work was begun immediately, are nearly completed and will be turning out work within sixty days. These new buildings are all modernly equipped throughout. All machinery will be operated by electric motors. In addition to the Third Avenue welding now nearly completed in New York, the company has the contract for welding 5000 joints for the Union Railway Company, of New York, also the contract for welding the lines of the North Hudson Railway Company in Hoboken, N. J., 2000 joints for the Canton & Massilon Street Railway in Ohio, and is beginning the work of welding 6000 joints in Washington, D. C., for the Anacostia & Potomac River Railway.

The company's gear and pinion department has been running night and day for weeks, and in addition to its large American business, has also secured a number of good contracts abroad, among these being a second order from the Société de Anonyme des Tramways de Cairo.

Reorganization of a Prominent Boiler Company

The National Water Tube Boiler Company, of New Brunswick, N. J., is now in a better condition than ever before to supply the increasing demand for its type of boilers. A reorganization of the company has recently been effected, new capital introduced and the new owners will spare no efforts to sustain and even increase the enviable reputation enjoyed by the former company for careful and painstaking workmanship and excellency of materials employed in all departments of the plant. Mr. Schenck, the former manager, will continue to act in that capacity. He is thoroughly acquainted with the workings of the business, as a result of his wide experience, and will no doubt do much to improve the condition of the concern.

The new directors of the company are: Hugh McKeag, Philip Weigel, Jr.; Robert J. Smith, P. M. Welsh, P. G. Polhemus, C. A. Schenck and Hugh Boyd. The officers are: President, Hugh McKeag; vice-president, P. G. Polhemus; secretary and manager, C. A. Schenck; treasurer, Philip Weigel, Jr.

Personal

MR. ROBERT O. HARRIS has resigned the position of counsel for the Massachusetts Electric Companies.

MR. E. H. JENKINS has been elected president of the San Antonio (Texas) Street Railway Company, vice W. H. Weiss, resigned.

MR. P. A. B. WIDENER has resigned from the presidency of the board of managers of the Philadelphia National Export Exposition.

MR. A. C. GARDINER, treasurer of the Dartmouth & Westport Street Railway Company and secretary and treasurer of the

Union Street Railway Company, of New Bedford, has resigned both positions, to take effect Sept. 1.

MR. ARTHUR WARREN, manager of the advertising department of the Westinghouse Electric & Manufacturing Company, returned from Europe on Aug. 5.

MR. GEORGE F. SIEBEL will have charge of all the street railway companies centering in Taunton, Mass., that are owned by the Massachusetts Electric Companies.

MR. E. S. DIMMOCK has been appointed general manager of the Bay Cities Consolidated Railway Company, of Bay City, Mich., in place of Mr. S. L. Nelson, resigned.

MR. JAMES H. WILSON, president and general manager of the Mobile Light & Railway Company, Mobile, Ala., has been taking a short vacation at Asbury Park, N. J.

MR. C. N. DUFFY, formerly treasurer of a number of street railway properties in St. Louis, has, it is reported, accepted a position in Chicago under Mr. D. G. Hamilton.

MR. H. R. FEHR, of Easton, Pa., has accepted the position of superintendent of the Easton, Palmer & Bethlehem Electric Railway. Mr. Fehr has been city engineer of Easton since 1891.

MR. BROOKS CLARKE, formerly connected with the Atlanta Consolidated Street Railway Company, Atlanta, Ga., is now with the Macon Consolidated Street Railway Company, Macon, Ga.

MR. WILLIAM B. GIVEN, receiver of the Pennsylvania Traction Company, of Lancaster, Pa., has been appointed a Commissioner from the State of Pennsylvania to the Paris Exposition of 1900.

MR. F. A. BARR has succeeded Mr. F. W. McClement as manager of the Winston-Salem Railway & Electric Company, of Winston, N. C. The property has recently passed into the hands of new owners.

MR. F. A. HUNTRESS, manager of the Halifax, N S., Tramway Company, has returned from a trip to the West Indies, where he has been looking over the field, with a view to securing street railway franchises.

MR. C. W. FOOTE has resigned the superintendency of the Zanesville Electric Railway, to take effect Sept. 1, and has accepted the general managership of the Cincinnati & Miami Valley Traction Company.

MR. JOHN C. DOLPH, general sales agent of the Sterling Varnish Company, returned Aug. 4 from a four months' trip to Europe, during which time he has largely extended the business of his company abroad.

MR. NATHAN E. CAPEN has been elected superintendent of the Easton, Palmer & Bethelehem Street Railway to succeed W. E. Cox, who resigned July 1. Mr. Capen was formerly assistant superintendent of the road.

MR. N. W. L. BROWN, superintendent of construction, Atlanta Railway & Power Company, Atlanta, Ga., has resigned this position, which he has held for many years, to go into the cotton seed oil business in Alabama.

MR. ISAAC L. RICE has been forced to resign his position as president of the Electric Storage Battery Company owing to pressure of other duties. He has been succeeded by former First Vice-President George H. Day.

MR. GARRETT A. HOBART, having sold his holdings in the Paterson (N. J.) Street Railway Company, has handed in his resignation as president of the company. It is understood that Mr. David Young will succeed him.

MR. R. F. FOX, general manager of the Wilmington, Del., City Railway Company, has resigned. Mr. Fox will be succeeded by Joseph C. Lugar, formerly superintendent of the Roxborough, Chestnut Hill & Norristown Railway Company, of Philadelphia.

MR. A. E. WORSWICK, chief engineer in charge of the construction of the Mexico City electric lines, in behalf of Wernher, Beit & Co., of London, arrived in New York, on Aug. 11, from Mexico, joining here Mr. W. B. Rommel, who arrived from London on Aug. 8.

CAPT. ROBERT McCULLOCH, who for many years was manager of the St. Louis street railway system, owned by the National Railway Company, of Chicago, has severed his connection with this system, and, it is announced, will accept a position at Chicago under Mr. D. G. Hamilton.

MR. H. C. BENAGH, who has been superintendent of the Savannah, Thunderbolt & Isle of Hope Railway Company, of Savannah, Ga., and who has left this position to go to Nashville, was presented on the eve of his departure with a handsome silver tea service of six pieces by his former employees.

MR. SALVADOR POTIS, for many years chief engineer of the West Chicago Street Railway Company, has recently been selected chief engineer of the Illinois Telephone Construction Company, and will have full charge of the work of laying conduits and installing exchanges; his local office being at 746 The Rookery, Chicago.

MR. W. J. JOHNSTON, formerly proprietor of the "Electrical World," left New York recently. He intends to make a tour around the world, spending some time in Hawaiian Islands, Japan, China, India, Egypt, etc., and a visit to Manila is also in his itinerary.

MR. A. K. BAYLOR has resigned his position with the British Thomson-Houston Company, but will be for some time yet to come in close touch with its management in completing various contracts which have been taken during his incumbency. Mr. Baylor is now in America, but will return to London early in September.

MR. WILLIAM C. WHITNEY has returned to New York after a six weeks vacation trip, where he appears to have regained his health completely. He states that while abroad he heard of the so-called strike on the Metropolitan system, but had no uneasiness about it, realizing the system was left in hands entirely competent to manage it.

MR. GEORGE E. PRATT, who has been representing for some time past the Ajax Metal Company, with headquarters at Philadelphia, is now connected with the Hubbard Brake Company, a new concern recently formed for the manufacture of an electric brake of novel design, and which is briefly described in another column of this issue.

MR. C. A. INGLE has resigned his position as general manager of the Taunton Street Railway Company, of Taunton, Mass. He has accepted a position with the Pratt & Whitney Machine Company, of Hartford, Conn. On the last day of his services with the old company Mr. Ingle was presented with a gold watch and chain by his former employees.

MR. H. S. KEMP has accepted the place of superintendent of maintenance with the Staten Island Electric Railroad Company, in place of Mr. J. H. Sims, resigned. Mr. Kemp held a similar position with this company, but resigned about a year ago to become Eastern representative for the Gold Car Heating Company, which position he now leaves to return to Staten Island.

MR. AUSTIN E. SMITH, manager, treasurer and director of the Springfield Street Railway Company, of Springfield, Mass., died very suddenly on Aug. 8. Mr. Smith has been connected with this company for over twelve years, having entered its employ first as cashier. He rapidly rose to positions of greater responsibility until at the time of his decease he held the three offices mentioned above.

MR. GEORGE A. THOMSON, who was formerly connected with the Short Electric Railway Company, the Forest City Electric Company and other well known Western concerns, has been appointed Eastern representative of the Adams-Bagnall Electric Company, the well-known arc lamp manufacturers, in place of C. W. Phipps, resigned, and is now established at the company's New York office, 222 Havemeyer Building.

MR. W. B. ROMMEL, engineer with Wernher, Beit & Co., of London, arrived in New York on Aug. 8, and remains here until about the middle of September. While in this country he will purchase apparatus and material for the electrical equipment of the Lisbon (Portugal) tramway. Mr. Rommel will reside in Lisbon for a period of three years or more, having undertaken the management of the Lisbon tramway system. He is accompanied on his American trip by Mrs. Rommel.

MR. H. H. VREELAND, president of the Metropolitan Street Railway Company, of New York City, on Aug. 12, gave the heads of departments of his system an outing on the grounds of the Tonetta Outing Club, near Brewsters, N. Y. The party arrived on special cars, and were taken in carriages to the club grounds at Tonetta Lake, where a clambake was prepared. A sail on the lake was followed by a drive of three miles to "Rest Awhile," the country home of Mr. Vreeland, where the party was received by Mrs. Vreeland and several young ladies. Luncheon was served on the piazza and lawn.

MR. CHARLES N. BLACK, who has been for several years connected with the Brush, Walker and Westinghouse interests, has retired from the service of the Westinghouse Company in order to engage with Ford, Bacon & Davis, the well known consulting engineers of New York city. Mr. Black is well known as one of the ablest designers of arc lighting machines in the country, one of his prominent achievements in this direction being the design of the 125-h.p. Brush arc machine, which has made a remarkable record throughout the country, and has been installed in large numbers in Brush stations. Mr. Black is a graduate of Princeton University, class of 1888.

MR. OSCAR T. CROSBY, who has been delayed in this country for several weeks longer than expected on account of the organization of the Washington Traction Company, sailed for England on the St. Louis Aug. 9. He will be at the Savoy Hotel, London, for some weeks, and will then travel quite extensively. He is particularly looking forward to an extended sojourn in Africa, where he may penetrate some of the regions rarely visited by tourists, including Abyssinia and the Soudan. It is Mr. Crosby's intention on returning to this country, six months or more hence, to devote his entire time to sociology and other studies in which he has long been interested.

MR. W. F. FURBECK, who has been long associated with Mr. Charles T. Yerkes in his street railway interests in Chicago, has resigned the position of private secretary to Mr. Yerkes, and will probably also resign all other positions he now holds with the street railway companies. Mr. Furbeck is a director and vice-president of the North Chicago Street Railway Company, vice-president of the Chicago Consolidated Traction Company and also a member of the executive board of the Lake Street Elevated Company. He intends to engage at once in the banking business.

DR. J. S. LAWRENCE, president of the Charleston Consolidated Railway, Gas & Electric Company, of Charleston, S. C., died at Capon Springs, W. Va., on Aug. 5. He had been ill for several months, and had recently returned from a trip to Europe in an unsuccessful effort to regain his health. Dr. Lawrence was a resident of Washington, D. C., for many years, until in 1896 he secured control of the horse car lines in Charleston, S. C., and converted them into a large and excellently equipped system, ranking among the best in the South. In 1897 he built the Charleston & Seashore Railroad and founded one of the largest amusement parks in the country on the Isle of Palms. These properties were both very successful financially, and in the early part of this year he consolidated all of the street railroad, gas and electric light properties.

MR. GEORGE HENRY WHEELER, formerly president of the Chicago City Railway Company, died very suddenly on Aug. 11, at Plattsburg, N. Y. Mr. Wheeler had been one of Chicago's leading business men for over forty years, and had been closely identified with several important local enterprises. He was born at La Porte, Ind., on August 1, 1841. He moved with his parents to Chicago in 1849, and his early education was obtained in the public schools of that city. After taking a college course at Racine, Wis., he returned to Chicago in 1860, and entered into business with his father. He became connected with the Chicago City Railway Company in 1891, and in that year was elected its president. He continued as the executive head of the entire system until about three years ago, when he was forced to retire by failing health. Mr. Wheeler was a member of the Chicago and Union League Clubs; also a prominent figure in the Board of Trade; a director in the World's Columbian Exposition in 1892-3, and a director of the Continental National Bank.



GEORGE HENRY WHEELER

MR. HENRY M. RANSOM, who is one of the youngest, yet one of the most popular and more successful salesmen, in the street railway industry, has left his position with the Consolidated Car Heating Company, to take the office of purchasing agent for the International Traction Company, of Buffalo. Mr. Ransom was born in 1870 in Albany, and was educated at the Albany Boys' Academy. He entered the employment of the Ransom Stove Company at the age of eighteen, and in 1893 held the position of shipping clerk. In that year he went with the Consolidated Car Heating Company, of Albany, representing that concern in the electrical branch of its business. At that time electrial heaters were practically unknown to roads in general, the Consolidated Company having its heaters on but four roads, operating from one to sixteen cars. At the present time in the territory alone just left by Mr. Ransom Consolidated heaters are used on over 200 roads, the total number of cars equipped being over 5000.

AMONG THE MANUFACTURERS

ROGER W. BABSON, banker and broker, of Worcester, Mass., is making a specialty of Massachusetts street railway bonds.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has removed its New York office from 20 Broad Street to the fifteenth floor of the American Surety Building, 100 Broadway.

THE JOSEPH DIXON CRUCIBLE COMPANY, of Jersey City, is out with another handsome brochure, finished in colors, describing graphite and its uses. Graphite makes an excellent lubricant for engine bearings and valves.

THE AMERICAN ELECTRICAL WORKS, of Providence, R. I., is sending out invitations for its annual clam bake. The invitations are engraved on thin sheets of copper, and announce that the twenty-first annual clam dinner will be held at Pomham Club, on Saturday, Sept. 9, 1899.

THE PACKARD ELECTRIC COMPANY, of Warren, Ohio, the well-known manufacturers of incandescent lamps and transformers, announce that Messrs. Mayer & Englund, of 10 South Tenth Street, Philadelphia, Pa., have taken the agency for its incandescent lamps for the street railway field.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, announces by card that its New York office has been removed to the American Surety Building, 100 Broadway. At the bottom of the card announcing the change is the very significant statement: "160,000-h.p. hours are stored daily in chloride accumulators."

THE AMERICAN ENGINE COMPANY, of Bound Brook, N. J., has just received an order from the Hollingsworth & Whitney Company, of Waterville, Maine, for the entire engine equipment of its new mill, consisting of two special 300-h.p. double engines and a 125-h.p. engine, and also a complete 75-kw. electric generating plant.

THE LORAIN STEEL COMPANY, through its Chicago representatives, Littlefield & Mysenburg, has secured the order for 100 Dupont trucks for the Indianapolis Street Railway Company, at Indianapolis, Ind. The western agents report that this truck is becoming more and more popular and that business in the western territory is extremely promising.

THE EDWARD P. ALLIS COMPANY, of Milwaukee, Wis., describes recent improvements in its well-known system of engines in a handsomely prepared pamphlet of 183 pages. The more prominent types of its latest horizontal and vertical engines are shown in full page engravings. To purchasers of apparatus for power plant the catalogue will be of great value.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY'S bulletin, No. 2734, for August, is devoted to "Bullock Engine Type Generators." These are designed to meet the demand for a slow rotative speed machine for direct connection to either steam or gas engines or water wheels. Any one interested in apparatus of this kind should send for this August bulletin.

MARLIN & COMPANY, Inc., of Pittsburgh, Pa., are receiving a rush of orders for their specialties consisting of exhaust heads and pipes, portable tanks for storage of oil, ice cans, filters, cornices and skylights, etc. The Marlin exhaust head especially is receiving attention from steam engineers and is being sold in all parts of the country. This apparatus was fully described in the Street Railway Journal for April, 1899.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has just received a heavy stock of the Standard trolley wheels as made by the Central Union Brass Company. These wheels are finely finished, ample in size and are claimed to give lasting service from fact of excellent metal used in their construction, combined with the peculiar arrangement of strengthening webs. Easy running is secured by use of the best grade of graphite bushings.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has the contract for erecting the new car barn for the New Bedford, Middleboro & Brockton Railway Company. In connection with the car barn there will be an engine and boiler room of the same construction. The Syracuse Construction Company has also placed the order for its bridge over the D. L. & W. R. R. at Syracuse, N. Y., with the Berlin Iron Bridge Company.

LEONHARDT WAGON MANUFACTURING COMPANY, of Baltimore, Md., reports that it never has been so busy as during the last seven months in building its special lines of tower and emergency wagons, both for foreign and domestic orders. These wagons are growing steadily in favor with the trolley lines in all sections of the globe, as is demonstrated by receipts of duplicate orders and the complimentary testimonials sent in unsolicited.

GEORGE W. LORD, of Philadelphia, the manufacturer of Lord's boiler clensing compound for reducing scale, is running his factory to its fullest capacity to keep up with orders in hand. These compounds are being rapidly introduced in various countries as well as in the United States. Among recent orders is one from Brazil for 10 tons, this being the third order from the same party. Mr. Lord would be pleased to correspond with any one having trouble with their boilers from scale or other causes.

ROBERT H. DERRAH, of Boston, the well known expert in arranging trolley excursions, is meeting with great success in his new venture in Boston. Mr. Derrah makes arrangements with the different street railway companies in suburban Boston for running special excursion cars three or four times a week, and these have been very well patronized. On these tours everything is done to make the excursionists comfortable, and they are relieved of all care or anxiety regarding connections, refreshments, etc.

ELMER P. MORRIS & COMPANY, of New York, in line with their policy to add to their list of agencies, the best materials in the street railway field, have made arrangements for handling the products of the Wagenhals Manufacturing Company, of Cincinnati; the Mundel Electric Works, of Springfield, and the Spiral Journal Bearing Company, of St. Louis. Mr. Morris reports a very heavy business during the past month, the demand for poles and bonds being especially good. Several large orders from foreign countries have also been filled.

THE BUFFALO FORGE COMPANY, of Buffalo, N. Y., has published a pocket edition of its general catalogue describing the many specialties handled by this concern. These include horizontal and upright steam engines, mechanical draft, heating, ventilating and drying fans and apparatus, blowers and exhausters, blacksmith drills, punches, shears and cutters, stationary, portable and heating forges, etc. The book contains over 398 pages, and its value is greatly increased by the numerous cuts which are given in conjunction with the descriptive matter.

THE CHARLES SCOTT SPRING COMPANY, of Philadelphia, whose works were destroyed by fire a few months ago, has been hard at work completing a new factory, and announce that this is now rapidly nearing completion. Additional ground has been added to the spring plant, covering about 55 ft. x 155 ft. A new machine house, 35 ft. x 200 ft., has also been built. With these increased facilities the company will be better able to supply its well known line of flat and spiral springs than ever before, and an excellent business is expected during the coming months.

FRED. M. LOCKE, of Victor, N. Y., manufacturer of the well known Locke insulator, has been successful in his legal controversy over the validity of his patents. Mr. Locke filed his application for letters patent in February, 1897, and on August of the same year, Mr. Boch, of the R. Thomas & Sons' Company, East Liverpool, Ohio, filed an application for the same thing. Interference proceedings have been pending since September, 1897, but the Patent Office has just decided that Mr. Locke was the first to conceive and reduce to practice the invention in issue.

THE BABCOCK & WILCOX COMPANY, of New York, has sold to the Manhattan Elevated Railway Company, of New York city, the boilers required for its new electric generating plant, which will furnish electric current for operating its entire elevated railway system in New York city. The boiler equipment will consist of sixty-four 520-h.p. Babcock & Wilcox all wrought steel boilers, capable of carrying a working pressure of 200 lbs. per sq. in. The boilers will be fitted with Roney automatic stokers, manufactured by Westinghouse, Church, Kerr & Company. This is the largest single order ever placed for stationary boilers.

THE large increase in English orders that has come to the Bullock Electric Manufacturing Company, has necessitated the sending of B. W. Spellmire, the company's engineer of tests, to the London headquarters of the company. Mr. Spellmire will superintend the installations of Bullock machines in the territory mentioned, the first installation being in the large printing establishment of Cassell & Company, London; the Nottingham "Guardian," Nottingham; Birmingham "Daily Post," Birmingham; Manchester "Evening Chronicle," Manchester, and the Belfast "Evening News," Belfast.

AMONG RECENT ORDERS received by the Ridgway Dynamo & Engine Company for McEwen engines and Thompson-Ryan generators, are three 75-h.p. tandem compound engines direct connected to three 50-kw. generators, purchased by the Treasury Department for lighting the United States Court House and Post Office Building at Cincinnati, Ohio; two 250-h.p. engines direct connected to two 150-kw. generators for the Berwind-White Coal Mining Company, Philadelphia, Pa., for its mining operations at Windber, Pa. This will make a total of fourteen engines and ten generators of this make installed by these same people at Windber, Pa., within the last two years.

THE GOLD CAR HEATING COMPANY AND THE GOLD STREET CAR HEATING COMPANY, of New York, report that the number of orders which they have taken during the past few months are of such magnitude as to surpass all their former records. It is a certainty that the improved Gold electric heaters have struck a popular cord among railway officials. Prominent among the orders for electric heaters which have been taken recently is one from the Boston Elevated Railway Company, formerly the West End Street Railway Company, of Boston, which has awarded the contract for electric heaters for its 100 new cars to the Gold Car Heating Company.

WILBUR B. DRIVER & COMPANY, of New York, have published for the convenience of the engineering trade a neat booklet containing valuable resistance and capacity tables for "Climax" resistance wire. It is claimed that this wire has forty-eight times the resistance of copper, while German silver has only sixteen times and ordinary steel wire about eight times the resistance of copper wire of the same diameter. Its low temperature coefficient fits it for any use to which German silver can be applied, and its high specific resistance renders it an economical substitute. Its chemical properties make it available for rheostat work where German silver is useless on account of its brittleness caused by heating and cooling.

WESTINGHOUSE, CHURCH, KERR & COMPANY, of New York, deserve the credit for producing one of the most artistic catalogues of the season. This is printed on the finest of tinted paper, and the pages are illustrated wih artistic drawings of private residences and hotels where electric lighting is provided by the Westinghouse Company's engines and generators. The catalogue is published with the view of calling attention to what has been accomplished by the Westinghouse Company in the way of electric light and power installations in hotels, private residences, etc. A number of the installations include apparatus for lighting houses, stables and grounds, and also for furnishing power to operate pumps, elevators, ventilating fans, ice cream freezers, dairies, laundries, etc.

ONE OF THE MOST VALUABLE points relating to the use of belts is not often enough realized, or, at best not emphasized; this is the fact that the more belt surface running in contact with the pulley the more power there is transmitted by the belt. In running a belt tight only about half of the pulley surface is in contact with the belt, therefore if a belt can be made to run without slipping it can be run slack and much power will be gained. The Cling-Surface Manufacturing Company, of Buffalo, N. Y., reports that it is adding scores of belts every week to the number already running slack through the use of Cling-Surface, and of the daily letters received acknowledging this, one from Alhambra, Cal., says: "After thoroughly testing Cling-Surface I find that I can run with a slack belt and get more power by far than I could with a tight belt before using Cling-Surface."

WENDELL & MACDUFFIE, of New York, general supply agents, have received orders since the first of August for fifty

snow plows and sweepers, as follows: Twenty-two plows to the Boston Elevated Road; five plows to the Brooklyn Heights Railroad Company; eleven sweepers and one plow to the North Jersey Street Railroad Company; five plows to the Bridgeport Traction Company; eight plows to other roads. This firm is doing an extraordinary business in this line this year, and orders are being placed much earlier than usual. This is accounted for by the fact that some of the roads were caught short of snow equipment last year. The above orders will tax the capacity of the Taunton Locomotive Manufacturing Company, who are the manufacturers of the above plows and sweepers, and railroad managers would do well to place their orders at once if they contemplate purchasing snow equipment.

THE STAR BRASS WORKS, of Kalamazoo, Mich., manufacturers of the Kalamazoo long distance trolley wheel, are meeting with marked success in the sale of their wheels and harps. The demand has been so great that they have been compelled to more than double their facilities within the past year, and have increased their capital stock from $10,000 to $20,000. The increased orders from the leading roads of the country, together with the additional new business must certainly be very gratifying to them. The company's officials credit their success to the fact that they aim to manufacture a superior article, judiciously advertise it and secure only the most capable salesmen to handle their goods. The Western Electrical Supply Company, of St. Louis, Mo., is their western and southwestern representative, the home company handling the north and east exclusively.

THE HARRISON SAFETY BOILER WORKS, of Philadelphia, report recent sales of Cochrane feed-water heaters and purifiers as follows: Bethlehem (Pa.) Steel Company, 12,000 h.p.; Pennsylvania Light & Power Manufacturing Company, Phila., 3000 h.p.; Waterbury Rope Company, New York, 850 h.p.; Durham Iron Works, Riegelsville, Pa., 600 h.p.; Blodgett Estate, Boston, 300 h.p., special; Thorley Building (Pabst Brewing Company), New York, 300 h.p.; Pittsburgh (Pa.) Brewing Company, 600 h.p.; E. P. Allis Company, Milwaukee, Wis., 200 h.p.; American Nut & Bolt Works, Cleveland, Ohio, 350 h.p.; Peoples Independent Rice Mill Company, Crowley, La., 350 h.p.; Plaza Hotel, New York, 300 h.p., special; International Paper Company, Franklin Falls, N. H., 350 h.p.; Providence (R. I.) Machine Company, 250 h.p.; Lorain (Ohio) Street Railway Company, 850 h.p.; Warden Power Building, Phila., 1000 h.p. Many orders for Cochrane separators have also been received.

THE PROVIDENCE ENGINEERING WORKS, of Providence, R. I., has recently acquired the entire equipment and business of the Providence Steam Engine Company as well as the domestic business of the Rice & Sargent Engine Company. The works of the company occupy the block bounded by South Main, Pike, South Water and Bridge Streets, with water frontage on the Providence River, and are amply equipped with cranes, tools and other facilities for turning out its product with promptness and of the highest degree of excellence. The shop methods in use are based upon the highest American standards, and include not only extensive use of gages, jigs and fixtures, but a rigid system of inspection of work. The business of the new company consists of the manufacture of the Rice & Sargent engine and the improved Greene engine, for both of which it is the sole builder. The design and construction of general machinery will also be engaged in. The officers of the company are as follows: R. A. Robertson, president; W. Fred Reynolds, vice-president; Richard H. Rice, treasurer.

AMONG the recent orders received by Broomell, Schmidt & Company, Ltd., York, Pa., manufacturers of the American Fuel Economizer, are the following: For Hillingsworth & Whitney Company, Waterville, Mo., two large economizers, two induced draft fans, with 14 ft. wheels, direct-connected engines, together with about 150,000 lbs. of steel smoke breechings, dampers, stacks, etc.; Iukens Iron & Steel Company, Coatesville, Pa., two American fuel economizers, two induced draft fans, with 12-ft. wheels and direct-connected engines, also about 80,000 lbs. of smoke breechings, dampers and connections; Weston Electrical Instrument Company, Newark, N. J., for the power house of its new works at Waverly, two American fuel economizers, with metallic casing, connections, etc.; Vacuum Oil Company, Rochester, N. Y. (third order), one American fuel economizer for utilizing waste heat from oil stills; Monterey Electric Light Company, Monterey, Mexico, one American fuel economizer complete, with metallic casing, induced drafts, fans, etc. The York Light, Heat & Power Company, York, Pa, has closed a contract with Broomell, Schmidt & Co., Ltd., for two 250-h.p. American water-tube boilers complete, with induced-draft fans, settings, etc.

AMONG the more important sales made by the Bullock Electric Manufacturing Company, of Cincinnati, during July, are the following: Union Depot, Dayton, Ohio, two 50-kw. engine type generators; Fuller Construction Company, New York city, four 50-kw. engine type generators; Wilson Aluminum Company, Holcomb Rock, Va., one 60-kw. belted generator; Warren K. Blodgett, Boston, Mass., one 150-kw. belted generator; American Type Foundry Company, Cincinnati, Ohio, twenty-five slow speed motors for direct connection to type machine; D. E. Whiton Machine Company, New London, Conn., one 30-kw. belted generator; United States Government, San Francisco, Cal., one 30-kw. belted generator; Pullman Palace Car Company, St. Louis, Mo., one 12½-kw. belted generator, one 25-kw. engine type generator; "Daily Mail," London, Eng., two 50-h.p. printing press equipments, Bullock "Teaser Control System;" Aldrich Mining Company, Brilliant, Ala., one 30-kw. belted generator; Missouri Lead & Zinc Company, Joplin, Mo., one 20-h.p. motor; Boston News Bureau, Boston, Mass., one 9-h.p. belted motor, 900 r.p.m.; Hanover Manufacturing Company, Bethlehem, Pa., one 10-h.p. belted motor; Southern Electric Company, St. Louis, Mo., one 12½-kw. belted generator; Vulcan Metal Refinery Company, Sewaren, N. J., one 17½-kw. belted generator.

THE McGUIRE MANUFACTURING COMPANY, of Chicago, is working to its full capacity, particularly in the snow sweeper and car heating departments. It has just secured contract for sixty of its No. 39 double trucks for the San Francisco & San Mateo Railway, of San Francisco, Cal., this being the entire equipment. It is now delivering the 300 trucks for the Northwestern Elevated Railway Company, of Chicago. It also has orders from the Toledo Traction Company, Toledo, Ohio; Central Railway Company, Peoria, Ill.; Consolidated Traction Company, Pittsburgh, Pa.; Rochester Railway Company, Rochester, N. Y.; Monongahela Street Railway Company, Pittsburgh, Pa.; Madison Electric Railway Company, Madison, Wis.; Cripple Creek District Railway Company, Cripple Creek, Col.; Suburban Rapid Transit Company, Pittsburgh, Pa.; South Bend Street Railway Company, South Bend, Ind.; Peoria & Pekin Terminal Railway, Peoria, Ill.; Chicago City Railway Company, Chicago; W. L. Mellon, Pittsburgh, Pa.; Black River Traction Company, Watertown, N. Y.; Metropolitan Street Railway Company, Kansas City, Mo.; Indiana Railway Company, South Bend, Ind.; Canadian General Electric Company, Toronto, Ont.; Star Electric Company, Dubuque, Ia.; Bethlehem & Nazareth Passenger Railway Company, Nazareth, Pa.; St. Joseph & Benton Harbor Electric Railway Company, St. Joseph, Mich.; Tacoma Railway & Power Company, Tacoma, Wash.; Metropolitan Street Railway Company, New York, N. Y.

New Publications

Granite State Scenery In and About the Capital City. Published by the Concord Street Railway Company, Concord, N. H.

This is a very tasteful book of views, larger than is usually attempted by the street railway companies, and it gives a large number of very tasteful illustrations of the city of Concord. It is issued, of course, to interest citizens of and visitors to that city in the features of interest about it, and is written and published in a most attractive way.

Trade Catalogues

Engine Catalogue. Published by Edward P. Allis Company, Milwaukee, Wis. 184 pages. Illustrated.

Resistance Wires. Published by Wilbur B. Driver & Company, New York city. 16 pages. Illustrated.

General Catalogue. Published by the Buffalo Forge Company, Buffalo, N. Y. 398 pages. Illustrated. Pocket edition.

The Sturtevant Engine Catalogue 103. Published by The B. F. Sturtevant Company, Boston, Mass. 44 pages. Ilustrated.

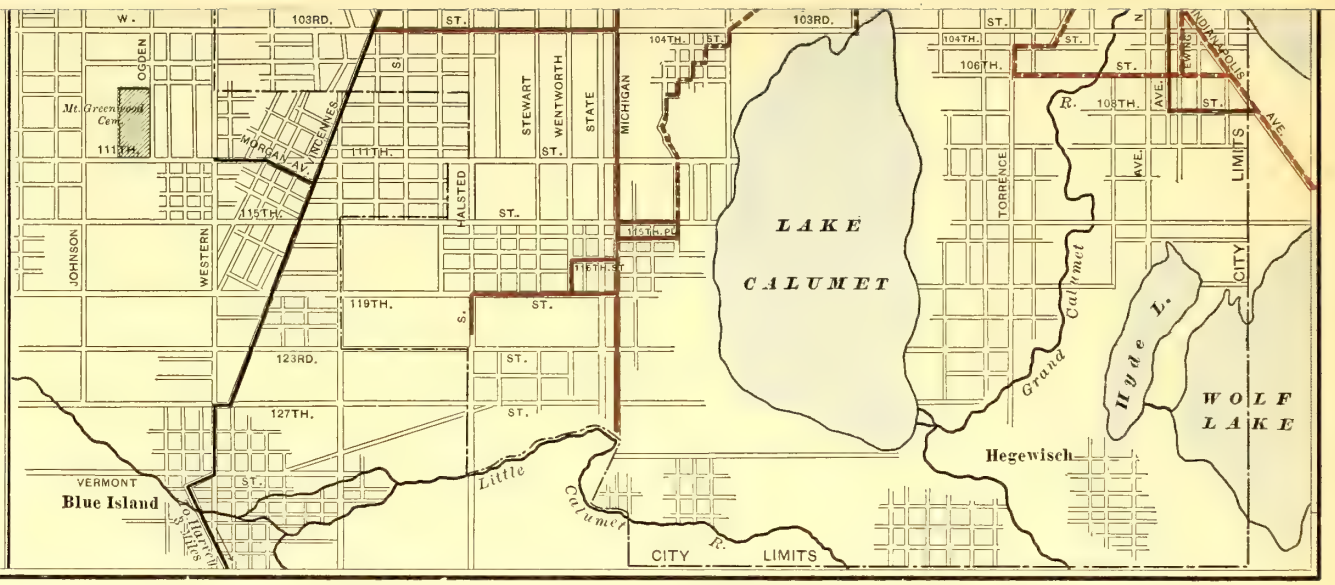
The Pittsburgh Feed Water Heaters and Purifiers. Published by James Bonar & Company, Pittsburgh, Pa. 40 pages. Illustrated.

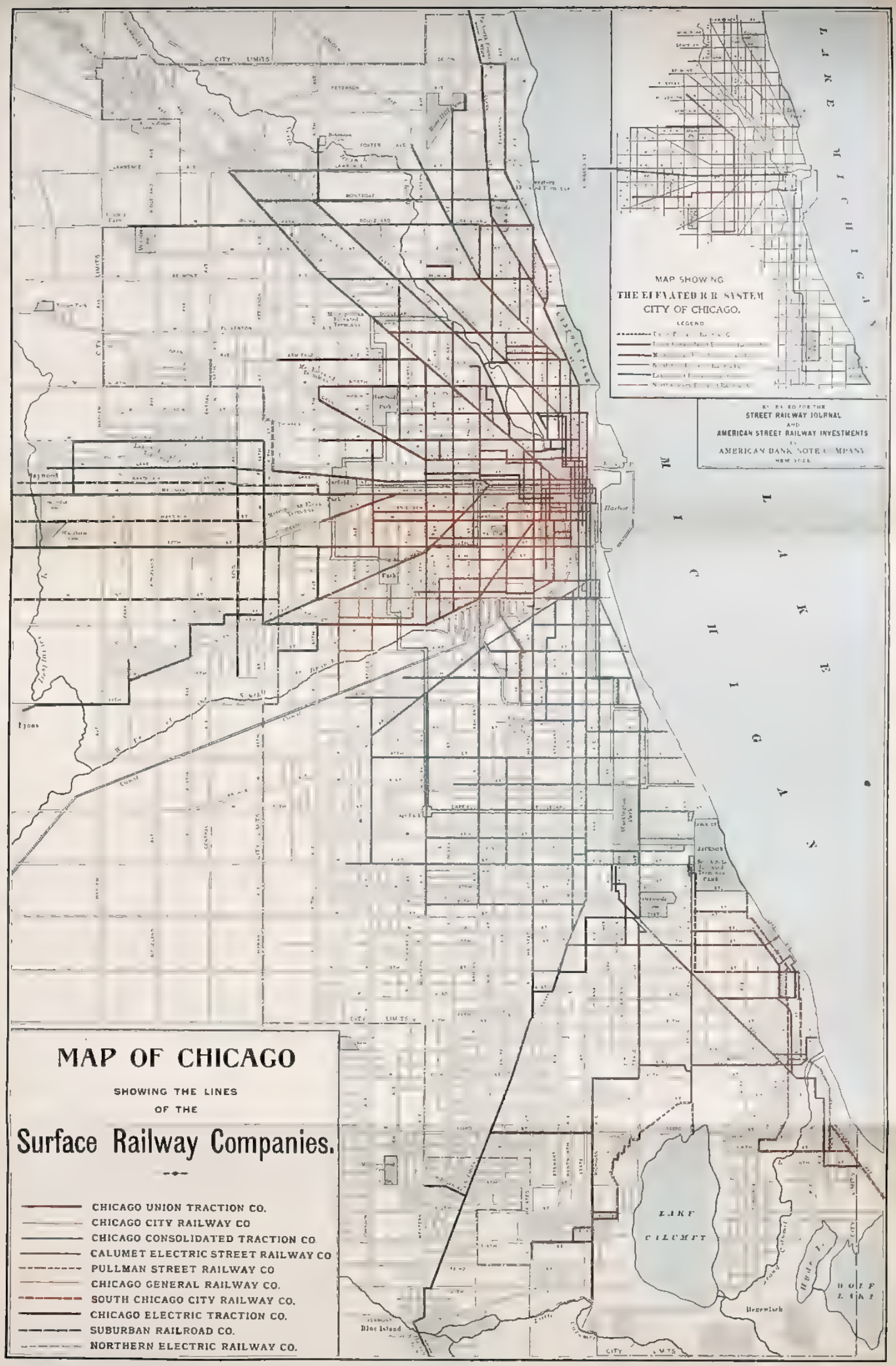
The Lighting of Private Residences and Hotels. Published by Westinghouse, Church, Kerr & Company, New York. Illustrated.

Some Recent Installations of Worthington Condensing Apparatus. Published by Henry R. Worthington, New York. 30 pages. Illustrated.

Surface Railway Companies.

- CHICAGO UNION TRACTION CO.
- CHICAGO CITY RAILWAY CO.
- CHICAGO CONSOLIDATED TRACTION CO.
- CALUMET ELECTRIC STREET RAILWAY CO.
- PULLMAN STREET RAILWAY CO.
- CHICAGO GENERAL RAILWAY CO.
- SOUTH CHICAGO CITY RAILWAY CO.
- CHICAGO ELECTRIC TRACTION CO.
- SUBURBAN RAILROAD CO.
- NORTHERN ELECTRIC RAILWAY CO.




MAP OF CHICAGO
SHOWING THE LINES
OF THE
Surface Railway Companies.
CHICAGO UNION TRACTION CO.
CHICAGO CITY RAILWAY CO
CHICAGO CONSOLIDATED TRACTION CO.
CALUMET ELECTRIC STREET RAILWAY CO
PULLMAN STREET RAILWAY CO
CHICAGO GENERAL RAILWAY CO.
SOUTH CHICAGO CITY RAILWAY CO.
CHICAGO ELECTRIC TRACTION CO.
SUBURBAN RAILROAD CO.
NORTHERN ELECTRIC RAILWAY CO.
MAP SHOWING
THE ELEVATED R R SYSTEM
CITY OF CHICAGO.
LEGEND
STREET RAILWAY JOURNAL
AND
AMERICAN STREET RAILWAY INVESTMENTS
CO.
AMERICAN BANK NOTE COMPANY
NEW YORK
LAKE MICHIGAN
MICHIGAN
CITY LIMITS
Harbor
LAKE CALUMET
Blue Island
Hegewisch
CITY LIMITS

Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, OCTOBER, 1899. No. 10.

ELECTRIC RAILWAY PRACTICE IN AMERICA AS EXEMPLIFIED IN CHICAGO

For good or ill, whether profitably or unprofitably, America has been forced to be a pioneer in the science of municipal transportation, and to bear the burden of experiments in every stage of development. The first passenger horse railway in the world was run in New York City, the first cable railway in San Francisco, and the first important commercial electric railway in Richmond. Many millions—measured in francs, dollars or pounds sterling, as you will—have been lavishly poured out on more or less promising schemes, only to find place eventually in the "profit and loss," or "experience" accounts.

It follows, therefore, that there is no such thing as a universal, well digested electric railway practice in America. Instead of this, all grades of intelligence are found represented in our existing city railways, from the broken down relics of early days, which may be run across occasionally even yet, to the best and most recently built systems, employing every material and labor saving device known. While there is much to learn from the older electric railways as to ways of "making the best of a bad bargain," it is the latest and best practice only which is worth description and analysis for the benefit of those who have



A LIGHT HOUR IN THE CONGESTED DISTRICT OF CHICAGO

now before them the problem of building and equipping new railways. It may be useful, therefore, before describing Chicago construction, in some respects excellent, in others not wholly not up to date, to take a broad survey of American experience as so far developed and briefly explain the latest and best practice used in American roads now building.

MOTIVE POWERS

Horse railways have almost disappeared in America, the only remaining examples being in one or two of the largest cities, such as New York and Chicago, where rights for electrical equipment have been for a long time denied or restricted, and in a few small towns and villages, where traffic has not seemed to warrant the cost of electrical equipment, so that horse cars have been continued almost as private stage or omnibus lines might be, frequently owned by an individual and run as a strictly private enterprise.

The cable system has been blasted out of the streets in all except three or four cities, in which it is also doomed, and where steps have already been taken to replace it with electric traction. The reasons for this are too well known to require repetition here.

Compressed air cars are now in regular operation on the Twenty-eighth and Twenty-ninth Streets line in New York City, the largest installation yet made in America, and the most carefully worked out in detail. So far, they appear to be giving excellent satisfaction to the public, and while they have been running for too short a time to determine the cost of operation, it is believed that they have some place in modern street railroading. Other experiments in compressed air are being made in Chicago, but without well defined results as yet.

More or less extensive experiments are also being made with stored steam motors, gasoline motors, and one or two other types of motive power involving reciprocating motion machinery, and it seems not impossible to hope that some of these, too, will find a place perhaps, in small towns or villages or on long distance interurban lines where car service is infrequent and the expense of power station installations would be too great a burden. Inventors of these systems are seriously handicapped by the disinclination of street railway managers to look into their merits carefully, owing to the strong hold which electric traction has upon the imagination, and the well nigh universal testimony to its merits.

Electric traction is now almost universal in America, over 90 per cent of the entire street railway mileage being equipped with this motive power. The overhead wire system is most generally used, the underground conduit having been adopted only in New York City and Washington, where climatic conditions are favorable, and where the city sewerage systems—an absolute necessity for successful operation of an underground conduit system—are good. So far there has been no serious agitation elsewhere for the adoption of the underground conduit, but the overhead wire system is considered by the municipalities as satisfactory and as having a number of advantages over any other form which will compensate for the slight disfigurement of the streets. There is but one important storage battery installation made in America, that on the lines of the Chicago Electric Traction Company, where twenty-five cars have been running over 25 miles of track for about two years with fairly satisfactory results. *



CROSSING OF AN ELEVATED RAILWAY, A STEAM SUBURBAN RAILROAD AND A SURFACE LINE

For heavy electric railroading at high speeds, the third-rail conductor has come into quite general use as affording a better means of getting the current from the power station to the cars than is the overhead wire. Various methods of sectionalizing the third rail in such a way as to avoid danger from shocks have been devised, but have not yet been put into operation on a large scale.

The "surface contact," or "button system" of electric

*See Street Railway Journal, September, 1899, p. 559.

railways, while worked out quite carefully experimentally, has not yet been adopted by any important American system on a scale sufficient to justify an opinion as to its permanent value.

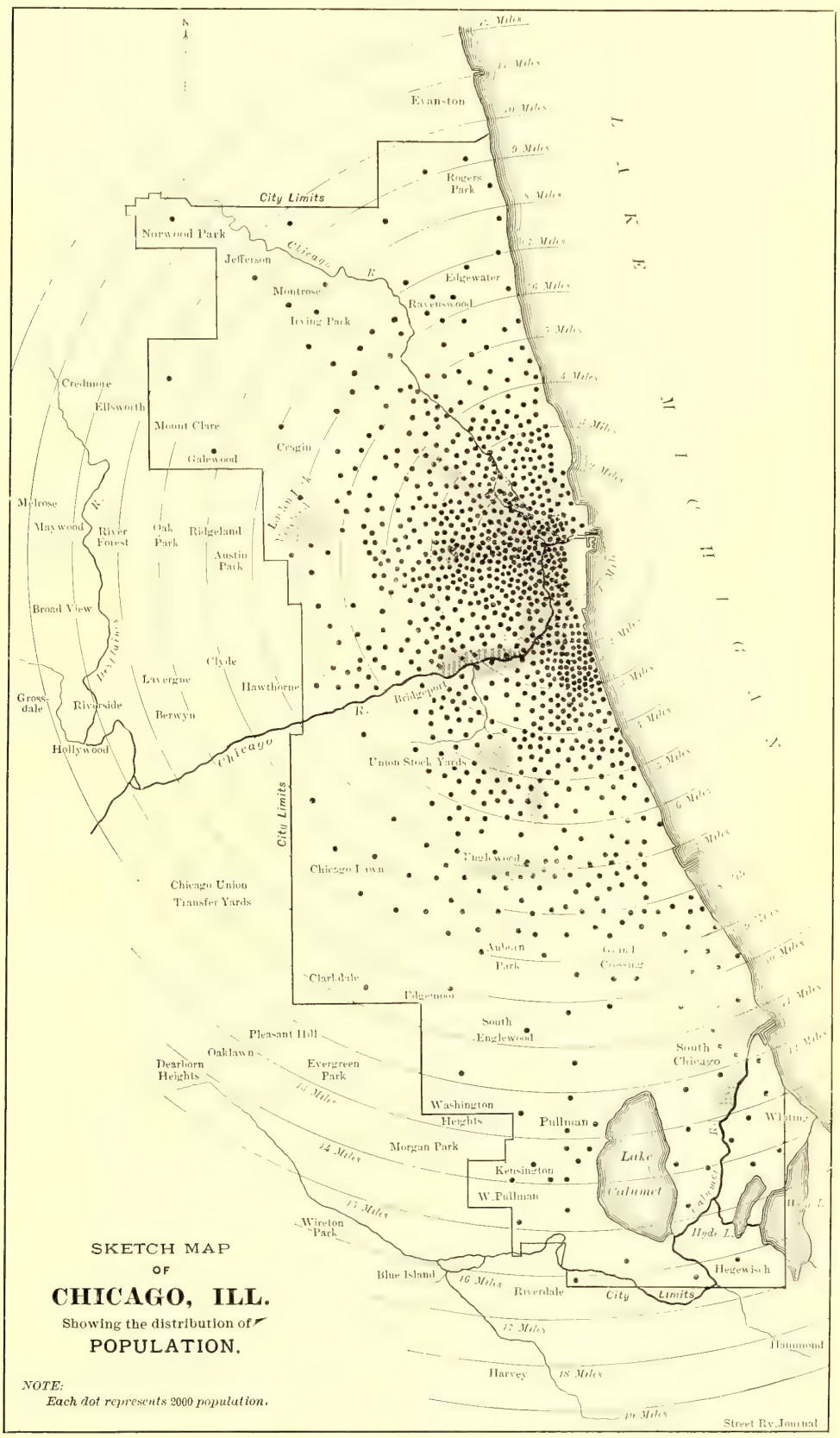
ROADBED CONSTRUCTION

Concrete substructure for track is as yet little used in America, partly because of its cost and partly because it is by many considered as making the track too rigid, non-yielding and disagreeable to passengers on the cars which ride over it. The common practice is to dig a trench in the ground, place ordinary or creosoted ties therein on a layer of broken stone or gravel of varying thickness, at distances of from 24 ins. to 36 ins. between centers (24 ins. and 30 ins. being frequent specifications), spike to these ties 7-in. or 9-in. girder rails, according to the height of paving blocks specified by the city, and, finally, tamp the ties carefully to surface. Between the ties is placed broken stone and above that a layer of sand to form a support for the paving stones. Tie rods are sometimes, though not generally, used in a construction of this kind. The practice of using concrete beams or "stringers" underneath the ties for additional strength of support has come into vogue latterly with a number of city systems, but the results of this practice are not yet fully demonstrated.

Rail is almost universally ordered now in 60-ft. lengths, and practically all the mills have provided manufacturing and shipping facilities for these lengths, finding that customers will no longer order 30-ft. rail. By this means, the number of joints, always the weak point in a track construction, have been cut in two for any given length of track, and no greater effects of contraction and expansion, certainly in rail imbedded in paving.

Joints are placed sometimes "opposite," sometimes "broken," and there is not yet any well settled practice on this point, although the tendency is toward the "opposite" form. The natural advantage of broken joints is held to be neutralized by a peculiar and highly disagreeable rolling motion of the car when the joints are seriously down, while with opposite joints the motion of the car is far less unpleasant, although perhaps slightly more noisy when joints are very poor.

The process of "cast welding" has come into very large use during the past four years and with generally satisfactory results. When the joints are well made, the percentage of breakage is comparatively small, and the opinion among street railway managers seems well settled that an exceedingly smooth and perfect riding track can be obtained and maintained by this means. Experiments in electric welding have been carried on for two or three years with varying success, the latest work, such as that in Buffalo, appearing to be quite promising, though the cost



is still rather high. There are a number of excellent special patented joints, some of which are strong and durable and can hardly fail to keep rail ends in position or to bring up old track to surface. The ordinary fish-plates, from 30 ins. to 36 ins. in length, are also used in many cases and give much better results than were obtained from the shorter fish-plates formerly common.

A number of large rolling mill and other manufacturing companies have gone extensively into the business of making "special work," switches, curves, crossings, etc., for street railways, and are producing some excellent material. In a few cases, the street railway companies themselves make their own special work, but in the majority of instances it is purchased on drawings and specifications. The wearing parts, such as switch points, frogs, etc., are generally reinforced by pieces of extremely hard steel made in various secret compositions let into the frog or switch point, and renewable when worn out.

Rail bonding for the return circuit is usually done with copper where the rail joint itself is not relied upon for the conduction of current, as is sometimes the case with cast or electric welded joints. The ends of such bonds are usually expanded into holes drilled in the web of the rail. Care is always taken to so proportion the bond as to give it a conductivity a little greater than that of the rail itself. The rails are frequently double bonded, often by one bond passing around the outside of the fish-plates, while the other is a short one placed within the space between fish-plate and rail. The rails of a track are usually cross bonded at short intervals. The "plastic," or amalgam bond has come into quite wide use also, and is so proportioned as to lie underneath the fish-plates. Curiously enough, there has been some trouble with the stealing of copper wire bonds outside the fish-plates, and for this and other obvious reasons, the shorter bond held by the fish-plates, has some advantage over the longer.

ROLLING STOCK

The general drift of practice is toward long, double truck cars, 30 ft. to 35 ft. over all, for suburban and interurban service, and even in some cases for city lines, although rather in the larger than in the smaller cities, inasmuch as the traffic is more continuous throughout the day, and the proportion of the time when the cars run lightly loaded is small. Trail cars are now rarely used, as it is considered that they cost more for labor per passenger carried, to largely increase the accident account, and, frequently, to involve difficult switching problems at termini. While the long cars are, of course, much heavier than the short ones formerly used, the hammer blow on track joints must be much less because the weight is divided among eight wheels instead of four, while there is none of the oscillation which comes when a long car is mounted on a single truck.

The "maximum traction" type of truck, where from 60 per cent to 70 per cent of the car and motor weight is distributed on four of the eight wheels of a long double truck car, is coming into quite general use, particularly in cities where the grades are severe or where rapid acceleration is required. There have been great improvements in the building of trucks for electric cars during the last three or four years, and all the leading types are now mechanically very well designed and durable.

The standard winter car in most of our cities has broad platforms, large windows and longitudinal seats, while the usual summer car has cross seats and running foot boards on both sides. There is little question that the public prefers cross seat cars as a rule, but for many reasons they are not so desirable from a street railway standpoint as are the longitudinal seated cars.

The one great disadvantage of a double equipment for summer and winter use lies, of course, in the difficulty of properly pleasing the public in spring and fall or in rainy weather in summer. It has been necessary either to have a full motor equipment for both closed and open cars, or to have a quick means of shifting closed and open bodies on to common motor trucks, while nothing has ever been found to provide properly for rainy weather conditions. There have latterly been devised, however, several types of "duplex" or "combination" cars with sides which will roll or fold up into the roofs in such a way as to make the car almost instantly convertible from closed to open, or vice versa. These cars are expensive to build and to purchase, but as they are intended to take the place of a summer and winter car and to furnish advantages which both together do not possess, it would be decidedly profitable to pay a high price for them, provided that there are no mechanical drawbacks. So far, they have not been in use long enough to demonstrate their durability or cost of maintenance, but they are among the most interesting of the present "experiments" now being tried in America.

The American electric motor is so well known throughout the world that there is little need of describing it at length. It is sufficient to say that its main qualities are (*a*) a high efficiency throughout a wide range of action, (*b*) load and speed curves adapted for the particular work to be done, no manufacturers consenting to furnish motors without full knowledge of all the local conditions, (*c*) their multipolar construction with separate coil armatures and high insulation throughout, (*d*) flexible support at one or both ends, (*e*) ease of inspection, and (*f*) a series multiple control through non-sparking contacts protected by magnectic blow-out device.

Powerful electric snow plows, capable of throwing snow in continuous streams away from the track, form a necessity of street railroading in the North, which has been well met by the manufacturers.

With the introduction of the long cars and of trains of cars in a city street has come the necessity for better braking power than has ever before been given to the old horse or cable railways, and many different forms of electric, compressed air and mechanical brakes have been devised to meet different conditions. Until recently, however, street railway managers have not been willing to spend large sums of money for special brake equipment, partly because of the cost, but chiefly because the brake manufacturers themselves have not been able to fully guarantee the life or working efficiency of their devices. Now, however, their apparatus has been brought up to such a point of excellence that they can readily do this, and there is little question that within a short time mechanical braking in some form where quickness of application is possible, will be adopted by many, as it now is by a few of our leading street railway companies.

POWER STATIONS

The horizontal or vertical, tandem or cross compound engine in large sizes, direct connected to multipolar electric generators, form the prevailing type of power station "unit" in use in America, small high speed engines with

belt connection for generators having long since passed into the background. Water tube boilers are generally used, but not a few managers still place their trust in the "old, reliable, horizontal, return tubular, boiler" of their forefathers. Such a boiler is no doubt economical, but it does not respond readily to the wide fluctuations in the demand for steam coming from electric railway engines, where loads vary so widely, and unless a large boiler surplus is provided, there are sometimes more or less serious difficulties in keeping a road running.

It goes without saying that in the best modern plant, careful provision is made for the economical storing and handling of coal from the point of delivery to the mouth of the furnace, and hand labor is reduced to a minimum.

The piping system was originally "duplicate," and even now this practice is quite common, but there are also many engineers who prefer to "place all their eggs in one basket and watch that basket," by putting in a single, well designed direct system with carefully made valves and appurtenances.

Where water for condensing purposes is not obtained, water cooling towers have come into use with very good results, and this plan is particularly applicable, of course, to central city stations. Every effort is made in our best stations to save the energy of the steam by feed water heaters, fuel economizers, and other economic devices.

Nearly all the engines now in general use in street railways are using some modification of the Corliss valve rigging, although there are several well known and popular engines which are working on different principles and with success. The electric generators are, as before stated, multipolar and are far better built now than ever before, special care being taken in all insulating processes. The largest engine generator so far built in this country has an economical rated capacity of 4500 h.p. and a maximum of 7000 h.p., and a great many of this size of engine have been ordered for the larger stations.

Broadly speaking, it has been proved possible to generate power for railway purposes in the best American stations at from $.005 to $.0075 per kilowatt hour, but in by far the larger number of stations it is still costing $.01 or more; these figures all covering cost for labor, fuel, water, material and repairs of power plant, and excluding interest on investment and allowance for unrealized depreciation.

DISTRIBUTION SYSTEM

The very latest practice in electric power distribution for large city railway plants—a practice represented more, however, by plans drawn and orders placed than by actual accomplishment—is the generation in a central power station of three-phase, high tension current, its transmission to a number of sub-stations at the high initial tension and its distribution through rotary converters and constant potential circuits into 500-volt direct current, adapted for the railway motors in common use. It is only by this means that the investment for copper and for conduits can be kept within reasonable limits on a large city plant, and although no comparative estimates of cost and running expenses have yet been given out, there is little doubt that this practice will become quite general for larger plants.

In practically all new work in the larger cities the feed wires are being carried underground in vitrified brick or clay, or iron pipe conduits. The feeders are stranded copper cables carefully insulated and lead covered. Alumnium is being tried for feeders, but it is too early to be sure of results.

Poles are now almost universally of iron except in the smaller cities, and on the suburban or interurban lines, where they are of wood, usually in the natural state, untreated by preservative compounds. Little desire is shown by American municipalities to have the railway companies use elaborate or highly ornamented poles, the general feeling being that so long as graceful lines are preserved, the simpler the pole the less noticeable is it in the street. The whole idea has been not to call attention to the poles even by beauty and elegance of design, but to minimize their obtrusiveness.

The devices for holding the trolley wire in position over the track and for making curves, turnouts, etc., have been developed to a point where the best types can be considered as highly satisfactory and as well serving their purpose. There is very little trouble now from break-downs of trolley wire, the overhead structure being built permanently and well.

Without further description of the latest standard American practice, we will take up the Chicago street railway system in its entirety, discussing as briefly as may be the decisions which have been made and the reasons therefor, by which the present stage of development—not yet a final one by any means—has been brought about.

THE TRANSPORTATION SYSTEM OF CHICAGO

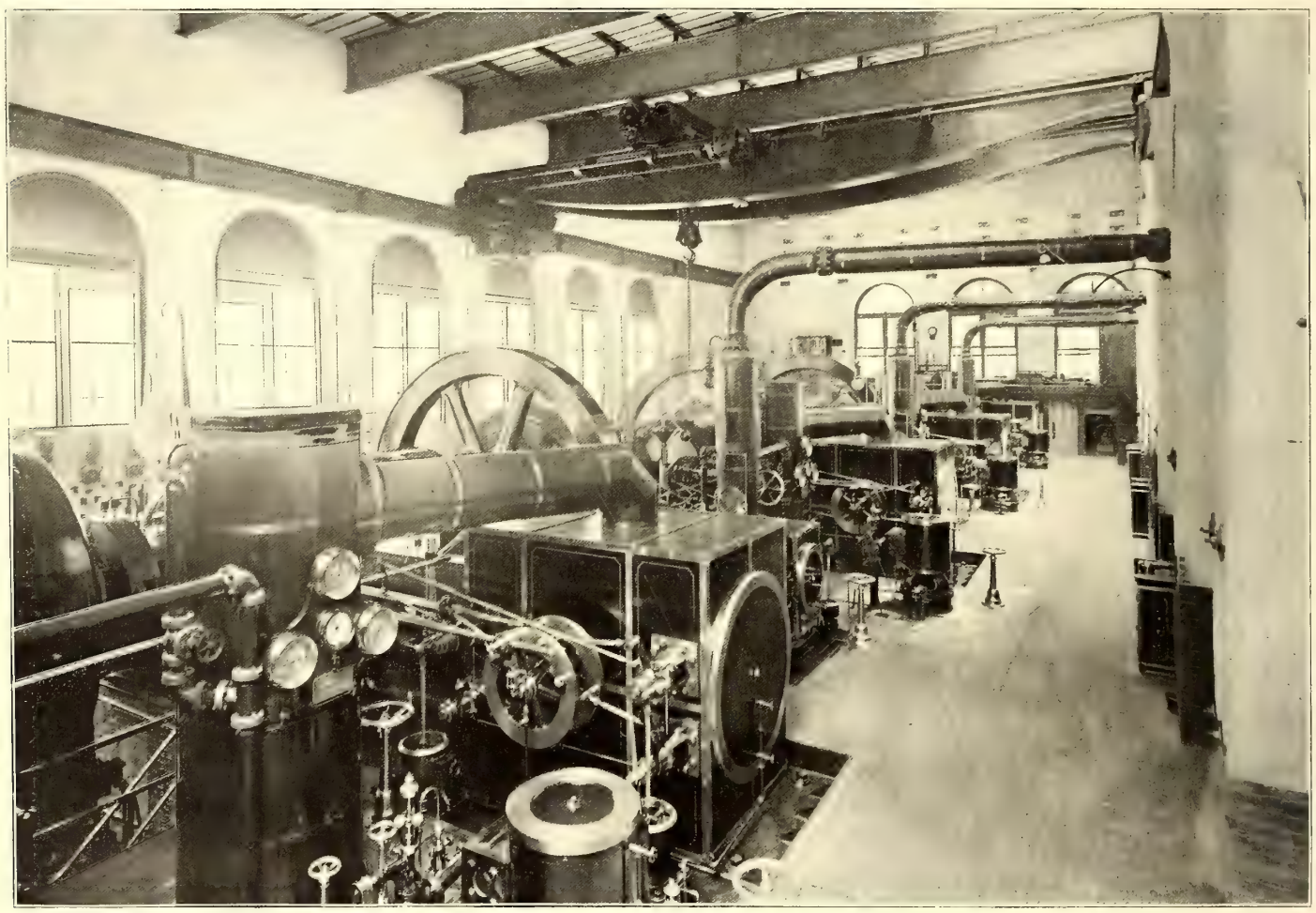
The Chicago River has played a part in the world wholly out of proportion to its size or intrinsic importance. Rising nowhere, it empties into an inland lake. At its broadest point it is little more than a creek and its navigable length is hardly a mile. Yet the existence of this little river with the possibilities which it offered of harborage, dockage and warehousing, led to the selection of its neighborhood, from the surrounding prairies and shorelands of the lake district, as the site for a little settlement. In course of time railroads came to town, the lake traffic grew to large proportions and the advantages of this site for transshipment of Western produce from railroad to water and vice versa were found to be so great that more, and still more railroads sought lake connections here until first gradually, then rapidly, then by immense forward leaps and bounds has been built up the great metropolis of the West, a city even now ranging among the half dozen great commercial centers of the world.

The Chicago River has dictated the geography of the city, dividing it into the North Side, South Side and West Side (see page 615), and has ruled in effect that the financial, business and shopping center of this great city shall be confined within the limits of the narrow peninsula bounded on two sides by the river and on a third by the lake. Into this little district each morning pours an enormous swarm of busy workers, getting over and under the Chicago River as best they may, or waiting patiently for boats to pass and bridges to be lowered. They crowd the immense "sky scrapers" which first attained their highest development in Chicago as a necessity of the situation, and which during the working hours of the day probably give to this business district the largest number of living souls per square inch of ground area to be found in any city of the world. The congestion in the streets of Chicago's

business district, morning and night, is something appalling, and a faint conception of it only can be given by the accompanying illustrations. Thousands of surface car trains of three, four and even five cars pass into and out of this district around loops or through switchbacks, the separate ownership until now of the North, West and South Side lines having made through runs impossible. Hundreds of elevated trains reach the Union Loop terminus and pour their thousands of additional passengers upon the streets. All is noise, bustle, apparent confusion and extreme congestion to sidewalks in this busy, throbbing heart of Chicago.

This congested business district dominates the entire transportation system of Chicago, determines the time interval between cars on all lines and has led to the universal running of surface cars in trains as against the unit system prevailing in most other American cities. The reason for this may be explained in a word. On each side of the city, north, west and south, there are several through or main lines radiating from the business district and intersected at many different points by cross, or feeder lines. Until the past three or four years nearly all the radiating lines have been run by the cable system, and the feeder lines by horses. The latter could not, of course, be allowed upon the radiating lines since they would greatly interfere with the speed of the cable cars, consequently, the horse cars have been brought to the intersecting points and have there been coupled to the cable cars, which in the course of their runs thus collect several horse cars at different intersecting points. On the return trip, the horse cars were disconnected, horses attached and the passengers carried to any point on the feeder lines without change of cars.

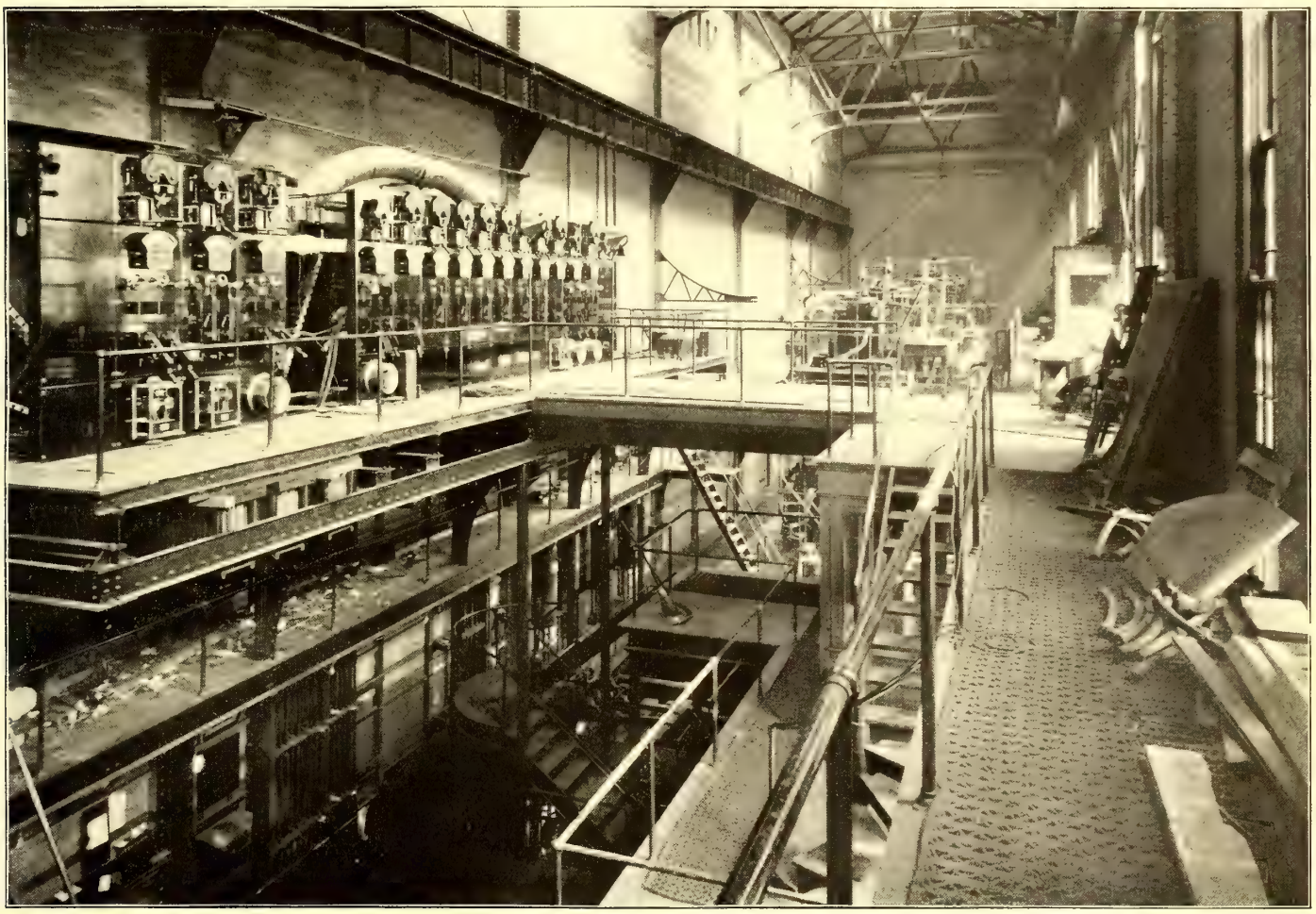
Within the past five years these horse feeder lines have been converted to electric traction, and it has been the constant effort of the Chicago street railway companies to secure from the City Council the right to run the electric cars down over the radiating lines between cable cars, for it imposes far too great a strain upon the cable to attach several heavy electric cars to the grips, and it is equally undesirable to give the passengers the trouble of transferring at intersecting points. This effort to secure electric rights into the center of the city has been successful in several instances, and undoubtedly will be so universally in the near future, for it has been proven again and again that the people greatly prefer electric to cable cars, and the latter will be abandoned for the former even at some inconvenience and additional walk.



ENGINE ROOM, SOUTH SIDE ELEVATED RAILWAY

When the entire Chicago system is operating by electricity, the probabilities are that the system of running cars in trains now in vogue will be largely done away with, and long double truck cars will come into general use instead, although the multiple unit system of car control would render it possible to run surface cars in trains to considerable advantage on some of the most heavily patronized lines. It is also more than probable that with the general consolidation of Chicago street railway properties which has now begun, and which can hardly fail to be completed within the next two or three years, the use of loops and switchbacks in the business center of the city will largely cease and cars will be run right through from North

to South and West Sides without change, and with immeasurably less traffic difficulties to overcome. On such a plan the combined city system can run a far greater number of cars than at present, and can also give universal transfers, thus making it possible for passengers to go any where they will throughout the city on the payment of a single fare. Such a plan, however, cannot be carried out unless the entire system be operated by one motive power and the cable done away with, for to obtain the greatest flexibility and ease of handling, uniformity of equipment is an essential, in order to avoid traffic difficulties at congested points.



GALLERIES IN POWER STATION, METROPOLITAN WEST SIDE ELEVATED RAILWAY

By reference to the accompanying map of Chicago, it will be seen that there are three large central transportation systems in Chicago owned by the Chicago Union Traction Company, the Chicago City Railway Company and the five elevated railway companies together, while there are also eight smaller properties, which are all, in reality, feeders to the three large systems just named, or to each other. The Chicago Union Traction Company is a consolidation, recently effected, of the North Chicago Street Railroad Company and the West Chicago Street Railroad Company, the former operating the lines north of the Chicago River and the latter those to the west, and both reaching the congested district near the lake front.

Seven of the outlying feeder systems formerly more or less independent of the North and West Side systems have recently been consolidated into the Chicago Consolidated Traction Company, which owns two city lines reaching the congested district over the tracks of the Chicago Union Traction Company. To the south of the Chicago City Railway system is a quite extensive network owned by three independent companies, the Calumet Electric Street Railway Company owning one of the largest purely suburban systems in the world, the South Chicago City Railway Company, and the Chicago Electric Traction Company (formerly the Englewood & Chicago Electric Street Railway Company.)

The track mileage owned by the eleven principal Chicago companies, the gross receipts of many of them, and the gross receipts per mile of track are shown in the following table:

SURFACE RAILWAYS	Miles Track	Gross Receipts	Receipts Per Mile Track
Chicago Union Traction Co.	304	$7,047,227	$23,182
Chicago City Railway Co.	197	4,832,806	24,532
Chicago Cons. Traction Co.	206	1,026,781	4,984
Calumet Electric Street Ry. Co.	90	....	....
Suburban Railroad Co.	56	....	....
So. Chicago City Railway Co.	37	....	....
Chicago Electric Traction Co.	35	....	....
Chicago General Railway Co.	30	119,739	3,991
ELEVATED RAILWAYS			
Metropolitan W. S. El. Ry. Co.	36	1,246,833	34,634
South Side El. Ry. Co.	19	978,330	52,598
Lake Street El. Ry. Co.	15	633,404	42,227

From this it appears that the greatest traffic density of all lines is found on the South Side Elevated Railway, while that of the Chicago General Railway and the Chicago Consolidated Traction Company are far less than all of the others whose returns appear.

In this connection it may be interesting to note that the

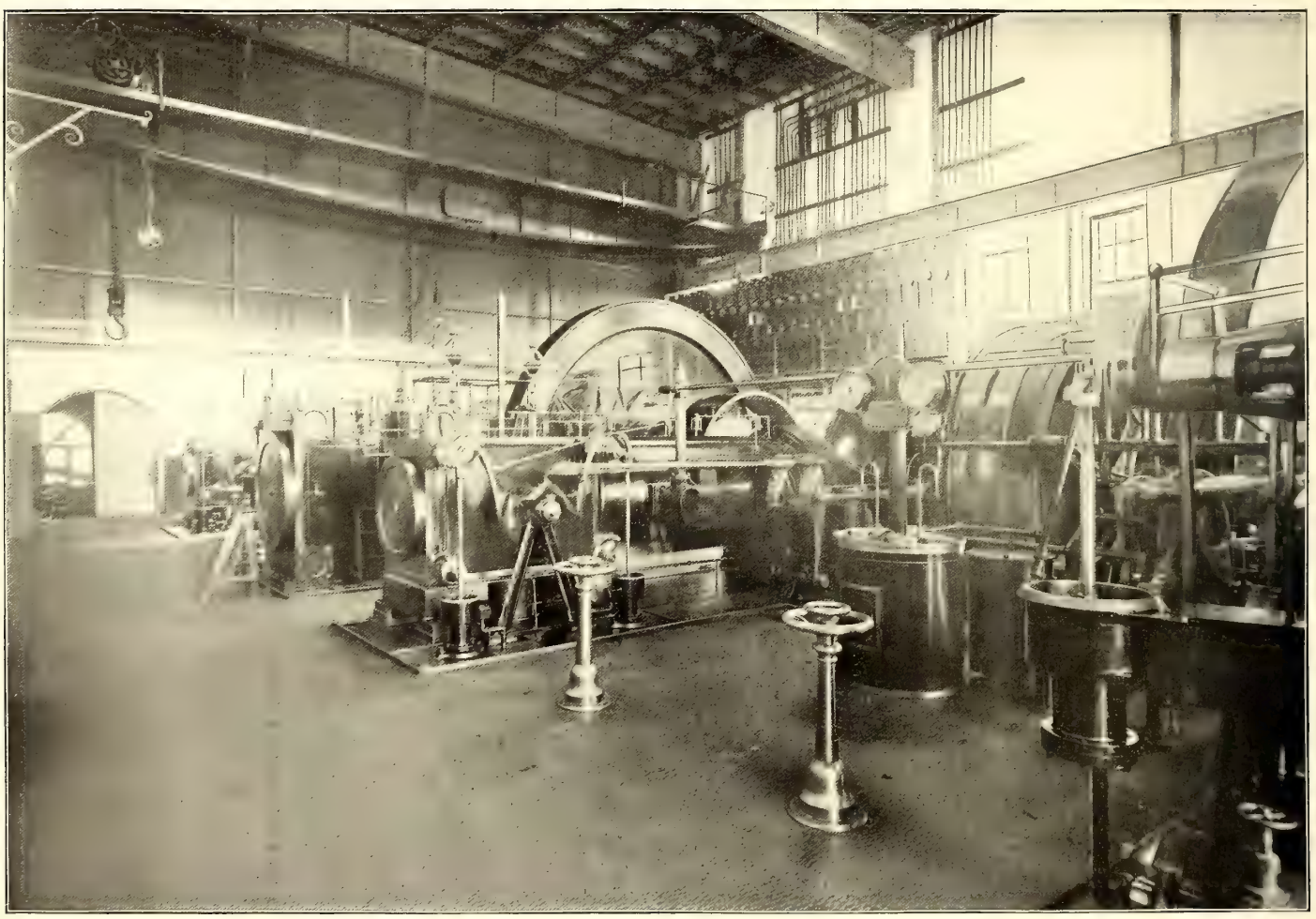
gross receipts per mile of track of the North Chicago Street Railroad Company, one of the components of the Chicago Union Traction Company, were in 1898, $29,855, while those of the other component, the West Chicago Street Railroad Company, were $19,862. The section of the city north of the Chicago River is narrow and wedge shaped, and the large number of people living in this territory are forced upon comparatively few lines, so that the reason for the greater traffic density of the North Side system as compared with the West Chicago system, which reaches a much larger area, is obvious.

United as the Union Consolidated Traction system, the North and West Side lines form an immensely valuable property, which can be operated far more economically together than under separate management, particularly on account of the possibility of running cars through from North to West Sides and return, without the delays incident to switchbacks or loops, by means of which a much greater number of cars can be forced through the congested district, as explained above.

The Chicago Consolidated Traction Company was organized early in 1899 as a consolidation of the following properties:

	Gross Receipts	Earnings from Operation
Chicago Electric Transit Company.....	$278,574	$116,297
Chicago & Jefferson Urban Transit Co.....	44,821	12,470
Cicero & Proviso Street Railway Company.	226,722	72,853
Evanston Street Railway Company.....	17,097	4,474
North Chicago Electric Street Railway Co.. (Including the Chicago North Shore Street Railway Company, operated under lease.)	330,266	161,986
North Side Electric Street Railway Co.....	67,428	31,011
Ogden Street Railway Company.....	61,870	7,198
Totals	$1,026,788	$406,292

All of these properties are located on the North and West Sides, and are feeders to the two great properties in those sections, most of them in outlying territory. The Chicago & Jefferson Urban Transit Company and the Chicago Electric Transit Company, however, own lines reaching quite well toward the business district, though dependent upon the Chicago Union Traction Company for entrance into the congested district.



LAKE STREET POWER STATION, CHICAGO CONSOLIDATED TRACTION COMPANY

The Chicago City Railway Company has always had a monopoly of the through traffic between the great South Side district and the heart of the city, except for the competition of the South Side Elevated Railway Company, which has been partially nullified once or twice by the purchase of control by Chicago City interests. The Chicago City Railway Company was the first company east of San Francisco to adopt the cable system for the operation of several of its through lines, and its financial success has been phenomenal. It is to-day one of the most strongly entrenched and valuable properties in the country.

The Calumet, South Chicago City and other properties in the extreme southern portions of the city are working in comparatively new territory, which will undoubtedly be the seat of a large population in the near future. Unfortunately, for several years past, this district has been suffering from a reaction from the World's Fair "boom," which abnormally increased real estate values and speculation in and around Jackson Park, but there are indications that

the tide has again turned upward, and that there will be a healthy growth in population henceforward.

As throwing light on the reasons why the cable system is disappearing even from Chicago, where its hold has been strongest, it will be interesting to quote the comparative costs of operation of horse, cable and electric traction on the lines of the Chicago City Railway Company. This company operated its electric cars in 1898 at 12.9 cents per car mile, its cable cars (including trailers) at 10.8 cents and its horse cars at 27.2 cents; while the electric cars earned 22.7 cents per car mile, the cable cars 16.5 cents, and the horse cars 16.6 cents. The net earnings per car mile of the electric lines were therefore 9.8 cents, while the cable lines earned only 5.7 cents, and the horse lines actually showed a deficit from operation of 10.7 cents per car mile.

The different Chicago properties which report earnings, exhibit the following percentages of operating expenses to gross receipts for the year ending Dec. 31, 1898.

	Per cent
North Chicago Street Railway Company	*46.1
West Chicago Street Railroad Company	*50.0
Chicago City Railway Company	†60.6
Chicago Consolidated Traction Company	*60.4
Chicago General Railway Company	*49.8
South Side Elevated Railroad Company	‡53.5
Lake Street Elevated Railroad Company	‡51.2
Metropolitan West Side Elevated Railway Company	‡47.4

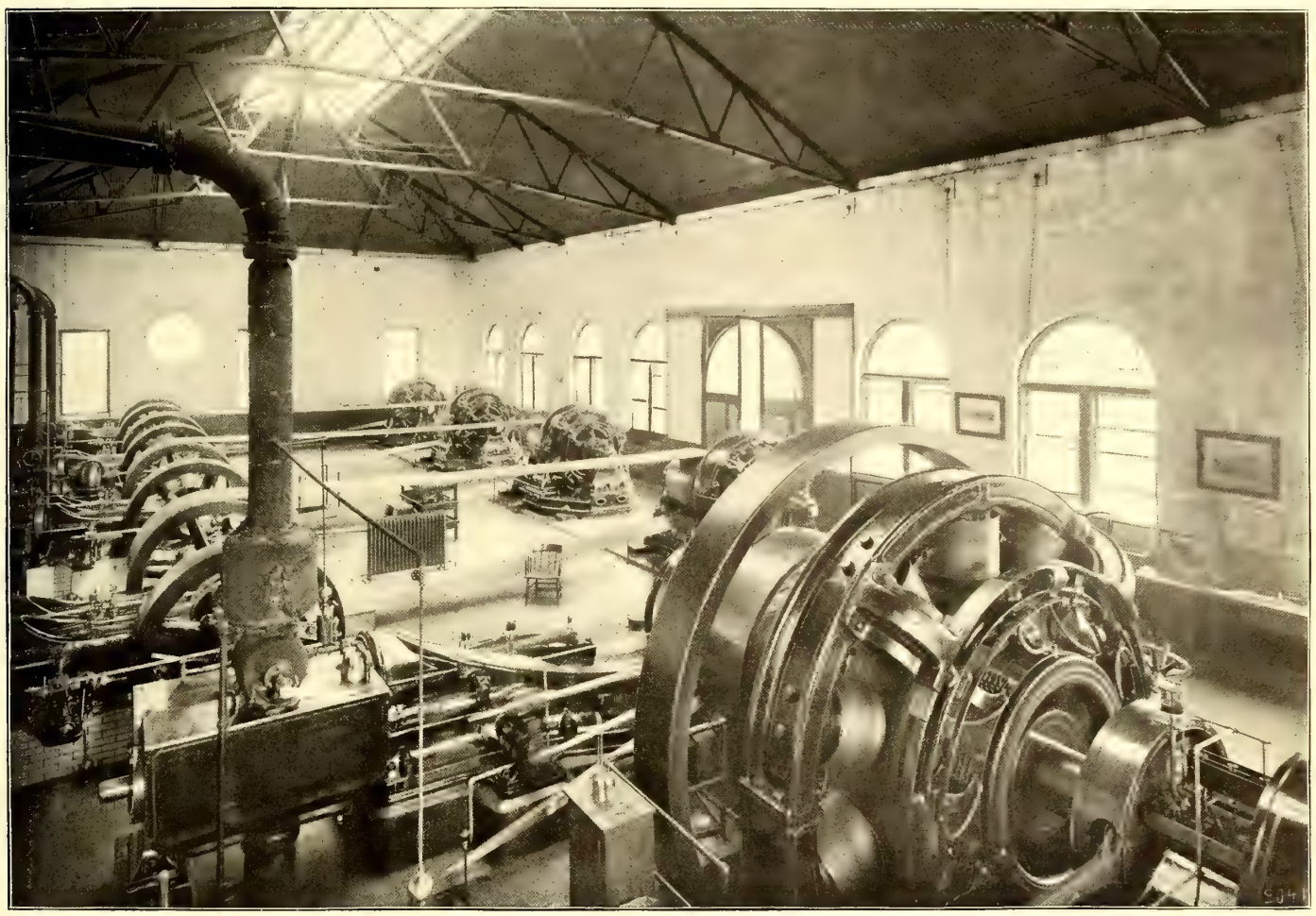
*Operating expenses exclude taxes.
†Operating expenses include taxes.
‡Operating expenses exclude taxes and loop rental.

THE POWER STATIONS OF CHICAGO

The general design and relative sizes of the power stations of Chicago may be understood from an examination of the diagrams on the inset between pages 628 and 629, and a good idea of the character of the work done in them appears in the accompanying illustrations. It will be seen that there is a wide variety of practice in the city stations, and that several of them are not of the most modern types, but would be built quite differently were the work to be done to-day instead of four or five years ago, in the light of later experience.

Several of the stations, however, are admirable. That of the South Side Railway Company, designed by Sargent & Lundy, is one of the most economical railway power stations in the world, if not, indeed, the most so, its cost of operation being well below 7½ mills per kw. hour. The original equipment of this station was with four horizontal, cross compound Allis engines, with cylinders 26 ins. and 54 ins. x 48 ins., each driving an 800-kw. Westinghouse generator, and there are now building two additional cross compound Allis engines, with cylinders 34 ins. and 70 ins. x 54 ins. to drive 1600-kw. Westinghouse generators. The new engines are capable of working up to a maximum of 4000 h.p., and their speed is 80 r.p.m. with 160 lbs. steam pressure.

Twelve B. & W. water tube boilers are installed in the station, with 48,000 sq. ft. of heating surface, and these are fired by means of B. & W. automatic chain grate stokers, fed by pendulum chutes communicating with steel



POWER STATION, CALUMET ELECTRIC STREET RAILWAY COMPANY

storage bunkers supported above the boiler room, to which coal is delivered by the Mead Company's McCaslin coal conveyors. Reynolds condensers and Blake pumps are used, together with the Warren-Webster feed water heater and the Green fuel economizer, the latter consisting of 832 tubes. The course of the feed water is through the heater, thence to the pumps, the economizer and to the boilers.

One of the most interesting features of this station is the water cooling tower, located outside of the power station proper. This was installed by the Wheeler Condenser & Engineering Company. The tower is 64 ft. long, 34 ft. high and 16½ ft. wide. It is to be enlarged to correspond with the increase in equipment now being made, and is to be extended in height so as to bring the shell above the roofs of the adjoining buildings, this being found necessary on account of local annoyance from the spray from the towers.

The condensing water is pumped to the top of this structure, where it is thrown upon vertical wire screens, down which it trickles, and by means of which it is brought in contact with an air blast created by a system of fans. These fans are ten in number, each 10 ft. in diameter, and are operated in pairs on the same shaft, but are located one on each side of the tower. In the middle of the tower is a baffling plate, which curves outward in the direction of each fan, and upon this plate the water passes to a tank beneath, so that the air blast cannot blow water from one fan to the other. The five shafts, by means of which the fans are operated, extend across the open space and enter the power station, where each is coupled to an 18-h.p. C. & C. motor, by which they are driven. By means of this cooling tower the temperature of the water is reduced 30 degs. to 40 degs.

The Westinghouse generators were built upon specifications which provided that they should be operated continuously at a load of 650 volts and 1230 amps., and to operate at 650 volts and 1845 amps. for three hours without injury. The minimum insulation resistance between copper and iron was required to be 2 megohms and the field coils were required to be capable of withstanding an alternating current of 3500 volts. The machines are guaranteed to have an efficiency of 94½ per cent at full load. In practice the machines work from no load to 50 per cent overload without sparking at the brushes, which rarely or never need to be adjusted after being once set.



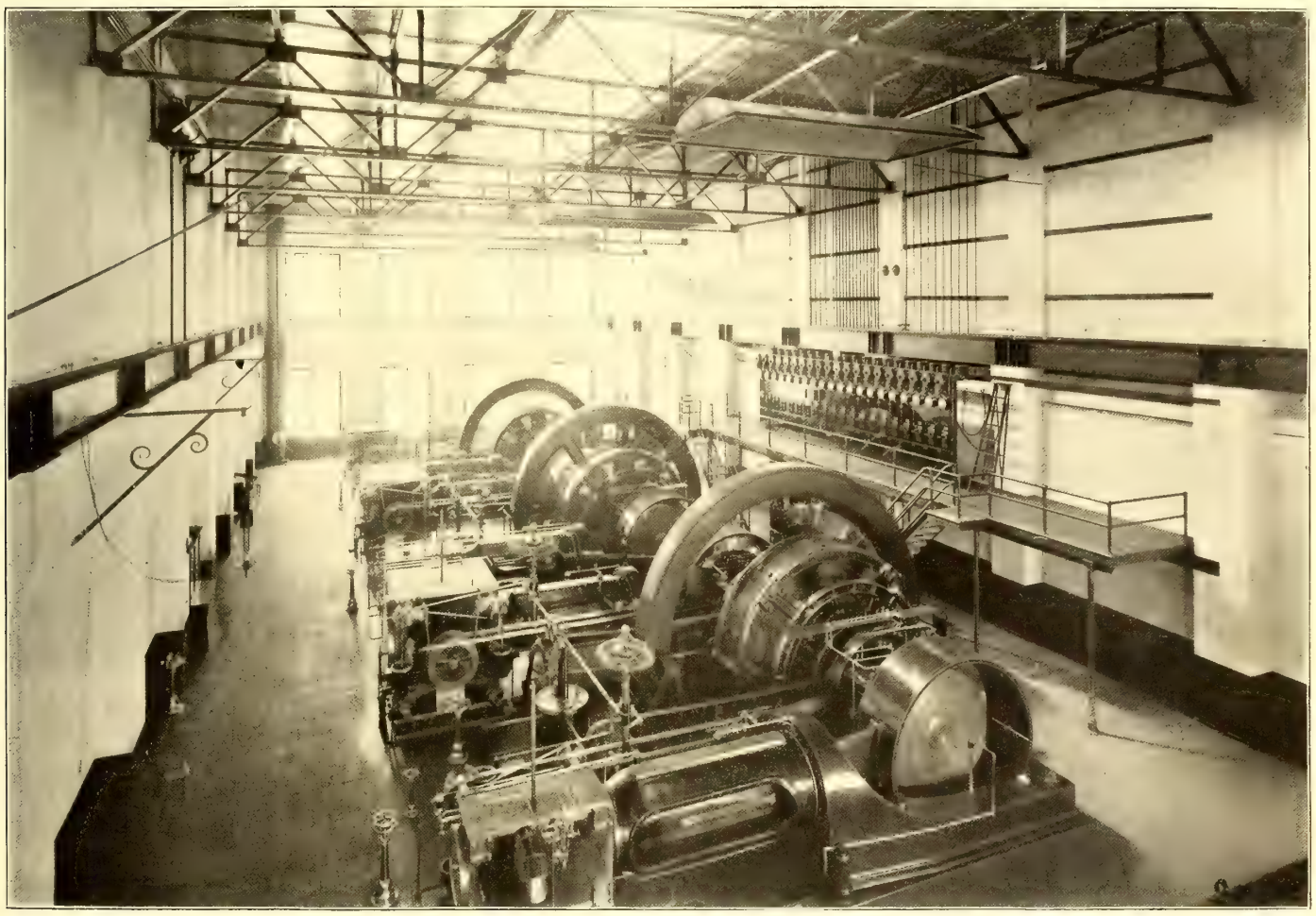
CALIFORNIA AVENUE POWER STATION, CHICAGO UNION TRACTION COMPANY

Included in the auxiliary equipment of the engine room is a Turner automatic oiling and filtering device, manufactured by the Economic Machine Works, of Chicago, and a 30-ton electric traveling crane, made by the Morgan Engineering Company, of Alliance. This crane has a longitudinal speed of 200 ft. per minute and a cross speed of from 50 ft. to 75 ft. per minute.

One of the features of this station which has undoubtedly given it its high economy for the fluctuating service for which the station is intended, is the extensive storage battery plant, of which one-half is located at Sixty-first Street, and one-half at Twelfth Street, each being at a distance of about 3 miles from the generating station. Each of these two plants consists of 263 cells of 750 kw.

total capacity, and on fluctuations they can deliver 2400 amps. to the line, while the output has run as high as 4300. The batteries are in charge of the ticket agent at one station and of the train dispatcher at the other, and the only duty of each is to throw in the circuit breakers should they fly out.

When the line was first opened this power station, then consisting of four 800-kw. units, was able to run but ninety cars, of the type shown in Fig. 19, page 635, all of these being motor cars run on the Sprague multiple unit system. Later on, however, when everything became "limbered up" and the motormen became more skillful in handling the cars, the station has been able to run 130 cars regularly, while 167 even have been operated, at a time when it was also necessary to provide for the heating of the cars by the electric current as well as to maintain the regular schedule of sixteen to seventeen miles per hour, including stops. The average power output per car mile ranges approximately from 2 kw. hours per car mile in summer to 3.55 kw. hours in winter, the latter figure including electric heating of cars, and both including lighting, air compressors for brakes, station lighting, switches in yards and power for fan and auxiliary motors.

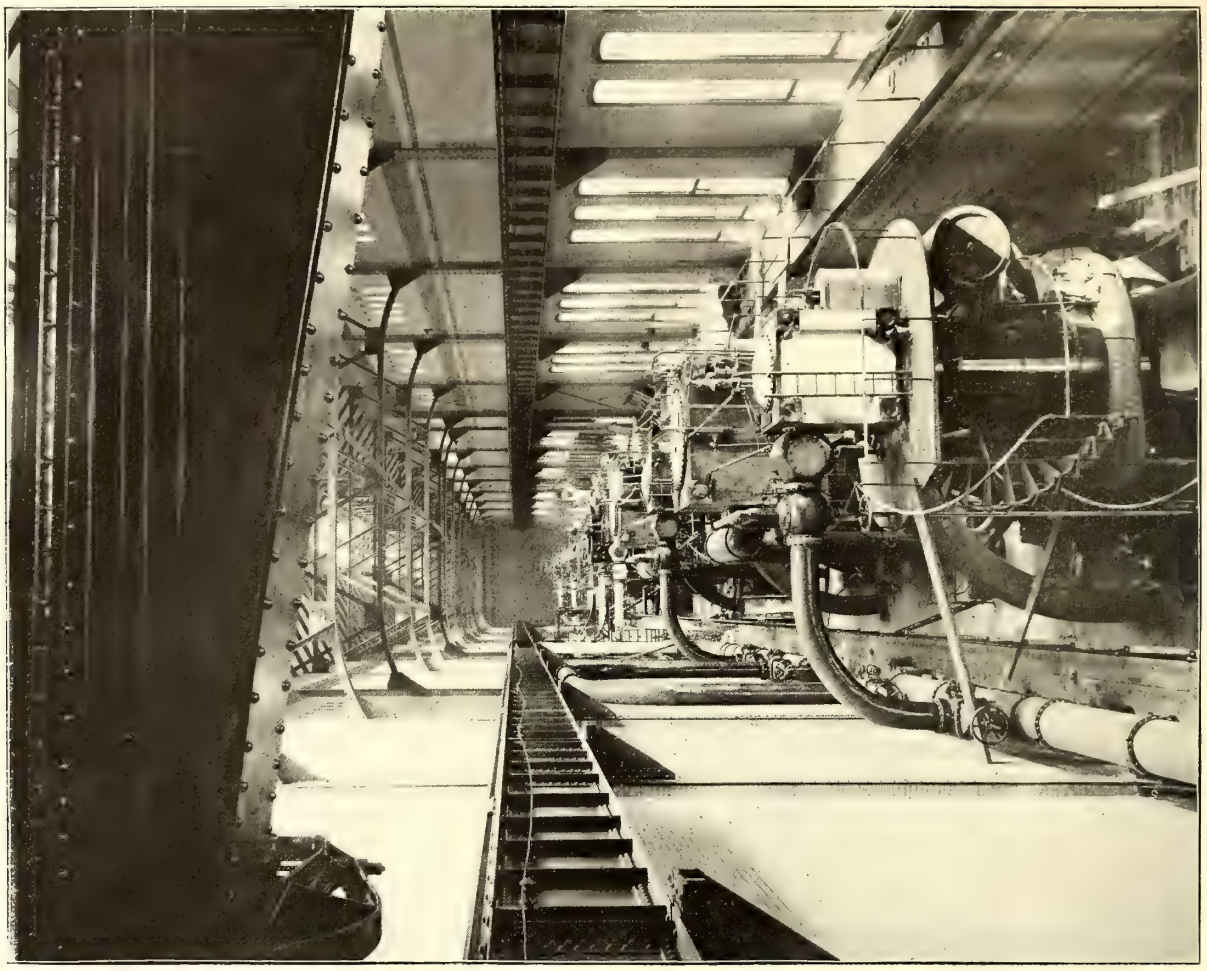


HOBBIE STREET POWER STATION, CHICAGO UNION TRACTION COMPANY

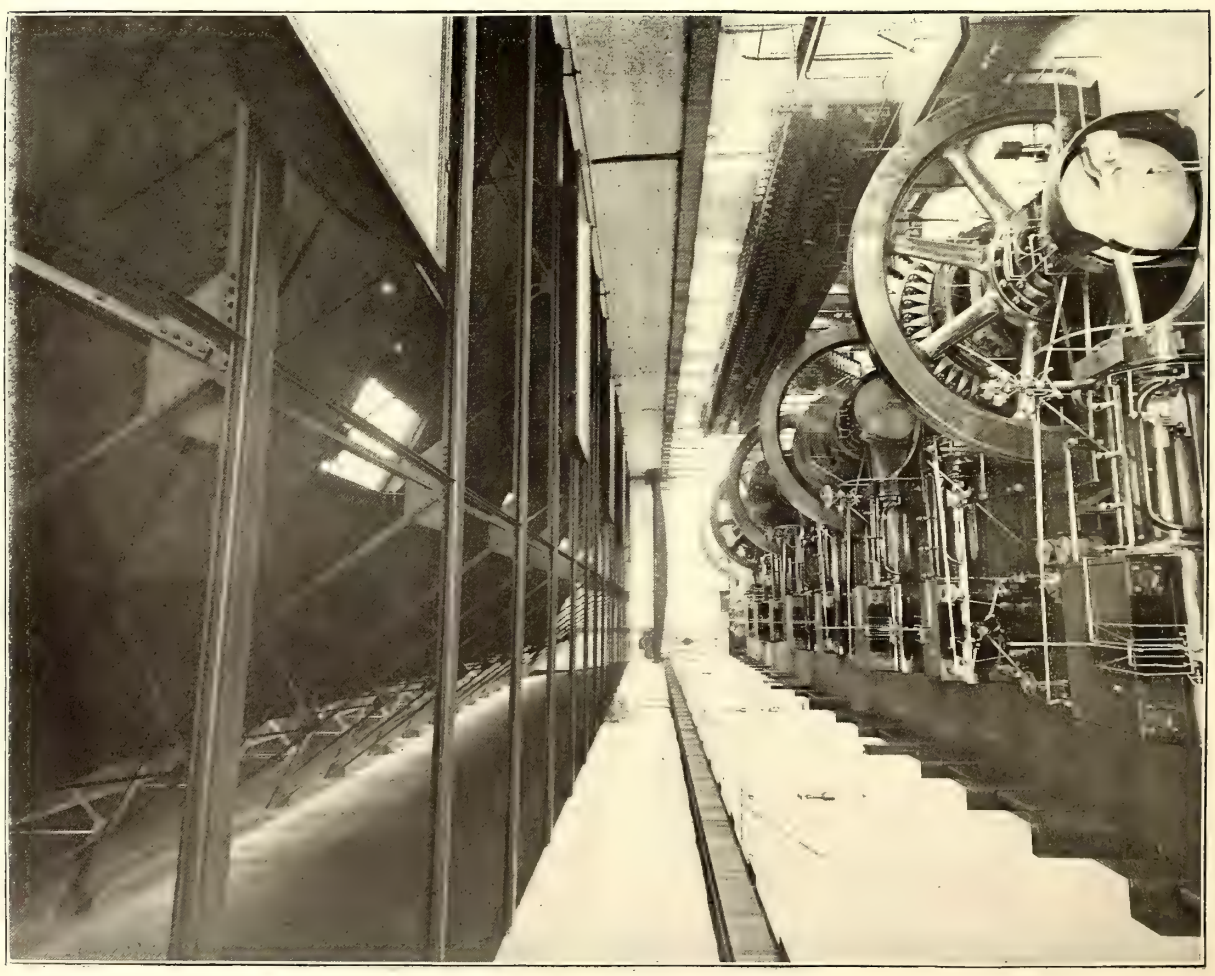
The South Side and Metropolitan West Side Elevated Railway stations, the Hobbie Street station of the Union Traction Company, the Calumet and South Chicago City stations are the only ones in the city which are operating condensing, though the new Northwestern station will, when completed, be run as a condensing station. The Calumet system of condensation is worthy of description. The original plant consisted of four Ball cross compound non-condensing engines, each belted to two 100-kw. Detroit generators. Under the present management by Mr. Sloan, provision was made to run these engines condensing, and when the change was made each Ball engine was belted to a 150-kw. Walker generator, and the power was thus increased from 250 h.p. to 330 h.p. per engine. At the same time, one 800-h.p. cross compound Buckeye engine was put in, direct coupled to a 500-kw. General Electric multipolar generator. Two Deane condensers were installed, in which a vacuum of 22 ins. to 23 ins. is secured in summer, and 24 ins. to 26 ins. in winter. There being no natural supply of condensing water, it is necessary to use city water and to make provision for economizing it in every possible way. On page 628 is shown a pond located near the power station, and a system of cooling tables. The tables are about 12 ft. wide and 70 ft. long, and the water passes from the delivery pipes to the feeder, when it falls upon the second table and returns to the shore of the pond, from which it is again passed to the condenser. The pond is first filled from city water main, but the supply is reinforced by rain water collected from the roofs of the neighboring buildings and conducted to the pond.

The Calumet power station is shown on page 621, and the very interesting Metropolitan power station and engine room on pages 619 and 624.

The Chicago City power stations are rope driven plants,



ENGINE ROOM, METROPOLITAN WEST SIDE ELEVATED RAILWAY



ENGINE ROOM, WESTERN AVENUE POWER STATION, CHICAGO, UNION TRACTION COMPANY

using small units as compared with present practices. They have return tubular boilers, and Green-Wheelock engines.

The Western Avenue and Hobbie Street stations of the Union Traction Company are shown on pages 623 and 624. The former is the largest surface railway station in Chicago, and contains engines made by Fraser & Chalmers, the George H. Corliss Company and the Pennsylvania Iron Works, all direct connected to Siemens & Halske generators. The last one built, of 500-kw. size, to run in connection with the 2000-h.p. Pennsylvania Iron Works condensing vessel of sufficient capacity to take care of the steam from 1,400 h.p. of engines.

The kilowatt capacity of the principal stations is as follows:

Chicago Union Traction Company—
- Hobbie Street Station.....3,200 kw.
- Western Avenue Station.....8,000 kw.

Chicago City Railway Company—
- Fifty-second Street Station.....5,000 kw.
- Forty-ninth Street Station.....5,200 kw.
- Twentieth Street Station..... 500 kw.



FORTY-NINTH STREET POWER STATION, CHICAGO CITY RAILWAY

Company's engine, is fitted with an internal commutator different from the Siemens & Halske former practice. Since building this generator further commutator improvements have been made. *

The Green Engineering Company, of Chicago, is now installing twenty of its chain grate stokers to go with the 8000 h.p. of Stirling boilers in this station.

The Union Loop station is interesting, having been originally designed to burn oil as fuel, although on account of a rise in prices this is now understood to have become uneconomical. †

The new Northwestern Elevated station, a description of which appeared in the Street Railway Journal for July, page 452, was designed by J. R. Chapman, and one of its most interesting engineering features is the Weiss counter current central condensing system, in which is a

Chicago Consolidated Traction Company—
- California Avenue Station.....2,800 kw.
- Edgewater Station (closed).....1,200 kw.
- Harvey Avenue Station.....4,000 kw.

Calumet Railway Station.....1,100 kw.
Chicago General Railway Station..... 400 kw.
Metropolitan Elevated Railway Station.....9,600 kw.
South Chicago City Railway Station.....1,100 kw.
South Side Elevated Railway Station.....6,400 kw.
Northwestern Elevated Railway Station.....5,300 kw.

Taking a general survey of the entire power station equipment of the city, it will be interesting to see how the different types of apparatus are represented.

The Babcock & Wilcox Company has installed sixty-four boilers, aggregating 23,600-h.p. capacity in the Metropolitan, South Side, Northwestern and Union Elevated stations; the Stirling Company has placed about 10,000-h.p. of boiler capacity in the Western Avenue plant of the Union Traction Company, and the stations of the Subur-

*For description see Street Railway Journal for July, 1899, page 429.

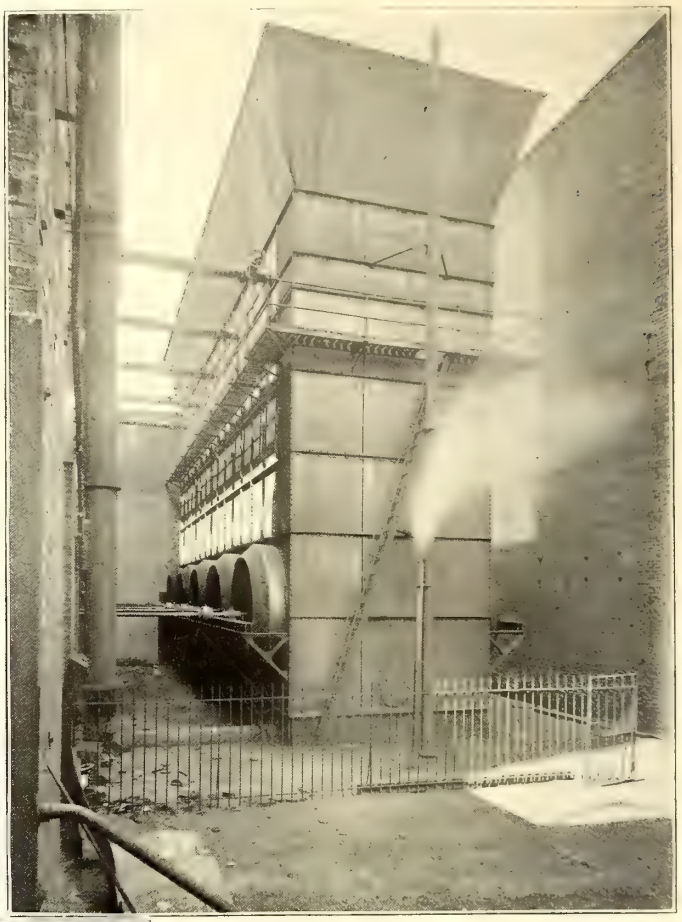
†For full description of this station see Street Railway Journal for December, 1898, page 769.

ban Railway Company and the South Chicago City Railway Company; 8400-h.p. of Campbell & Zell boilers are used by two of the stations of the Chicago Consolidated Traction Company; and the Abendroth & Root boilers are used by the Chicago General Railway Company; while the Chicago City Railway Company, as before stated, uses return tubular boilers chiefly, together with a Hazelton boiler and a Babcock & Wilcox in one of its stations.

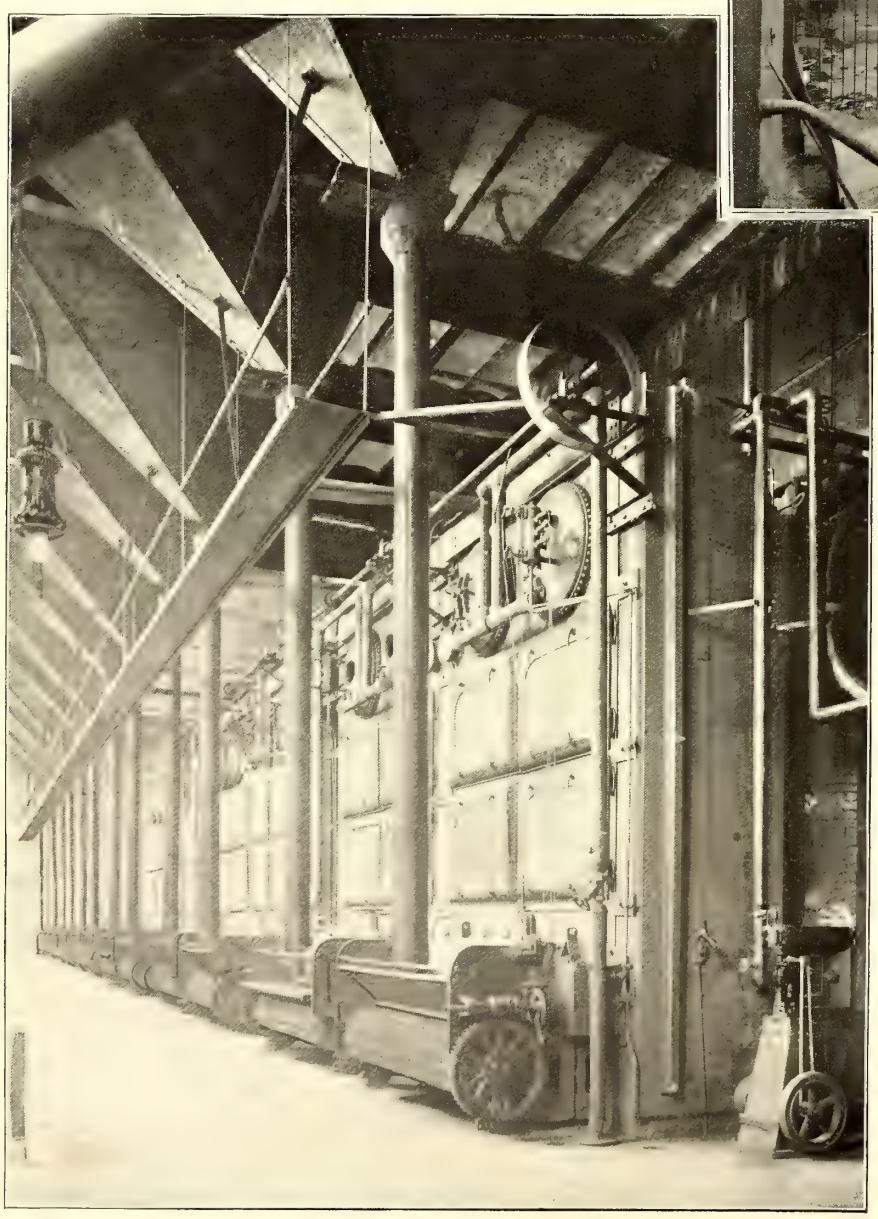
The Green economizers are used in the Metropolitan and South Side Elevated stations, and in those of the South Chicago City, Chicago & Milwaukee and the Chicago Electric Traction Companies.

The Wheeler Condenser & Engineering Company have furnished the South Side Elevated Railroad with a Barnard water cooling plant of 10,000 h.p., previously described, and has furnished the Union Loop station with a 7500-h.p. outfit of "Wheeler Admiralty" surface condensers, Wheeler vertical and horizontal feed water heaters, vertical twin air pumps, centrifugal circulating pumps, etc.

Blake pumps of various types are used in the Union Loop station, the Northwestern and South Side Elevated stations, the Western Avenue and Hobbie Street stations



COOLING TOWER, NEAR POWER STATION, SOUTH SIDE ELEVATED RAILWAY



BOILER ROOM, SOUTH SIDE ELEVATED RAILWAY

of the Union Consolidated Company, and the Cicero & Proviso and Chicago Electric Transit Companies stations.

Chapman high and low pressure valves are used in several of the elevated railway stations, and in those of the Union Traction Company and the Chicago City Railway Company. In some of the Union Traction stations and in the Northwestern station are also a large number of 18-in., 22-in. and 30-in. valves of the Ludlow Manufacturing Company.

The Siegrist Lubricating Company has installed a plant for oiling all of the engines and generators of the Metropolitan West Side Elevated Railway Company.

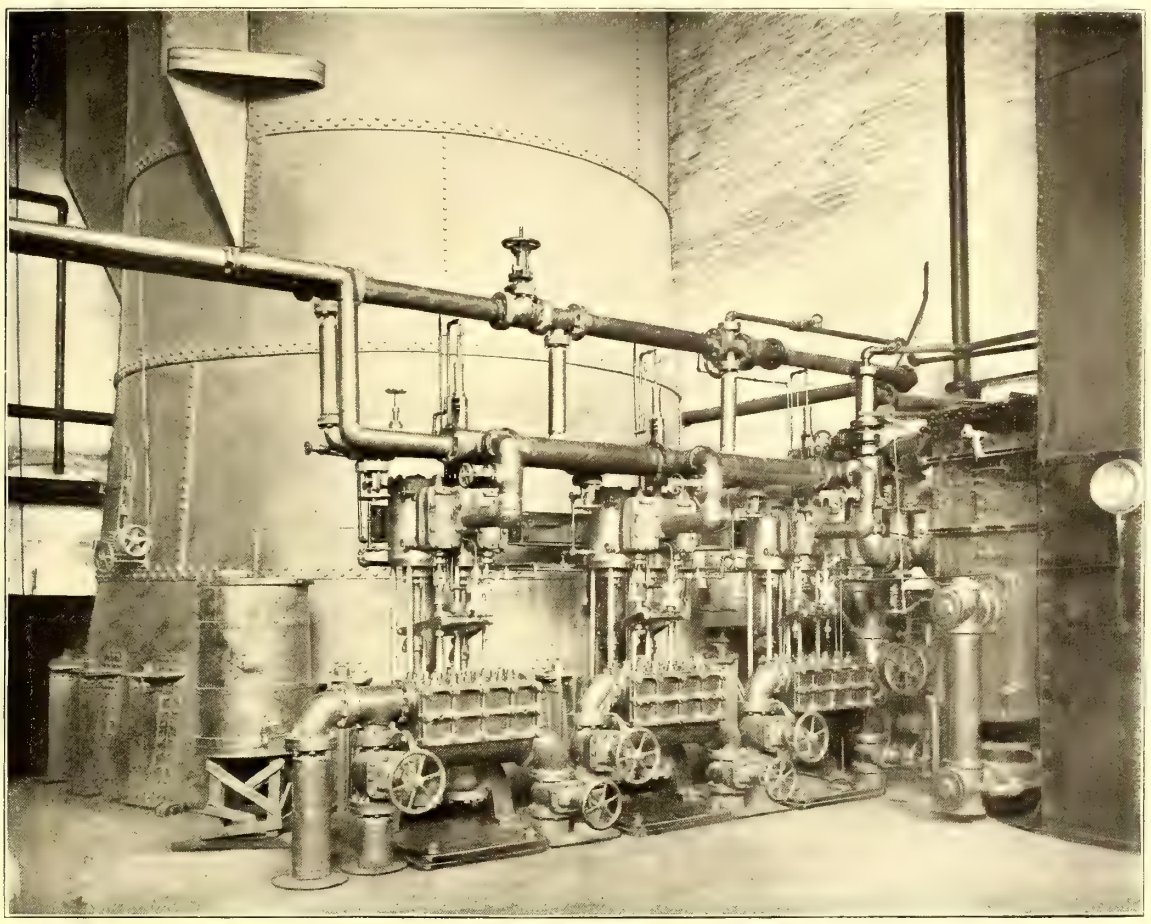
The Reynolds Corliss engines, of the Allis Company, are used in the stations of all the elevated railway companies of the city except the Lake Street and Union, and in the Hobbie Street and Cicero & Proviso stations. Between 3000 and 4000 h. p. in all have been installed for railway service in sizes ranging from 1200 h.p. to 2500 h.p. The Wheelock and Green Wheelock engines to the extent of 25,000 h.p. are used in the Chicago City power stations, and in the Edgewater plant of the Chicago Consolidated company, now closed. The

Fraser & Chalmers engines are now used in the Western Avenue and California Avenue stations, the Buckeye and Ball in the Calumet station, and Pennsylvania Iron Works and George H. Corliss in the Western Avenue station.

Twenty-six generators with an aggregate capacity of nearly 15,000 kw. have been furnished to the power stations of Chicago by the General Electric Company, sixteen generators with a capacity of about 11,000 kw. have been furnished by the Westinghouse Company, and nine generators with a capacity of 7500 kw. have been furnished by the Siemens & Halske Company.

In the auxiliary steam apparatus we find represented the Baragwanath, Hoppes, Berryman, Reynolds and Wainwright feed water heaters; Chapman, Crane, Jenkins and Ludlow valves; Worthington, Blake, Deane, Weir and Craig pumps; Rooney, Murphy, Link Belt, McCaslin, Babcock & Wilcox, Hunt, Jeffries and Borden & Sellers furnaces, grates and stokers; the Siegrist lubricating system; and the DeRycke grease extractor.

The kind of coal used chiefly in Chicago is the Indiana screenings, which costs from $1.12 to $1.30 per ton.



PUMPS AND FEED WATER SYSTEM, SOUTH SIDE STATION

OVERHEAD CONSTRUCTION IN CHICAGO

The overhead structure in Chicago is simple in design, is well put up and is durable. There has been no attempt at over-ornamentation of poles, but the entire structure is as inconspicuous as is possible to obtain. Iron poles weighing from 900 lbs. to 1200 lbs. are used, with wood poles through the "alleys" between streets.

The standard trolley wire of the Union Traction Company is No. 0 hard drawn copper, and the standard guard wire is No. 6 silicon bronze. In the business district silicon bronze is also used for span wire, while in the suburbs 5-16-in. stranded galvanized wires are used. Ætna insulation is used throughout with line material made by Albert & J. M. Anderson, the originators of the Ætna insulation.

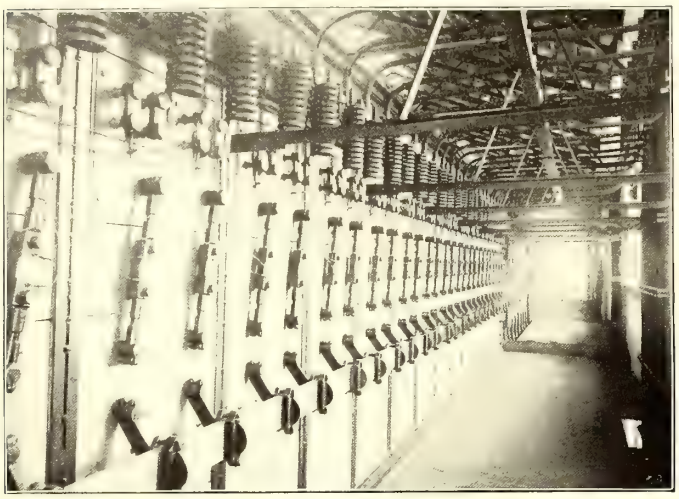
The Chicago City Railway Company formerly used No. 0 trolley wire, but now uses No. 00, both because of its mechanical strength and because of its assistance in helping out the general feeder distribution system. A span wire consisting of ⅜-in. seven strand galvanized iron cable is used at all places, but there are no guard wires on the Chicago City system, as they are believed to be a menace to life and property, and in all cases where they were formerly installed they have been taken down.

In the engravings pages 630-631 are shown all types of line material ever used on the Chicago City system, the engraving, Fig. 5, showing the material selected as the company's present standard. The following description of these standard pieces will well illustrate the latest development of overhead line material and the reasons for some of the mechanical details which have been devised.

Brass is employed in all of this material with one or two exceptions, and iron is in no place made to join iron, even where it is necessary to let an eye bolt, for example, into a brass core. Malleable and other iron material in overhead work has been practically abandoned because of its rapid deterioration and loss in cross section by rust, and also because it was found that the rust spread over the insulating material, causing short circuits. Brass is not affected by the weather, and when broken or discarded for any reason can be melted down, and is found cheaper in the long run than iron.

While the high insulating qualities of rubber are recog-

nized, particularly in places where it can be kept free from air and moisture, it is found in the Chicago City Company's practice that on exposure the surface cracks, and after a short time these cracks become filled with coal dust, soot



BACK OF SWITCHBOARD, CHICAGO CITY RAILWAY STATION

and other particles which serve to conduct the current around and across the insulation. The company's standard insulating material, therefore, is red fibre for switches and cutouts, and Ætna insulation for all other appliances, the Ætna being regarded as the best in use. Three insulations between the trolley wire and the ground are made in all cases, the first being a fibre spool in the pole band (Fig. 5, No. 41); the second, a similar insulating spool (No.50), attached to the first by a 3-ft. strand of galvanized iron wire, and the third, the regular straight line hanger (No. 19). This consists of an insulating bolt (No. 20), and a wood piece (No. 57).

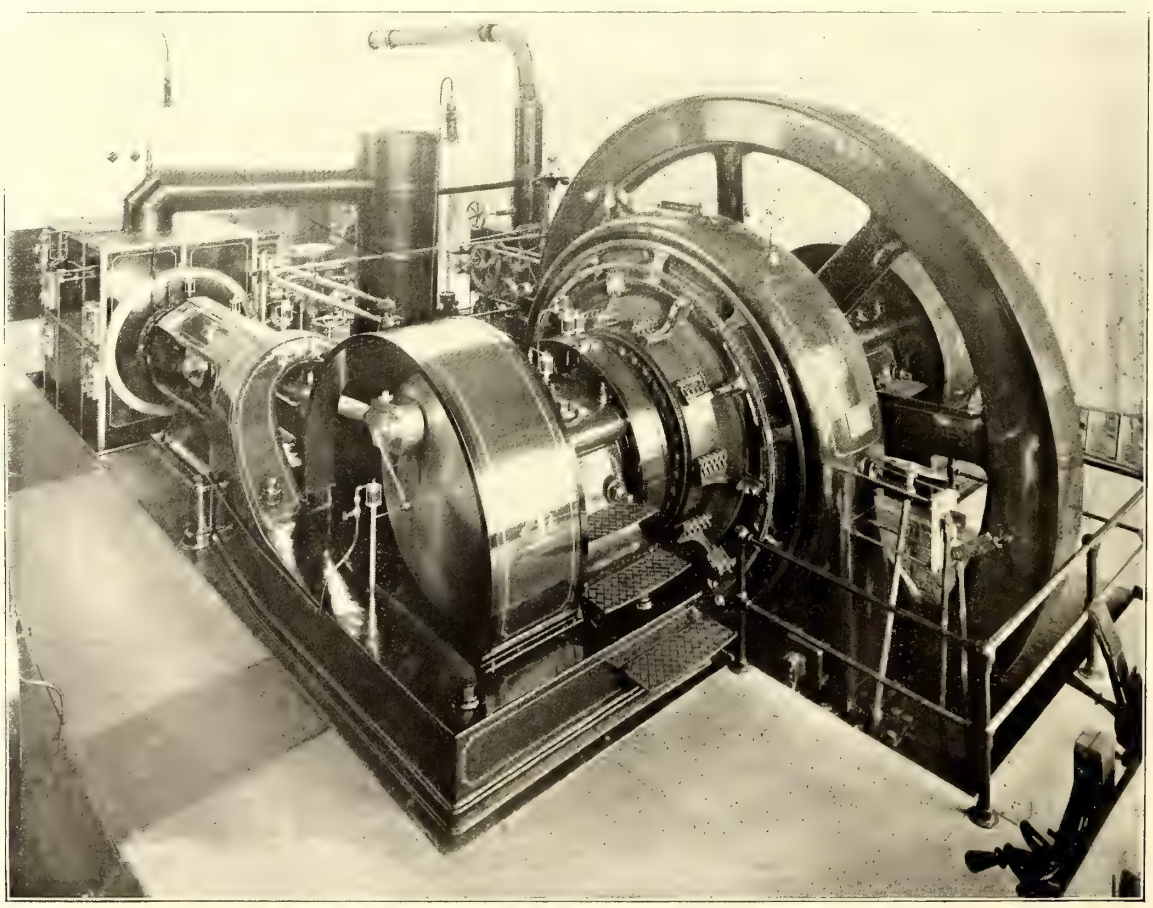
In splicing two pieces of trolley wire, their ends are brought to the splicing ear (No. 17), and bent up therein through holes, leaving a smooth run for the trolley wheel. No solder is used either in splicing or attaching straight line hangers, but only for connecting feeder cables. The heat necessary for the use of solder is found to anneal



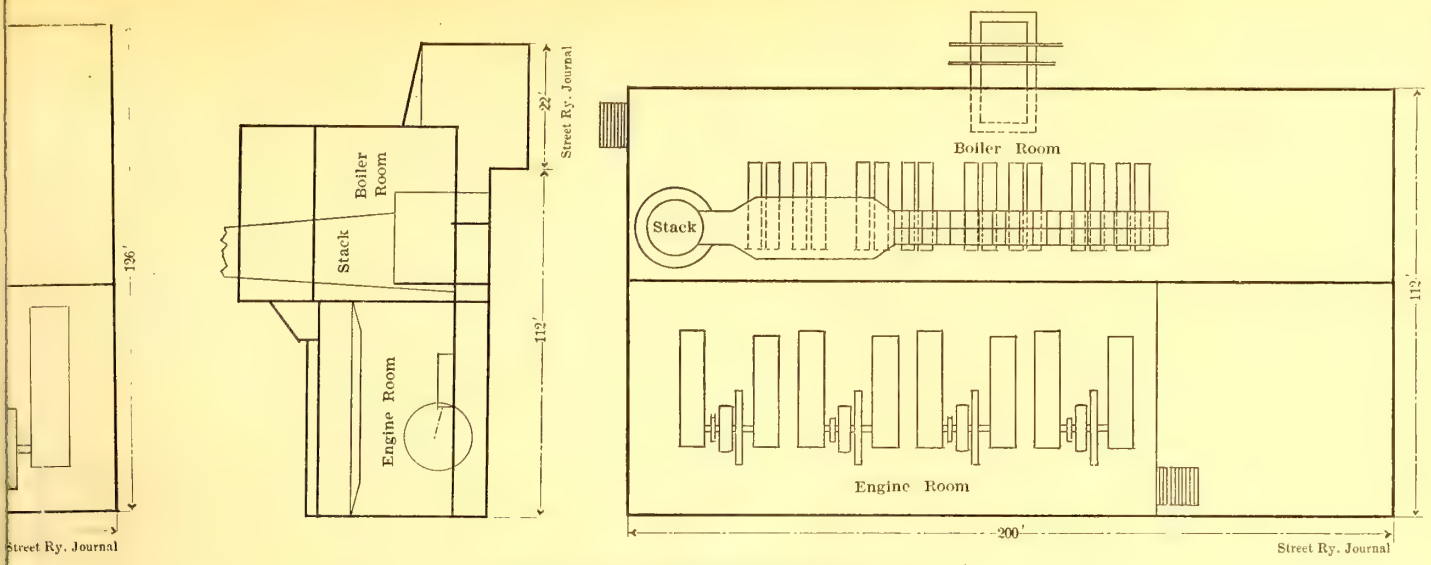
COOLING TABLES, CALUMET STATION

trolley wire, weakening it and making it liable to crystallization and breakage.

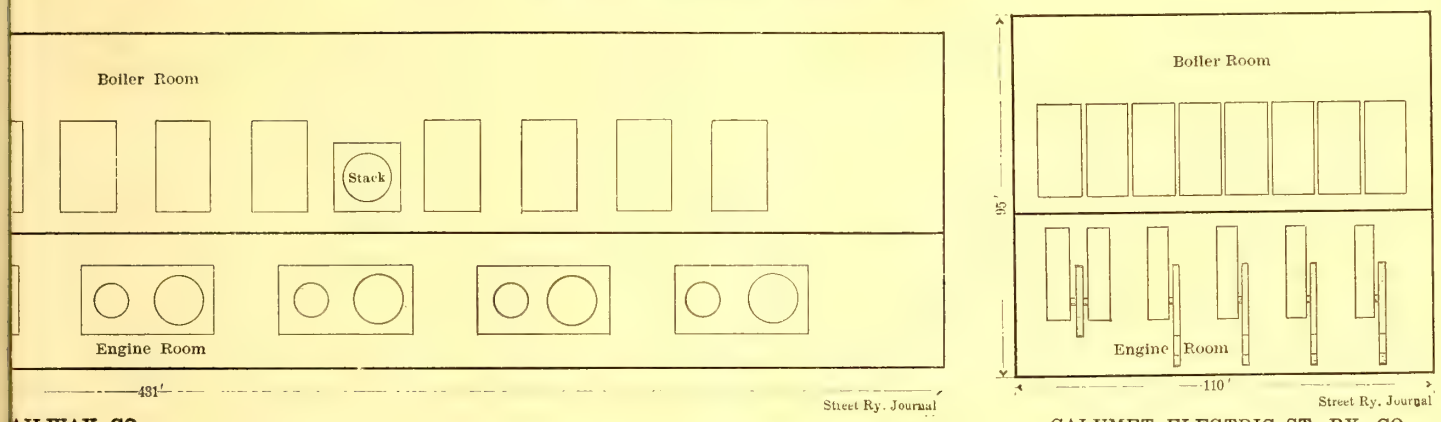
When trolley wires are strung in ordinary summer weather, or when the temperature runs about 75 degs., a sag of 8 ins. or 10 ins. is allowed in all spans of from 115 ft. to 120 ft., but in cold weather from 5 ins. to 6 ins. of sag only are allowed. The average height of the trolley wire above the ground is from 19 ft. to 19 ft. 6 ins., except at railroad crossings, where it is from 22 ft. 6 ins. to 23 ft. A



ENGINE GENERATOR UNIT, SOUTH SIDE STATION

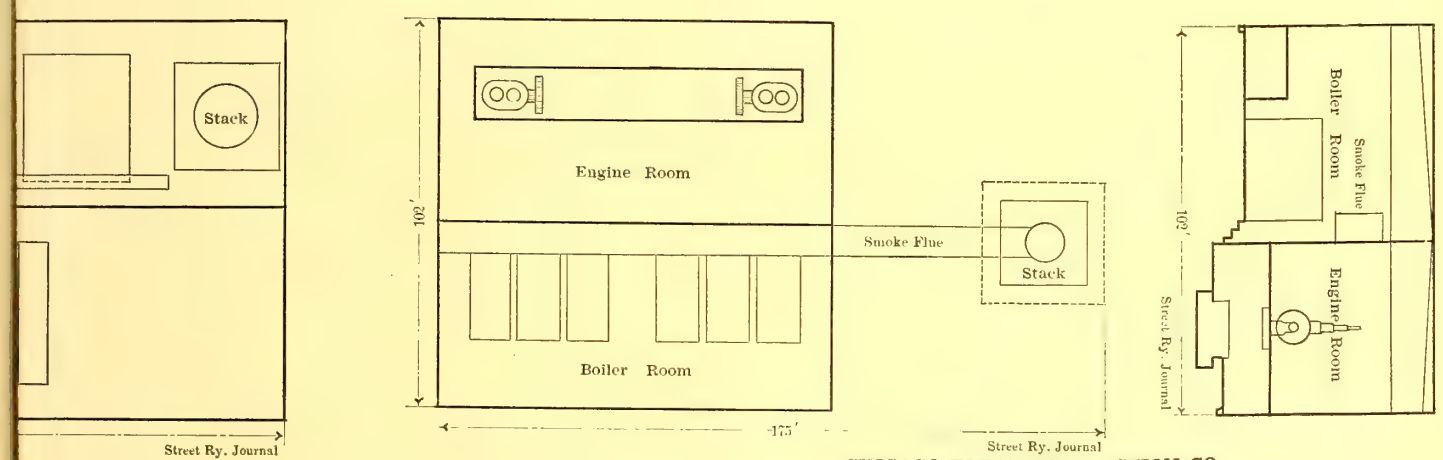


SOUTH SIDE ELEVATED RAILWAY CO.

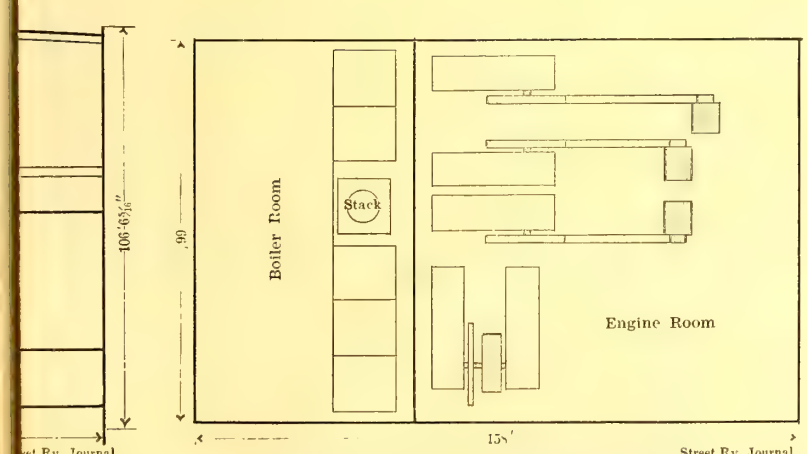


AILWAY CO.

CALUMET ELECTRIC ST. RY. CO.



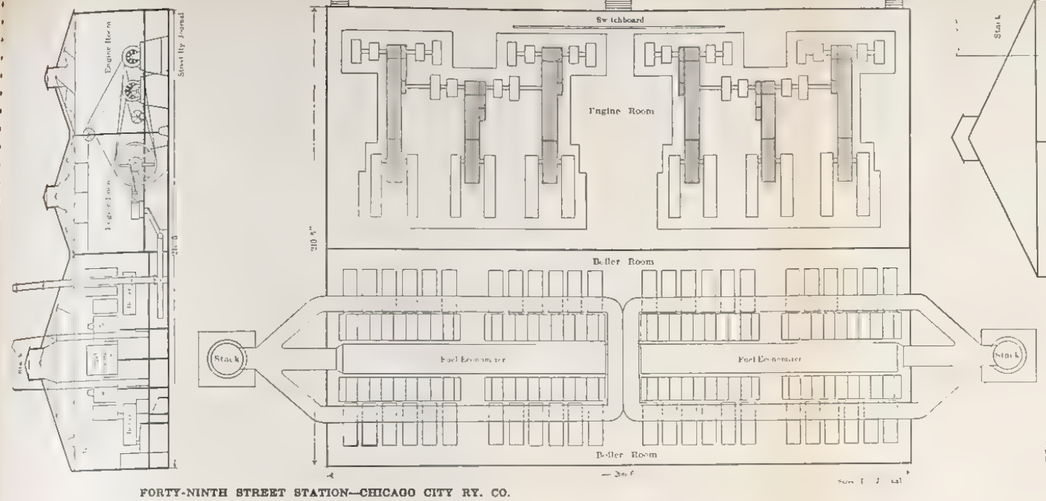
CHICAGO ELECTRIC TRACTION CO.



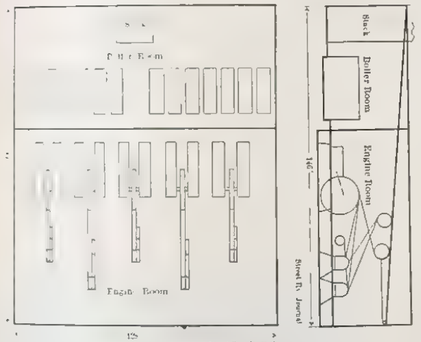
SOUTH CHICAGO CITY RAILWAY CO.

PLANS AND CROSS SECTIONS OF THE PRINCIPAL ELECTRIC RAILWAY POWER STATIONS IN CHICAGO

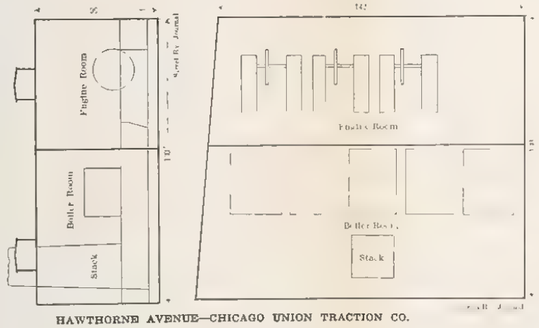
Scale: 1 inch = 50 feet



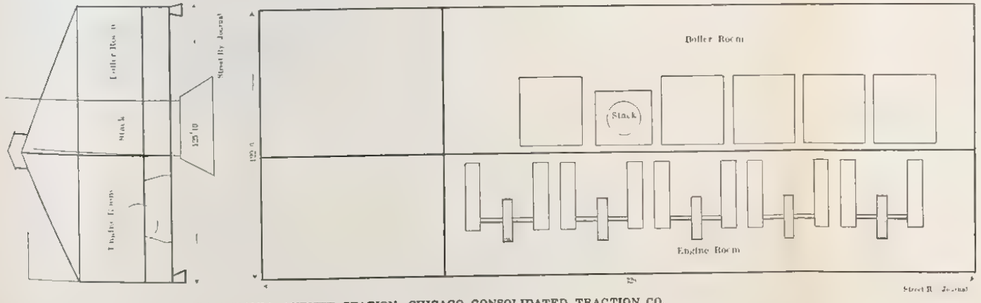
FORTY-NINTH STREET STATION—CHICAGO CITY RY. CO.



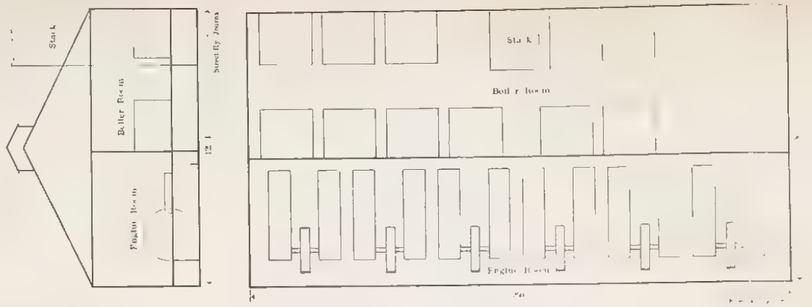
FIFTY-SECOND STREET STATION—CHICAGO CITY RY. CO.



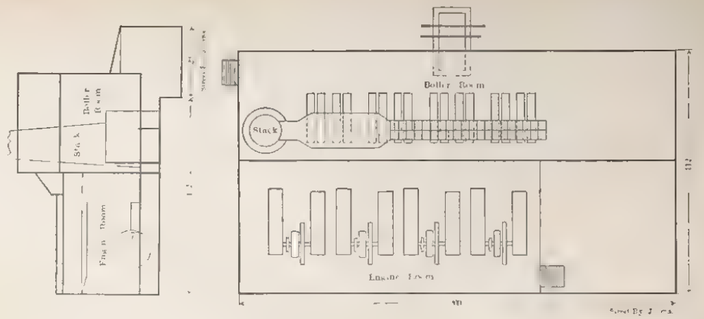
HAWTHORNE AVENUE—CHICAGO UNION TRACTION CO.



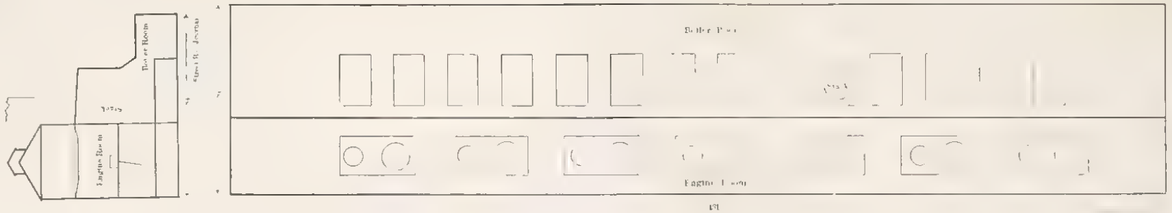
CALIFORNIA AVENUE STATION—CHICAGO CONSOLIDATED TRACTION CO.



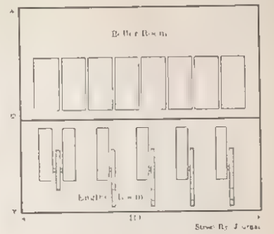
WESTERN AVENUE STATION—CHICAGO UNION TRACTION CO.



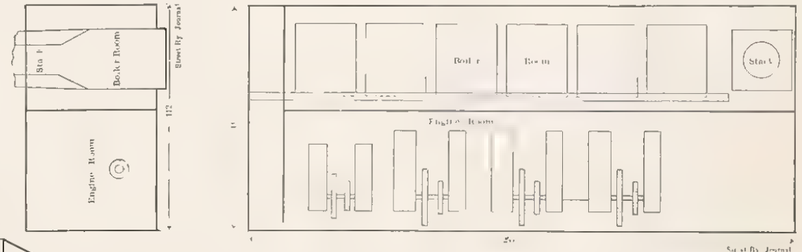
SOUTH SIDE ELEVATED RAILWAY CO



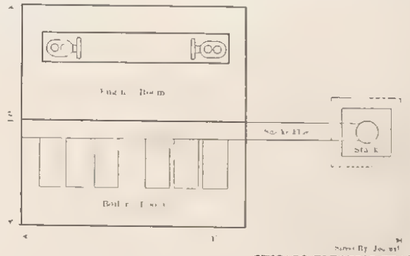
METROPOLITAN WEST SIDE ELEVATED RAILWAY CO.



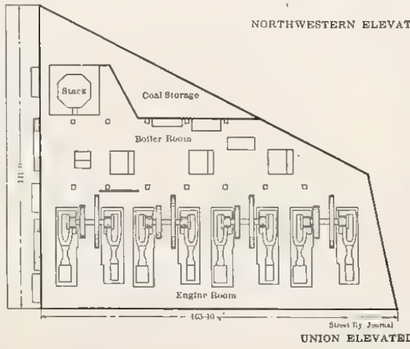
CALUMET ELECTRIC ST. RY CO



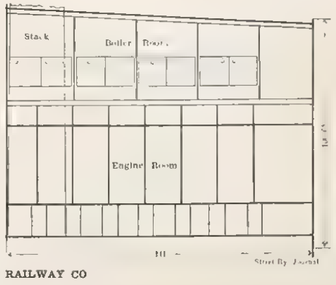
NORTHWESTERN ELEVATED RAILWAY CO

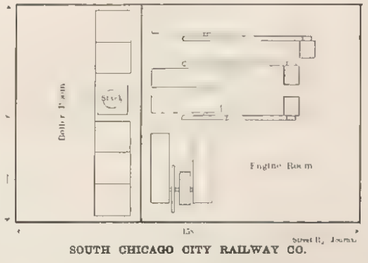


CHICAGO ELECTRIC TRACTION CO.



UNION ELEVATED RAILWAY CO





SOUTH CHICAGO CITY RAILWAY CO.

PLANS AND CROSS SECTIONS OF THE PRINCIPAL ELECTRIC RAILWAY POWER STATIONS IN CHICAGO

Scale: 1 inch = 50 feet

method of supporting the trolley wire from the elevated structure at a point where it passes over a railroad track is shown in Fig. 1.

Clinch ears are employed, as they are not likely to let the wire down, while on curves they will move slightly on the wire if the trolley pole catches in strain wires, and thereby prevent the pulling down of the line, as might sometimes occur.

Tubular iron poles are in all cases employed in new construction, lattice poles having been discarded. The standard straight line pole consists of three sections, 7 ins. 6 ins. and 5 ins. in diameter, which weighs from 850 lbs. to 900 lbs. Corner poles are 8 ins., 7 ins. and 6 ins. in diameter, and some extra strain poles weigh as high as 1200 lbs. In setting the pole, its base is treated by a preservative paint, composed of tar and other mixtures. It is then imbedded in concrete to a depth of 6 ft. or 7 ft., and the bottom rests on a hard wood board 12 ins. long x $1\frac{3}{4}$ ins. thick. At the street surface an iron thimble 12 ins. long encircles the pole and is imbedded in the concrete. The hole of this thimble is an inch larger in diameter than the pole which it contains, and when the latter is set in position, the space is filled with cement up to a flange in the thimble, so that a slanting roof of cement is made all around. Cement is preferred to tar, as the latter is apt to shrink and crack, thereby allowing water to reach the iron and rust it.

Where the poles are rusty, they are first scraped with steel brushes and painted. The first coat is a red paint, which is followed by a coat of graphite. A coat of paint lasts usually about three years, except on lines near the Chicago River, where the gases from the foul water in the river cause the poles to deteriorate rapidly. It is worthy of note also that the trolley wire on lines adjacent to the river oxidize much faster than others, and a bright copper wire tarnishes in half an hour after being strung in this neighborhood.

Poles are repainted every three or four years, and are stated to have a life of twenty or thirty years, the annual depreciation being regarded as about $3\frac{1}{2}$ per cent to 4 per cent, while cedar poles are said to depreciate at the rate of $6\frac{1}{2}$ per cent to 7 per cent per year, having a life of only fourteen or fifteen years.

An iron cap is placed at the top of each pole, and there is an ornamental cast-iron ring at each joint. Ordinarily, the pole band (Fig. 5, No. 41) is placed 10 ins. from the top of the pole. On some lines the poles carry an ornamental hanger for supporting electric lamps, these being installed and maintained by the city. Cross arms are of wood, with supporting iron brakes.

After trying nearly all kinds of trolley line switches on the market, a standard (Fig. 5, Nos. 9 and 12) has been adopted. No. 9 shows a "Y" shaped, and No. 12 a right-hand switch, with the corresponding left-hand. No. 1 is an insulated cross-over. This is composed of a section of red fibre 1 in. x 3 ins., and in adjusting it, it is not necessary to cut the trolley wire, as the wires of both lines can be led over the insulated portion, one above the other. A burn-out has never occurred with this style of cross-over on the Chicago City system. In Nos. 37 and 40 are shown two forms of live cross-overs; No. 40 is a design for ordinary right-angle crossings and has a small circle, while for the acute crossing, No. 37, the circle is larger. The



FIG. 1.—OVERHEAD WIRE BRACKET FOR SURFACE LINES ON ELEVATED RAILWAY STRUCTURE



FIG. 2.—CONSTRUCTION WAGONS, CHICAGO CITY RAILWAY



FIG. 3.—POLE-RAISING WAGON, CHICAGO CITY RAILWAY

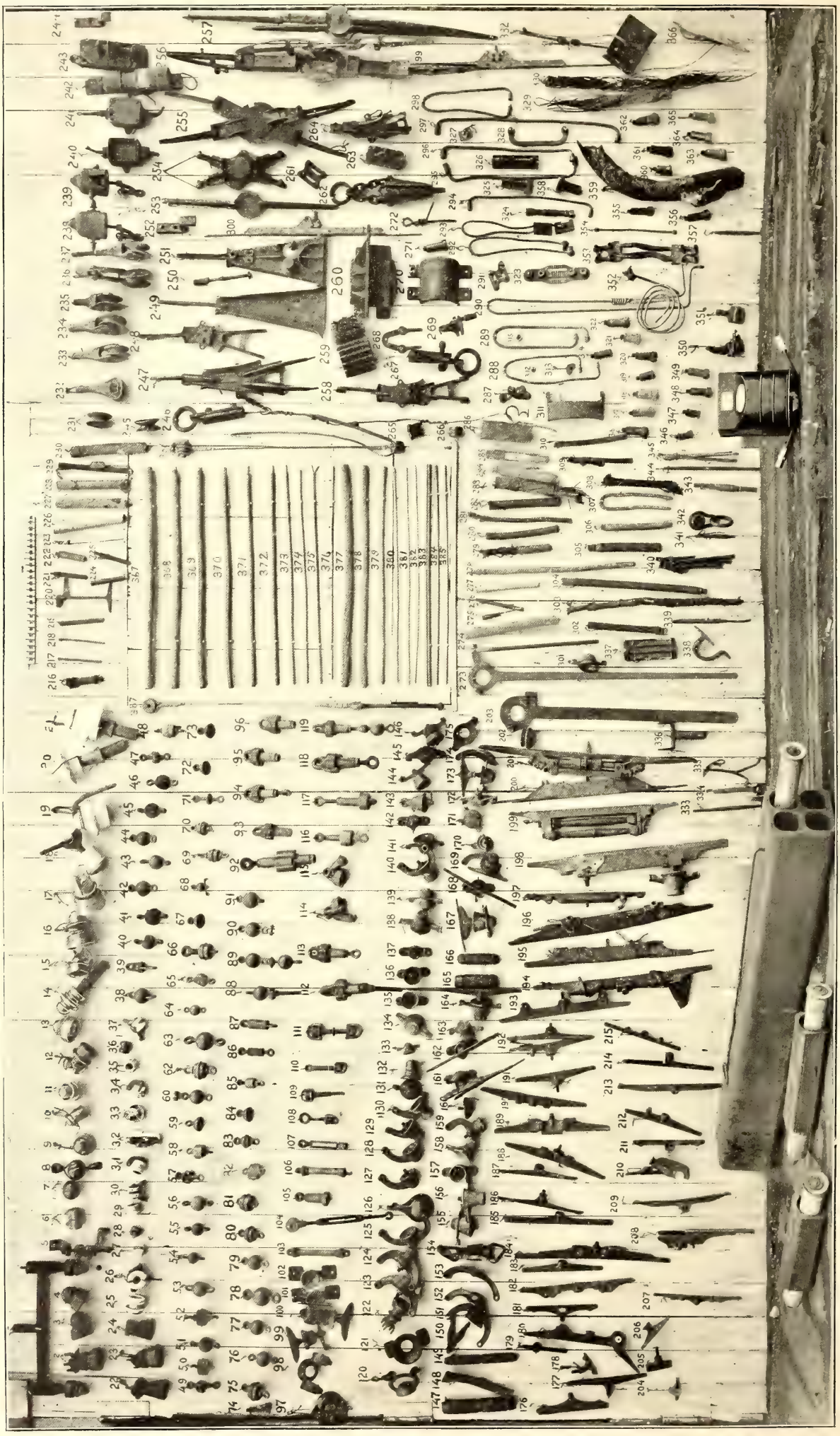


FIG. 4.—OVERHEAD LINE MATERIAL, PAST AND PRESENT PRACTICE, CHICAGO CITY RAILWAY

section insulator shown at No. 52 is of the same style of construction as the insulated cross-over, but has a hood to protect the fibre from the action of sleet and water.

At all section insulators and at insulated cross-overs, metal targets, shown at No. 22, are employed. These are in the shape of an incandescent lamp and are painted red

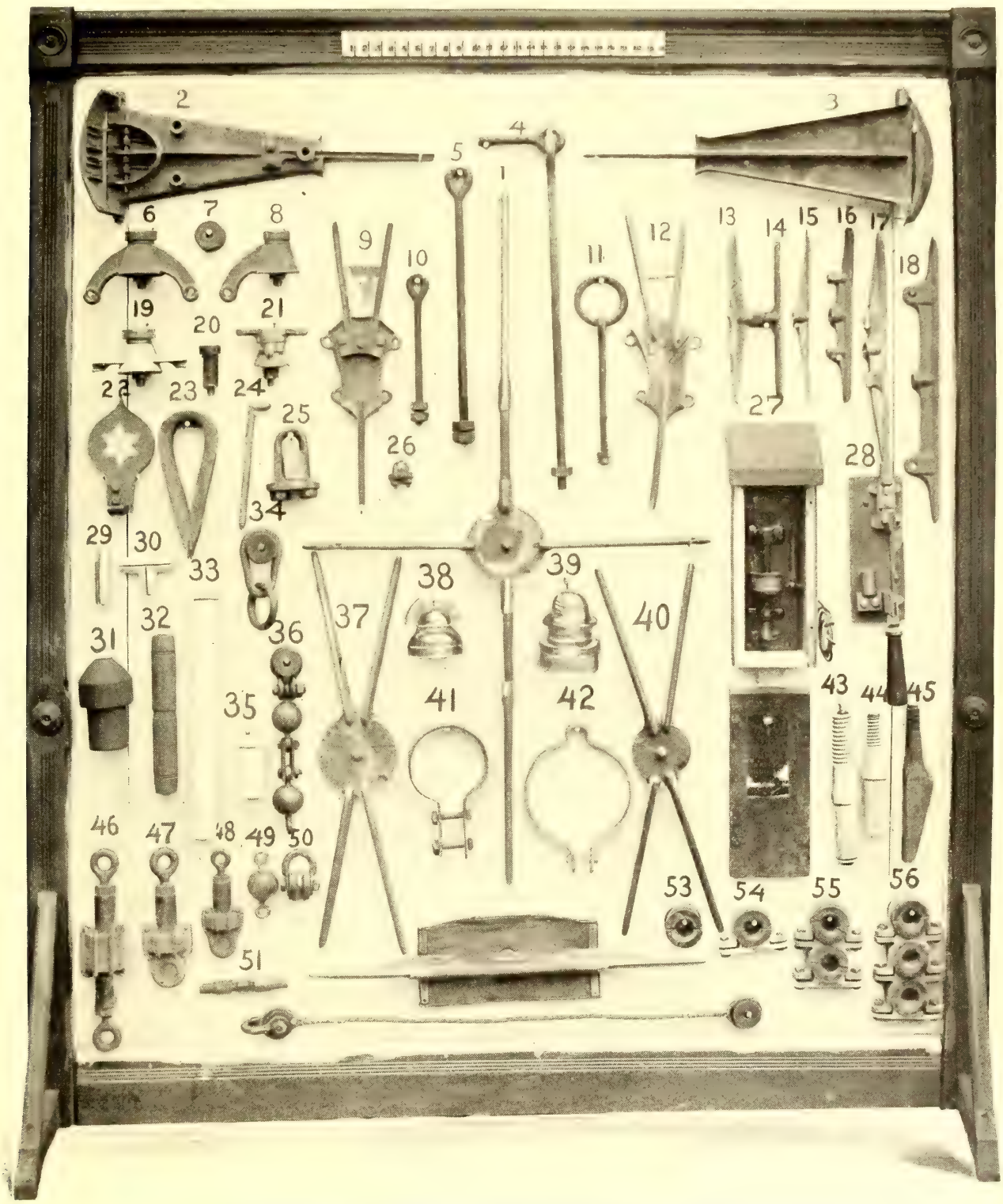


FIG. 5.—OVERHEAD LINE MATERIAL, PRESENT STANDARD, CHICAGO CITY RAILWAY

with a white star in the center. They are clamped to the span-wire or trolley wire at the section, and at these points the motorman is required to throw off the current in passing. This is in order to prevent the fibre from being injured by the arcing which would be caused were the run made with full current.

Lightning arresters are, as a rule, installed at every half-mile of double track or every mile of trolley. These are placed on the poles and grounded. The Garton type of arrester is mostly employed, although experiments have been made with all the commercial types. The arresters are frequently inspected, and in many of them a sheet of paper is inserted between the points, which is often found to be perforated, showing the good work of the arresters. Yet with all the precautions the atmospheric currents sometimes get by and damage the motor armatures or burn out the insulation of the underground lead-covered cables. This has occurred to the underground cables where arresters were placed on each side of the point at which the cables were led from the underground ducts up into the line.

Return feeders are in two sizes, one a 350 000 c.m. cable

and the other a 211 600 c.m. cable. The 500 000 c.m. sections are regarded as too heavy, and hard to maintain on poles. Considerable cable is employed with a jute insulation treated with tar, resin, etc. The company's standard, however, is the lead-covered cable with rubber insulation, of which there has never been a foot lost from the burning out of the insulation. The cost, however, is about 25 per cent more than the cables in which other insulation is employed.

The underground cables are enclosed in conduits of vitrified material, and both single and multiple ducts are employed. The four-duct sections are made in 6-ft. lengths.

In installing the return circuit cables on all sections within 2 or 3 miles of the power houses, 25 per cent to 30 per cent more copper is employed in the return than in the outgoing section. This is regarded a necessary allowance as a substitute by a number of companies, but it may not be generally known that the largest actual installation of it so far made is on the new Northwestern Elevated Railway, which has purchased 150,000 lbs. of aluminum feeders, of which 75,000 lbs. are now in position. This wire is of 1,300,000 c.m. sectional area, and is used uninsulated. It is supported every 9 ft. and anchored. The chief difficulty with aluminum in the past has been a question of welding, but this difficulty is said to have been entirely overcome in Chicago, though the process is a secret one. The metal is, of course, non-corrosive and is considerably cheaper than copper at present prices per unit of carrying capacity.

The Calumet Company is finally coming back to wood as an insulation material for hangers and strain poles. The bell shells are cast as in ordinary service, and the shell is then filled with a wooden block held in position by an ordinary bolt. The wood employed in the hangers and porcelain ears is first soaked in kerosene and then boiled in paraffine wax.

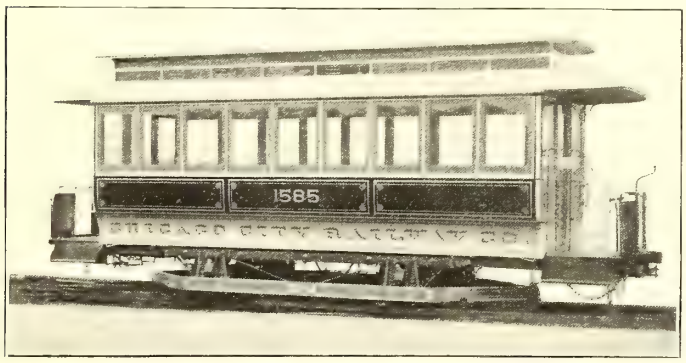


FIG. 6

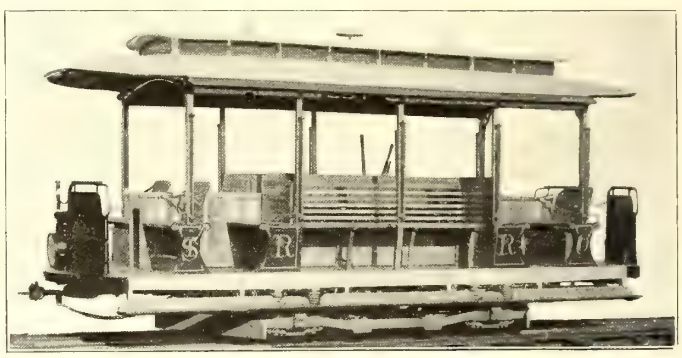


FIG. 7

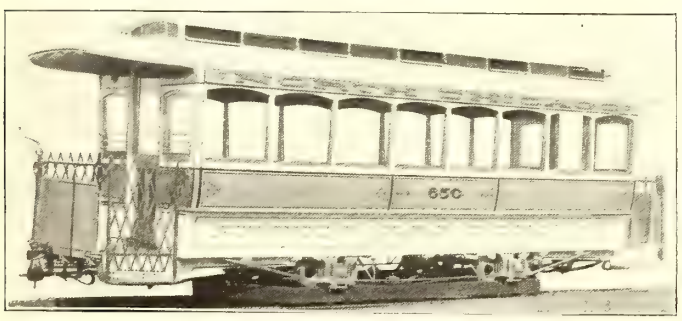


FIG. 8



FIG. 9

SOME TYPES OF CHICAGO CABLE AND ELECTRIC CARS

for safety, and to prevent electrolysis in neighboring substructures, no complaint from this cause ever having been charged against the system.

In connection with the line material should be noted the construction and repair wagons employed by the electrical department. Four of the tower wagons are shown in Fig. 2, and as will be noted, these are very substantial structures built to accommodate a large amount of material. The box-like body is provided with a door at the rear and is equipped with shelves and receptacles for different classes of material. The illustration shows the wagons as they are just starting out from the electrical storage yard. A pole raising wagon and water tank for concrete mixing is shown in Fig. 3. This pole raising wagon is employed not only for raising poles, but also for loading and unloading the reels from the wagons illustrated in the large figure.

The high price to which copper wire has lately been carried has led to the serious consideration of aluminum

ROLLING STOCK IN CHICAGO

The visitor to Chicago will not be impressed with the cars of its surface railway system, for, truth to tell, the number of new and modern cars is far exceeded by that of types which are rapidly passing away, among these latter being practically the entire equipment of grip cars, together with most of the horse cars which they have in tow, for many of the principal lines are still running by the cable system, as above stated. As these cable grips and trailers form so large a proportion of the whole rolling stock of the surface system, it may be well to briefly refer to them in passing because of the good service they have done.

The standard grip and trail cars of the North and West Side systems are shown in Figs. 7 and 8. The grip car

is entirely open and the gripman, placed in the center, has an unobstructed view both in front and behind. His box has an aisle or extension toward each platform, and on each side of it are longitudinal seats, entered from the side, while at each end are two seats with stationary backs, and opposite the latter a seat with reversible back. This grip car is used by smokers both winter and summer, and has been quite popular. The trail car has a 21-ft. body, with Brill equalizing running gears. A guard entirely surrounds the wheel and is carried by the axle boxes.

At an earlier date the same companies purchased a number of double truck cars of the type shown in Fig. 9, these being a combination open and closed car, with a gripman's box similar to that in the small grip car. A car of this sort, of course, requires a loop at the end of the road.

The Chicago City Railway Company's closed trail car is shown in Fig. 6. These have 21-ft. bodies and are slightly more than 6 ft. wide. They have the usual Chicago guard surrounding the wheels and the Brill equalizing running gear. All of the cars just described were made by the J. G. Brill Company.

The latest purchases of cars by the Chicago surface companies are shown in Figs. 10, 11 and 18. Fig. 11 represents an electric motor car, of which 100 were made for the Chicago City Railway Company by the John Stephenson Company, while sixty more of a similar pattern are being built by the St. Louis Car Company. These cars are 20 ft. long over corner posts and 30 ft. over all, and are 6 ft. 2 ins. wide at wheels and 7 ft. 6 ins. at belt rail. The platforms are 4 ft. 6 ins. long and are enclosed by vestibules, having three drop windows angularly placed. The front of the vestibule is curved below windows, and is faced with sheet steel. The platforms have entrances at both sides and are fitted with three doors folding against the vestibule. The steps are pressed steel with rubber treads. The platforms are fitted with angle iron buffers.

The window frames in this car are set in special molded rubber pockets to prevent all rattling whatever. The interior finish is in cherry, stained dark, with hand carved window and door pilasters and pressed moldings. The ceiling lining is bird's eye maple veneer. The seats are the Hale & Kilburn convertible type, with spring cushions and backs, covered with olive green carpet. The metal trimmings are extra heavy bronze throughout. These cars are painted in olive green in varying shades, the deck sash being set in green rippled glass to match. On the hoods are Hunter illuminated signs. The cars are wired for conductor's signal with buzzers on each platform and push buttons in the window pilasters. The weight of the car body is 9000 lbs., and it is mounted on a Moore electric truck, with 9-ft. wheel base, equipped with Price power brakes.



FIG. 10



FIG. 11

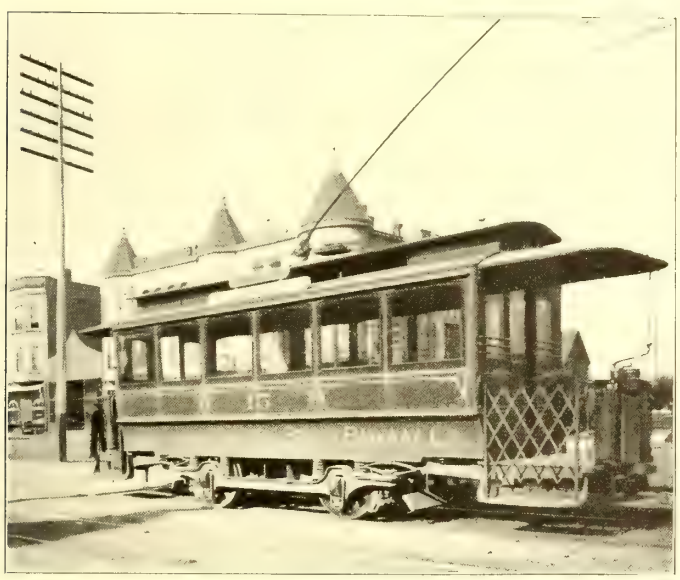


FIG. 12

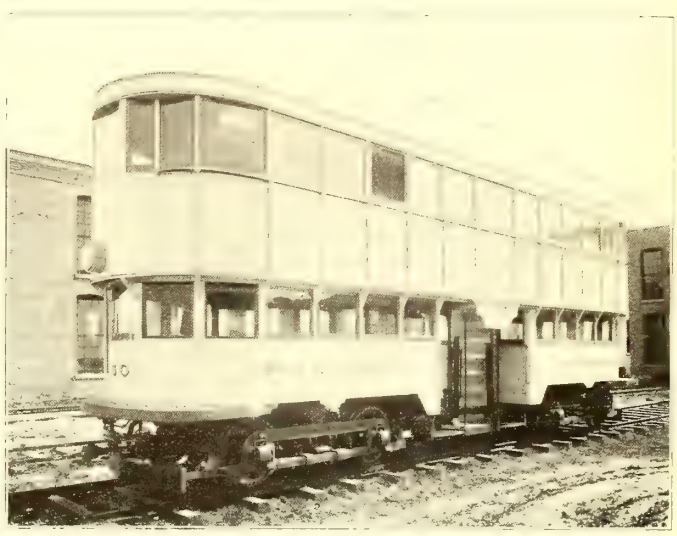


FIG. 13

SOME TYPES OF CHICAGO ELECTRIC CARS

In Fig. 10 is seen a type of electric motor car recently furnished to the North Chicago Street Railroad Company by the J. G. Brill Company, and in Fig. 18 is one of the latest suburban cars built for the Chicago, Harvard & Geneva Lake Railroad Company by the Jackson & Sharp Company. In Fig. 12 is shown the closed motor car of the Calumet Company, and in Fig. 13 a special double-deck Pullman car of the Chicago General Railway Company. In Fig. 44, page 645 may be seen the new cars just completed by the Pullman Company for the Northwestern Elevated Railway Company, and in Fig. 48 some of the details of construction. In Fig. 19 is shown one of the cars of the South Side Elevated Railway Company, built by the Jackson & Sharp Company.

The Chicago surface railway companies were among the first to appreciate the value of the independent motor truck, and the West Chicago Company alone purchased about 900 Brill trucks adapted for cable car use when they were first designed. Of the independent electric motor trucks used in Chicago, nearly 1300 are of the McGuire type, 1000 of the Brill 21 type with solid forged frame, and a considerable number of the Peckham type, including thirty-two "special elevated trucks, type 14A extra strong," on the South Side Elevated Railway.

The Moore truck is the standard of the Chicago City Railway Company. It was designed by C. E. Moore, the company's master mechanic, and is built by the Dorner & Dutton Company. It is described in full in the Street Railway Journal for October.

In Figs. 20 and 21 are shown the types of Westinghouse motors chiefly used by the Chicago roads, and in Fig. 22 the types of General Electric motors. Without going into too great detail, a general idea of the condition of the Chicago electrical car equipment as a whole may be obtained from the following statement of the relative numbers of the different types now in use:

General Electric Motors:		
Type	H.P.	Number in Use.
G. E.-800	25	1,688
G. E.-2000	125	118
G. E.-55	150	110
G. E.-1200	50	52
G. E.-57	50	40
G. E.-52	27	30
W. P.-50	25	30
W. P.-30	15	8
All types		2,076
Type K controllers		1,984
Type L controllers		202

Westinghouse Motors:		
Type	H.P.	Number in Use.
No. 3	25	237
No. 12	25	548
No. 49	35	145
No. 47	35	2
All types		932

In addition to the motors of these two companies there are some 200 30-h.p. and 50-h.p. Siemens & Halske motors in use, and a number of Walker motors.

In behalf of the Lake Street Elevated Railway Company, J. R. Chapman, electrical engineer of the North and West Sides systems and of the Lake Street and Northwestern Elevated Railways, made a series of careful tests for the purpose of determining the motor equipment best adapted for the Lake Street Elevated Railway, and through Mr. Chapman's kindness the results of these tests are reproduced herewith. The type finally selected was the G. E.

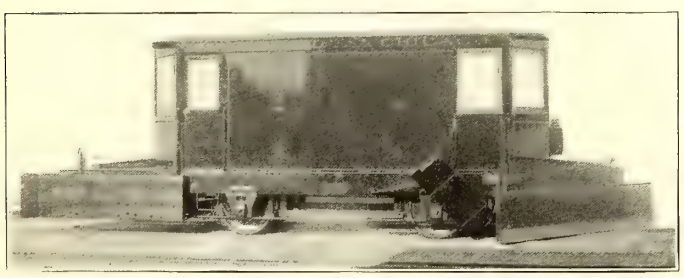


FIG. 14.—STORAGE BATTERY SNOW SWEEPER



FIG. 15.—WEST CHICAGO SNOW SWEEPER

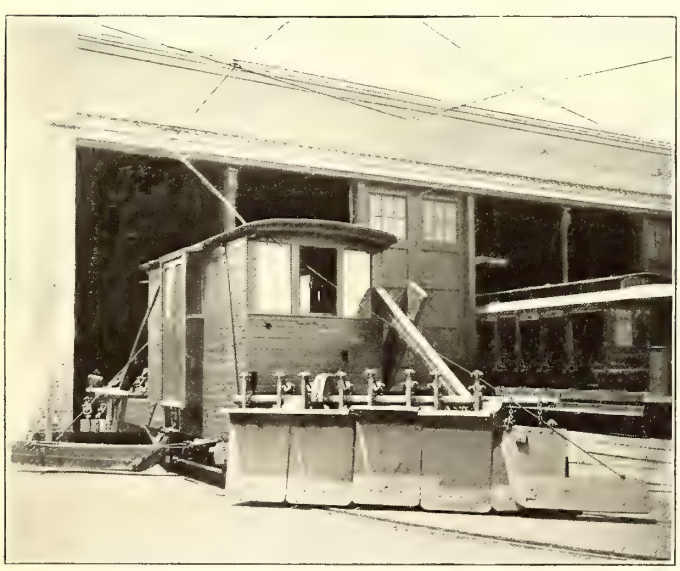


FIG. 16.—FRONT VIEW, CALUMET ADJUSTABLE SNOW SWEEPER

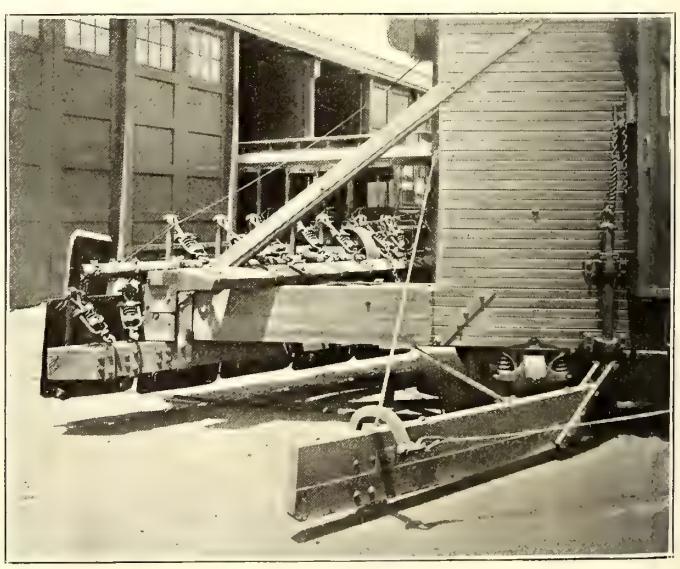


FIG. 17.—SIDE VIEW, CALUMET ADJUSTABLE SNOW SWEEPER

55 (.150 h.p.) motor, with type L controller, illustrated in Fig. 22.

Figs. 16 and 17 show a snow plow designed by H. M. Sloan, general manager of the Calumet Electric Street Railway Company, which has quite a number of novel features. The nose of the plow is composed of steel plates arranged in sections and supported by means of bars which have a spring attachment and permit each individual plate to rise independently of the others in case a partial obstruction is encountered, so that damage to the nose and to the bar is prevented. The height of the plate from the pavement is adjusted by means of a hollow shaft about 5 ins. in diameter, which is operated by means of a chain attached to a quadrant in the shaft, and adjusted about a windlass in the back. The wings, or side flukes, are also attached to the bar. By a spiral spring and wire rope, as shown, this provides an elastic support, so that if any obstructions are met with underneath, the wings yield without undue strain or danger of breakage, and after passing the obstruction they return to position. Plows constructed on this principal were in continuous service in the winter of 1897-8 for seventeen days, removing badly drifted snow from the tracks and were not once brought in for repairs nor did they suffer serious damage during that time.

A large double end snow plow for heavy drifts is also employed by the Calumet Company when necessary. This is provided with a pilot having a one-sided oblique mold board, so that it throws the snow nearly all to one side. The short side is only 5 ins. or 6 ins. wide, but is built back and terminates in a square side, so that it rests against the end of the snow bank and prevents the plow from being derailed by the unequal pressure. Side flukes are attached by means of the same kind of spiral springs and wire ropes as those just described.

Fig. 14 shows a storage battery snow sweeper built by the Brill Company for the Chicago Electric Traction Company. This is 19 ft. long and 6 ft. wide. The outside sills are fitted with $\frac{1}{2}$-in. iron, and each shear board has an extension wing. The shears themselves are operated by worms. The batteries are carried under the floor of the car between the wheels, which are 9 ft. 3 ins. apart.

The Brill Company has furnished the North Chicago Street Railroad Company some sixteen sweepers of the type shown in Fig. 15, and the McGuire Manufacturing Company has furnished twenty of its sweepers to the different companies of Chicago.

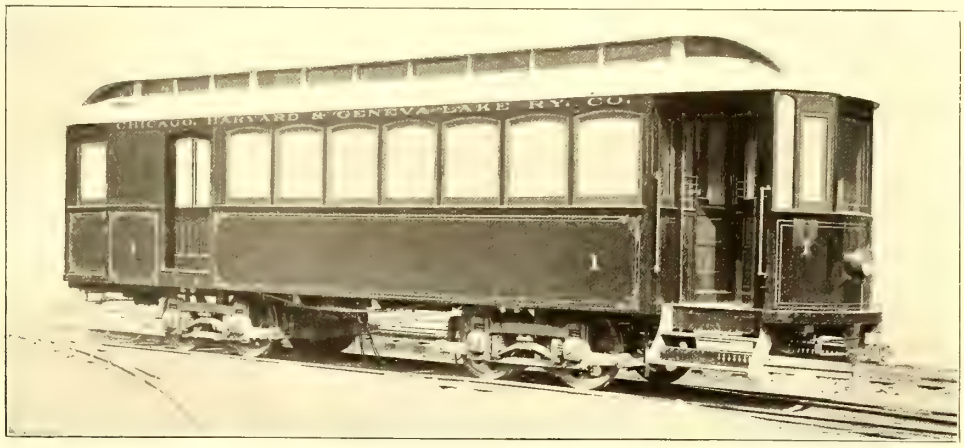


FIG. 18.—A CHICAGO SUBURBAN SURFACE RAILWAY CAR

Although trail cars are used so generally in Chicago, trains of two, three, four and even five cars being frequently made up for the heavy hours of the day, no attempts have yet been made to apply power brakes for the handling of these trains, except that on the Chicago City system a large number of the Price momentum brakes, manufactured by the Peckham Company, are used. On the South Side elevated lines, the Christensen brakes with independent motor compressors are used on all trains, and the same makes are also used to some extent upon the Metropolitan and Lake Street elevated trains, but the New York air brakes are used more largely on the Metropolitan. Electric brakes have not made their way into popular favor as yet.



FIG. 19.—A SOUTH SIDE ELEVATED RAILWAY CAR

About 250 of the Chicago City cable cars, 200 of the North Chicago cable cars, and 150 of the West Chicago cable cars are lighted by Pintsch gas. The surface and elevated electric cars are lighted, of course, by electricity.

Electric heating is quite general on the Chicago cars, both surface and elevated. The South Side cars are using the "Gold" heaters, the Metropolitan elevated, the "American" and "Consolidated" heaters, and the Lake Street the "Consolidated," while the new Northwestern has ordered "Consolidated" for its complete equipment. The latter are also used on practically all the surface lines, about 500 having been so far installed, while the North Chicago is also using the F type panel heaters of the American Electric Heating Corporation. The grip and trail cars of the Chicago companies are heated chiefly by the McGuire and Columbian stoves.

The Hale & Kilburn Manufacturing Company has furnished seats to about 2500 cars in Chicago, including 700

on the elevated lines and 1500 on the Chicago City lines. The car registers have been purchased chiefly from the Meaker Company, which has furnished some 2500 in all to practically all the street railways of Chicago. Curiously enough, the Lake Street Elevated Railroad Company is using 120 portable registers (manufactured by the

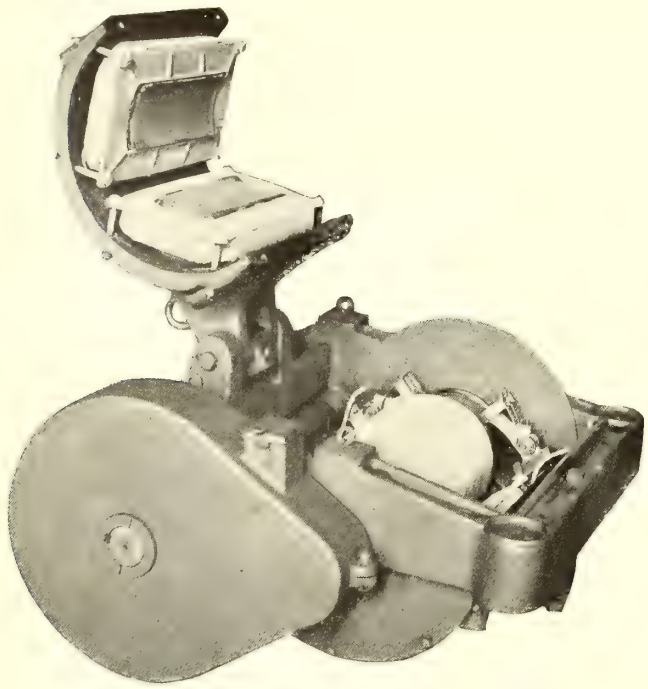


FIG. 20.—THE WESTINGHOUSE NO. 3 MOTOR

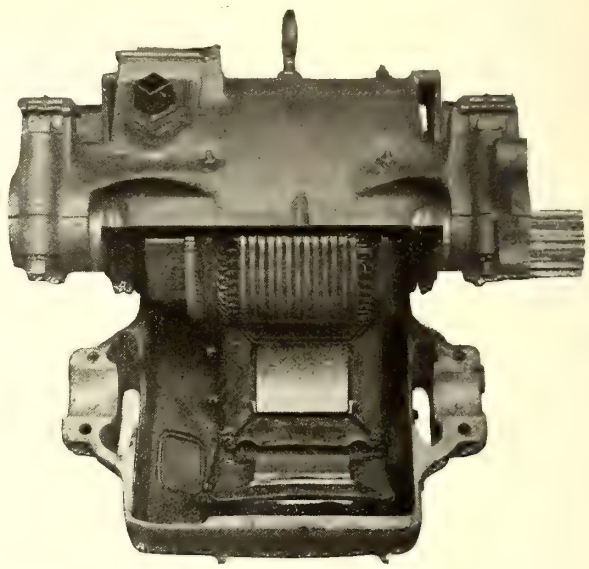


FIG. 21.—THE WESTINGHOUSE NO. 12A MOTOR

International Register Company), which is a novel practice in the operation of an elevated railroad. By this means they are able to do away with station agents almost entirely, except at the busiest stations, each guard or conductor collecting fares from those who go in at his gate, except at the stations where they have station agents.

In addition to the Meaker registers, a few Lewis & Fowler registers are used on the Union and Consolidated systems, the New Haven registers on the Calumet, and the International on the Chicago General.

The magnitude of traffic of the Chicago lines is well shown by the number of employees engaged in handling the cars. The Chicago Union Traction Company has over 900 motormen and gripmen and 1300 conductors, the Chicago City has nearly 750 motormen and gripmen and over 900 conductors, the Chicago Consolidated has 185 motormen and 200 conductors, and the Calumet Company has 90 motormen and 100 conductors.

ROADBED CONSTRUCTION IN CHICAGO

The building of electric railway track in Chicago has been along simple lines and with but little variation of practice. No concrete is used as substructure, but 7-in. and 9-in. girder rails are spiked directly to ties laid on dirt or on a light layer of broken stone or gravel at the bottom of an excavated trench. The standard construction of the Chicago City Railway is shown in the accompanying photographs and sections. This construction, on 6 ins. of broken stone, is used by the company for 10½ miles of track on Halstead Street. In the subconstruction recommended by the engineers of the Chicago Union Traction Company, which has, however, been used only on the Lake Street extension, oak ties 5 ins. x 7 ins. x 6½ ft. or 7 ft. long are laid 2 ft. apart from center to center, and ballasted to a depth of 8 ins. under the ties, the ballast being thoroughly rolled and strained to level and filled in between the ties.

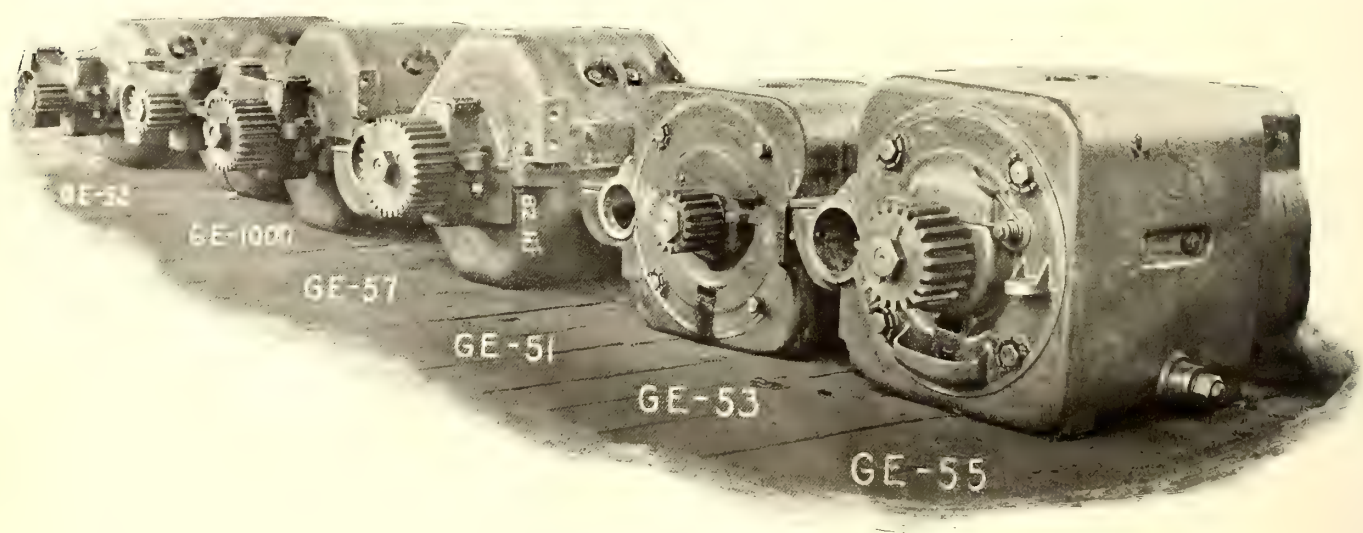


FIG. 22.—RECENT GENERAL ELECTRIC MOTORS

Speaking generally, it would seem as if enough attention had not been paid in the past in Chicago to a deep and durable substructure, for the soil of Chicago is moist even

TESTS OF RAILWAY MOTORS ON THE LAKE STREET ELEVATED RAILWAY

Made by James R. Chapman, Electrical Engineer

CONTROLLER POSITION	CONTROLLER ADVANCED TO FULL PARALLEL							
Type of Motor	G. E. 55				G. E. 51 B			
Gear Ratio	21 : 52				18 : 67			
Date of Test	Mar. 19, 1899				April 2, 1899			
Motor Car. No.	101				115			
Motor Car wt.	52,000 lbs.				56,500 lbs.			
Trailers, wt.	64,000 lbs.				64,000 lbs.			
No. Motors on Car	2				4			
No. " on same truck	2				2			
NO. OF TEST	1	2	3	4	1	2	3	4
Voltage	Normal	Normal	High	High	Normal	Normal	High	High
From	Halsted St.	Ashland Av.	Halsted St.	Ashland Av.	Halsted St.	Ashland Av.	Halsted St.	Ashland Av.
To	Ashland Av.	Western Av.	Ashland Av.	Western Av.	Ashland Av.	Western Av.	Ashland Av.	Western Av.
Distance	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile
Time: Start to Stop	2 m. 25 s.	2 m. 30 s.	2 m. 21 s.	2 m. 22 s.	2 m. 38½ s.	2 m. 38½ s.	2 m. 34⅜ s.	2 m. 28 s.
Speed in Miles per hr. at end of 10 sec	10 35	9.49	11.56	11.21	10.70	10.92	11.56	10.05
Speed in Miles per hr. at end of 20 "	15.18	14.66	16.82	15.53	18.46	15.35	19.49	15.53
Speed in Miles per hr. at end of 30 "	21.56	20.70	23.38	22.43	22.43	19 84	22.72	21.56
Speed in Miles per hr. at end of 40 "	25.13	24.15	25.87	25.44	25.01	22.43	25.01	24.15
Speed in Miles per hr. at end of 50 "	25.50	25 87	28.46	28 46	25.01	23.29	25.44	25.01
Speed in Miles per hr. at end of 1 min.	25.87	28.31	30.19	30.19	25.44	24.15	25.88	26.74
Max. speed noted	30.19	31.48	32.34	32.78	26.74	26.74	28.46	29.33
Time using current	2 min.	1 m. 54 s.	1 m. 50 s.	1 m. 47 s.	2. m. 22 s.	2 m. 22 s.	2 m. 18 s.	2 m. 12 s
Time coasting	8 sec.	19 sec.	14 sec.	18 sec.	0	0	0	0
Time braking	17 sec.	17 sec.	17 sec.	17 sec.	16½ sec.	16½ sec.	16¾ sec.	16 sec.
Total watt hours	4,230	4,245	4,560	4,425	4,590	4,500	4,935	4,755
Average volts	505	506	542	553	520	528	553	559
Max. amperes	650	650	680	640	650	570	720	590
Amp. at full speed	190	185	192	195	210	200	210	200
Kw. hours per car mile	1.41	1.42	1.52	1.48	1.53	1.50	1.65	1.59

CONTROLLER ADVANCED TO FULL PARALLEL				CONTROLLER ADVANCED TO FULL SERIES ONLY					
G. E. 51 B				G. E. 55		G. E. 51 B.		G. E. 51 B.	
21 : 64				21 : 52		18 : 67		21 : 64.	
April 23, 1899				Mar. 19, 1899		April 2, 1899.		April 23, 1899.	
115				101		115		115.	
56,500 lbs.				52,000 lbs.		56,500 lbs.		56,500 lbs.	
64,000 lbs.				64,000 lbs.		64,000 lbs.		64,000 lbs.	
4				2.		4.		4.	
2				2.		2.		2.	
1	2	3	4	5	6	5	6	5	6
Normal	Normal	High	High	High	High	High	High	High	High
Halsted St.	Ashland Av.	Halsted St.	Ashland Av.	Halsted St.	Ashland Av.	Halsted St.	Ashland Av.	Halsted St	Ashland Av.
Ashland Av.	Western Av.	Ashland Av.	Western Av.	Ashland Av.	Western Av.	Ashland Av.	Western Av.	Ashland Av.	Western Av.
1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile
2 m. 22 s.	2 m. 24 s.	2 m. 19 s.	2 m. 16 s.	3 m. 23 s.	3 m. 20 s.	3 m. 48½ s.	3 m. 46¼ s.	3 m. 19 s.	3 m. 20 s.
12.42	10.35	11.21	11.21	11.21	10.70	0.70	10.44	12.42	11.56
17.25	14.84	15.87	15.71	15.35	14 85	13.80	13.28	15.53	14.66
23.29	20 70	21.56	22.94	16.82	16 39	14.84	14.32	16.91	16.42
25.01	25.01	25.88	25.88	17.25	17.25	15 70	15 18	17.60	17.25
26.74	26.31	27.17	28.03	17.77	17.77	16.30	15.70	18.11	17.77
27.60	27.17	29 33	30.19	18.11	18.11	16.56	16.04	18.46	18.11
21.05	31.48	33.21	34.07	19.49	20 18	17.01	17.01	19.66	19.49
2 m. 4 s.	2 m. 8 s.	2 m. 3 s.	1 m. 56 s.	3 m. 10 s.	3 m. 5 s.	3 m. 40 s.	3 m. 36 s.	3 m. 7 s.	3 m. 9 s.
0	0	0	0	0	0	0	0	0	0
18 sec.	16 sec.	16 sec.	20 sec.	13 sec.	15 sec.	8½ sec.	10¼ sec.	12 sec.	11 sec.
5,070	5,112	5,295	5,280	2,595	2,595	2,640	2,655	2,715	2,790
532	526.5	564	568	570	576	557	558	564.5	565
650	640	630	730	400	430	420	450	500	500
230	218	230	230	68	67	85	85	88	88
1.69	1.70	1.77	1.76	.86	.86	.88	.89	.905	.93

General method : Start from rest, run one mile and stop. Train : Motor car and two trailers.

to muddiness, and the track frequently shows evidence at the joints of insufficient strength of support.

Many rail sections have been used in times past, but practice is generally settling down to the section shown in Fig. 28, which is the Lorain Steel Company's 7-in. 85-lb. section. The same company's 9-in. 93-lb. section is also used in places as well as the 9-in. 90-lb. Cambria sections, ing to cast weld its future work by either the Falk or the "American Improved" process.

The Northwestern and Union Loop Elevated Railway Companies are using the Weber joint, following in this respect the practice of the Manhattan Company in New York. The Chicago Weber joint is illustrated in Fig. 47. It is 24 ins. long, with $4\frac{3}{4}$-in. bolts and nuts fitting A. S.

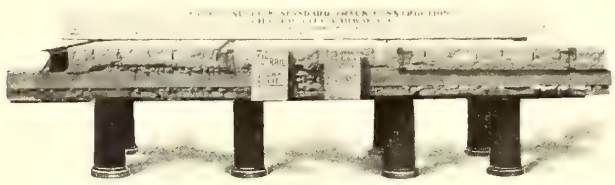
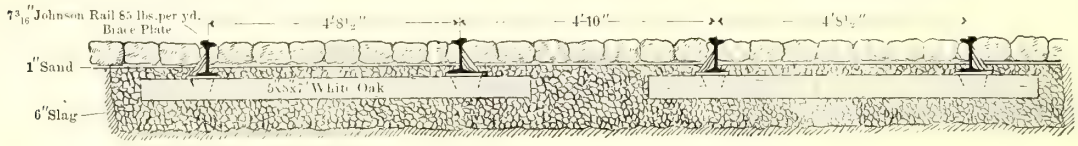


FIG. 23.—END VIEW



FIG. 24.—SIDE VIEW



CROSS SECTION OF THE CHICAGO CITY RAILWAY STANDARD ROAD BED.

Street Ry. Journal

FIG. 25.—CHICAGO CITY RAILWAY ROADBED

shown in Figs. 26 and 27. The elevated lines use an 80-lb. 5-in. T. rail of A. S. C. E. standard section. (Fig. 46).

All new purchases of rails by the Chicago surface companies specify 60-ft. lengths.

The Falk cast welded rail joint is the standard of the three large Chicago surface systems, and all have now C. E. section of the 80-lb. rail. About 48 miles in all have so far been fitted with the Weber joints.

As may naturally be supposed, there is an immense amount of complicated and most expensive track "special work" in Chicago. In addition to the great number of crossings, loops, curves, etc., of the street railway lines

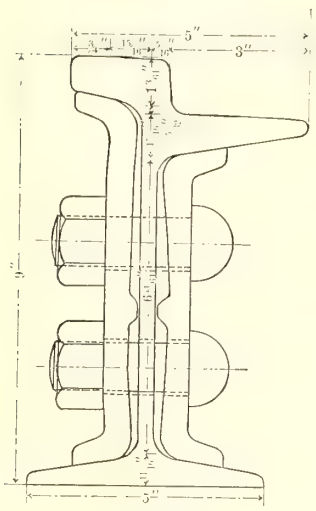


FIG. 26

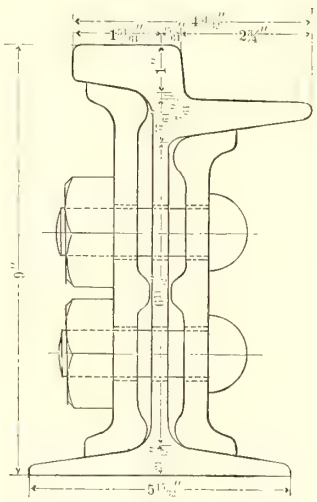


FIG. 27

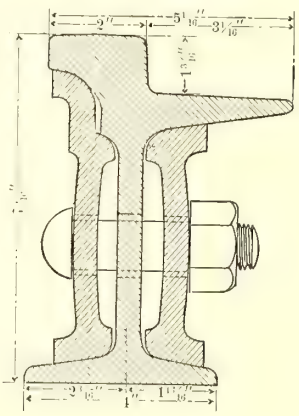


FIG. 28

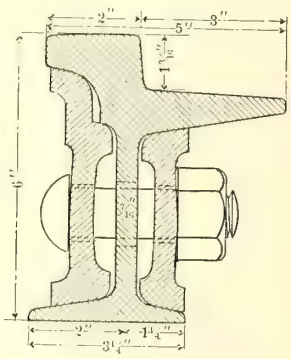


FIG. 29

RAIL SECTIONS AND JOINTS USED IN CHICAGO

taken out a license from the Falk Company to do their own welding. How carefully the details of the cast weld joints are worked out, both for old and new track, may be inferred from the number of the Falk joint molds used by the Chicago City Railway Company, as shown in the accompanying engravings. The Chicago City Railway Company was one of the first in the country to adopt this joint, about 40,000 joints being welded in 1895 and 1896, while there are now nearly 100,000 joints on its system. Complete welding outfits with licenses are now owned by the North Chicago Street Railroad Company, the West Chicago Street Railroad Company, the Chicago Consolidated Traction Company and the Chicago City Railway Company, and the Calumet Company reports that it is intend- proper, there are far more crossings with steam railroad lines than are ordinarily found in a city, Chicago being a great railroad center with tracks coming into the business heart of the city at grade in almost all cases. In addition to this, there are further complications from the crossing of cable lines with each other and with electric and horse railways, so that altogether Chicago is an excellent place to study how to solve complicated engineering problems in track construction.

For example, the Weir Frog Company not long ago made for the West Chicago Street Railroad Company two most complicated nests of crossings at Clinton and Randolph Streets and Clinton and Madison Streets. These crossings are of unusual length, the intersections between

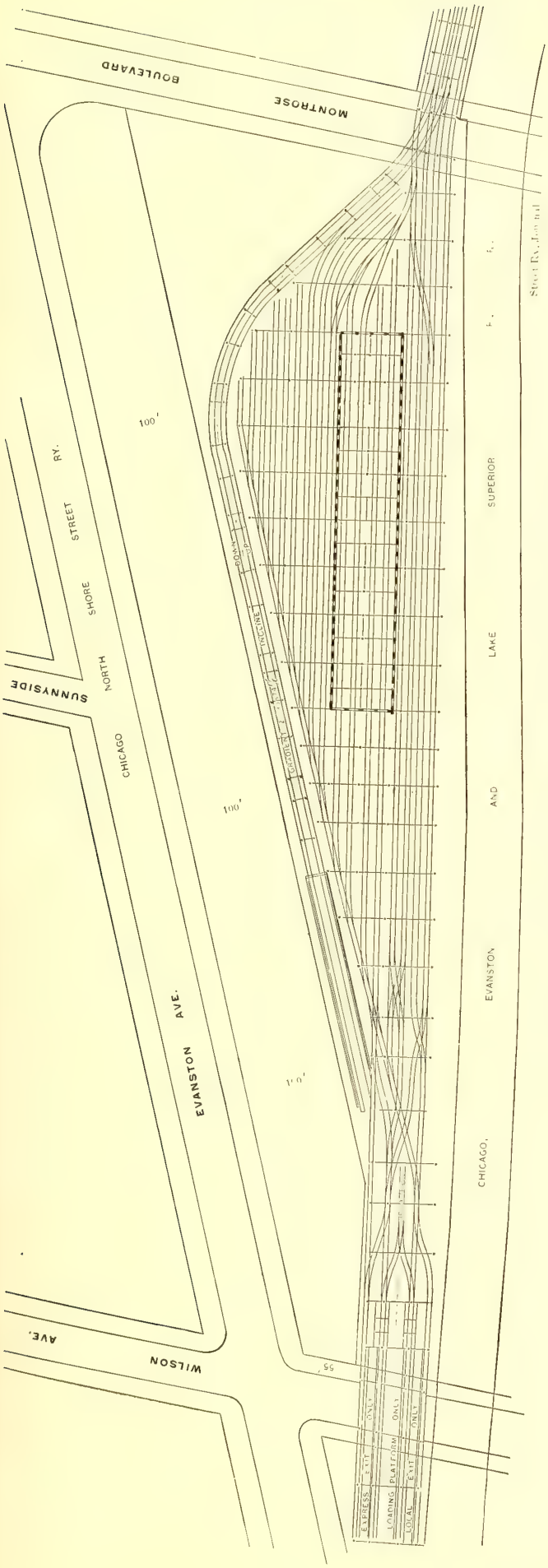


FIG. 30.—TRACK PLAN, NORTHWESTERN ELEVATED RAILWAY TERMINAL

switches measuring 130 ft., and between centers of opposite curves about 57 ft. Composing each set of crossings there were sixteen frogs, four special, open hearth, cast-steel, double switches and mates, four single switches and mates, four 90-deg. angle crossings and six 38-deg. angle crossings. All were made from 9-in. Cambria guard rail of weight 104 lbs. and 107 lbs. per yard.

The Johnson "built up," "cast-steel" and "guarantee" work is also used extensively in Chicago, while the Chicago City Railway Company uses the hardened center frogs, mates, switches, etc., of the Pennsylvania Steel Company in building its own crossings and other important special work.

In Fig. 36 is shown a cable curve and trolley crossing recently put in by the Chicago City Railway Company at Twenty-second Street, Indiana Avenue and Cottage Grove Avenue, and it may be interesting to speak of the way in which the old, worn-out crossing was taken out and the new one put in, as illustrating the rapidity with which such work can be done.

The new construction of the inside curve was put in position on the night of July 18, and that of the outside on the night of the 26th of July. The paving and concrete had previously been removed, the track and slot rails cut, bolts loosened and everything made ready. The old construction of one track was removed and the new section, together with the cable pulleys, was put in ready for the operation of the cars, after the cable stopped running at 1 o'clock, and the line was ready for service at 5 o'clock in the morning—this without even interrupting the running of the night horse cars. About fifty men with three overseers were required to do the work, the scene being lighted up by the ordinary torches employed for night work, and by special electric lights suspended on poles from the trolley wire, and lighted from the trolley circuit. Each curve with its portion of the crossings had previously been set up complete, in the rail yard of the company, and each man had been given instructions as to how he should perform his part of the labor when the section was to be put in place, so that by this drill the installation was effected in an incredibly short time, as noted above.

This curve is of about 80-ft. radius, and extends about 50 ft. on Twenty-second Street, and about the same distance on Cottage Grove Avenue. In the new construction cast yokes were employed in place of the wrought iron yokes of the old construction. A 7-in. rail was employed, with $7\frac{3}{4}$-in. guard rails. This curve was constructed by the Falk Manufacturing Company, of Milwaukee, and was installed by Assistant Superintendent Heidelberg and Track Master Stephens, of the Chicago City Company.

The practice is becoming quite general in Chicago of omitting copper bonds where cast welded joints are made, it being held that the close union of metals brought about by pouring the molten iron around the rail sections in the process of cast welding, forms an electrical connection of greater conductivity than the rail itself, which is, of course, all that can be desired. In order to promote this union great care is taken by all the companies when welding the rails to clean the ends thoroughly by a sand blast. Cross bonds are, however, used every 500 ft. in order to unite in parallel the conductivity of the two rails. With ordinary fish-plate joints, however, of which there are still a great many in Chicago, the usual copper bonds, of practically all existing types, are employed.



FIG. 31.--CAST WELD JOINT MOLDS—MISCELLANEOUS SECTIONS

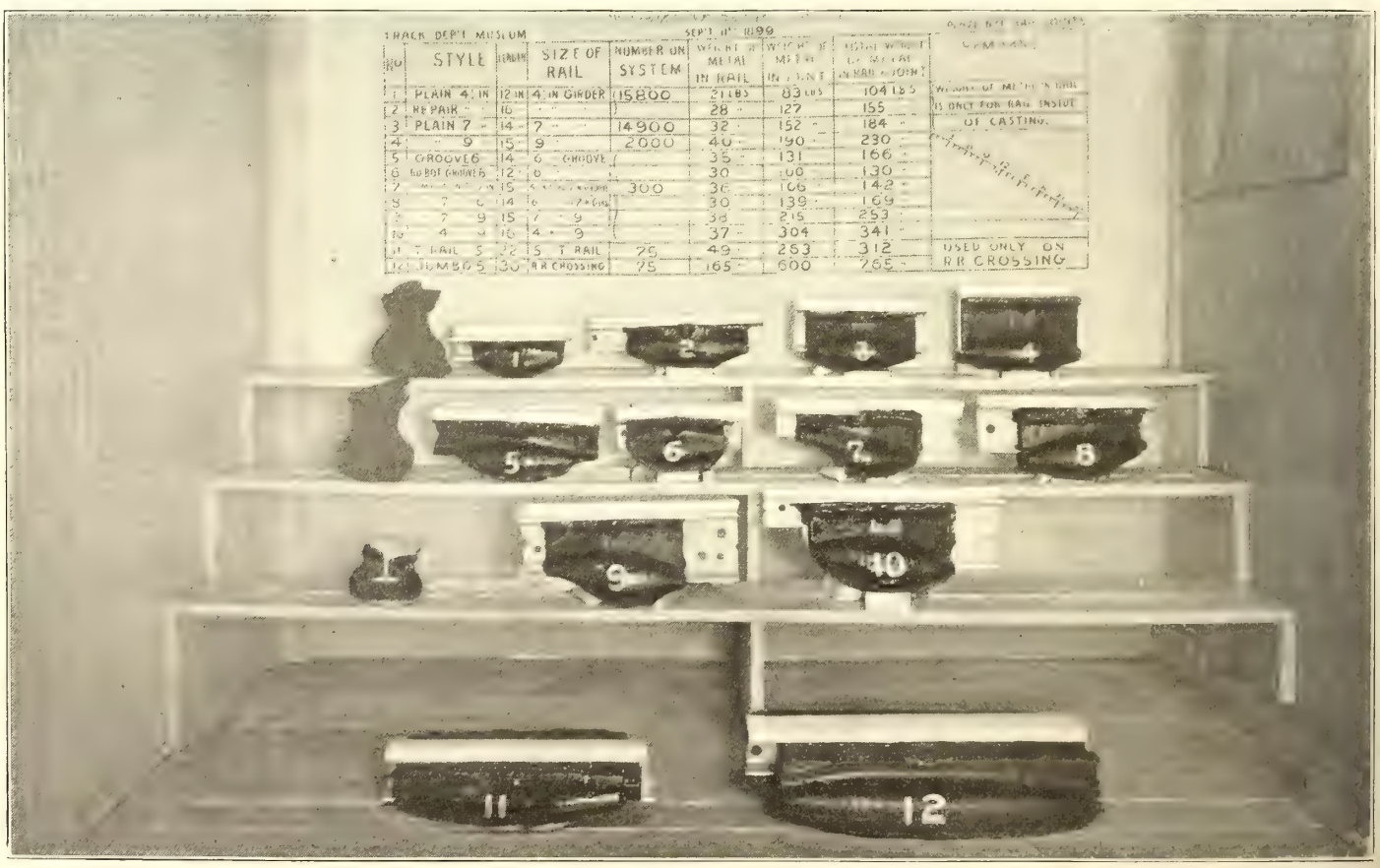


FIG. 32.—CAST WELD JOINT MOLDS—MISCELLANEOUS SECTIONS

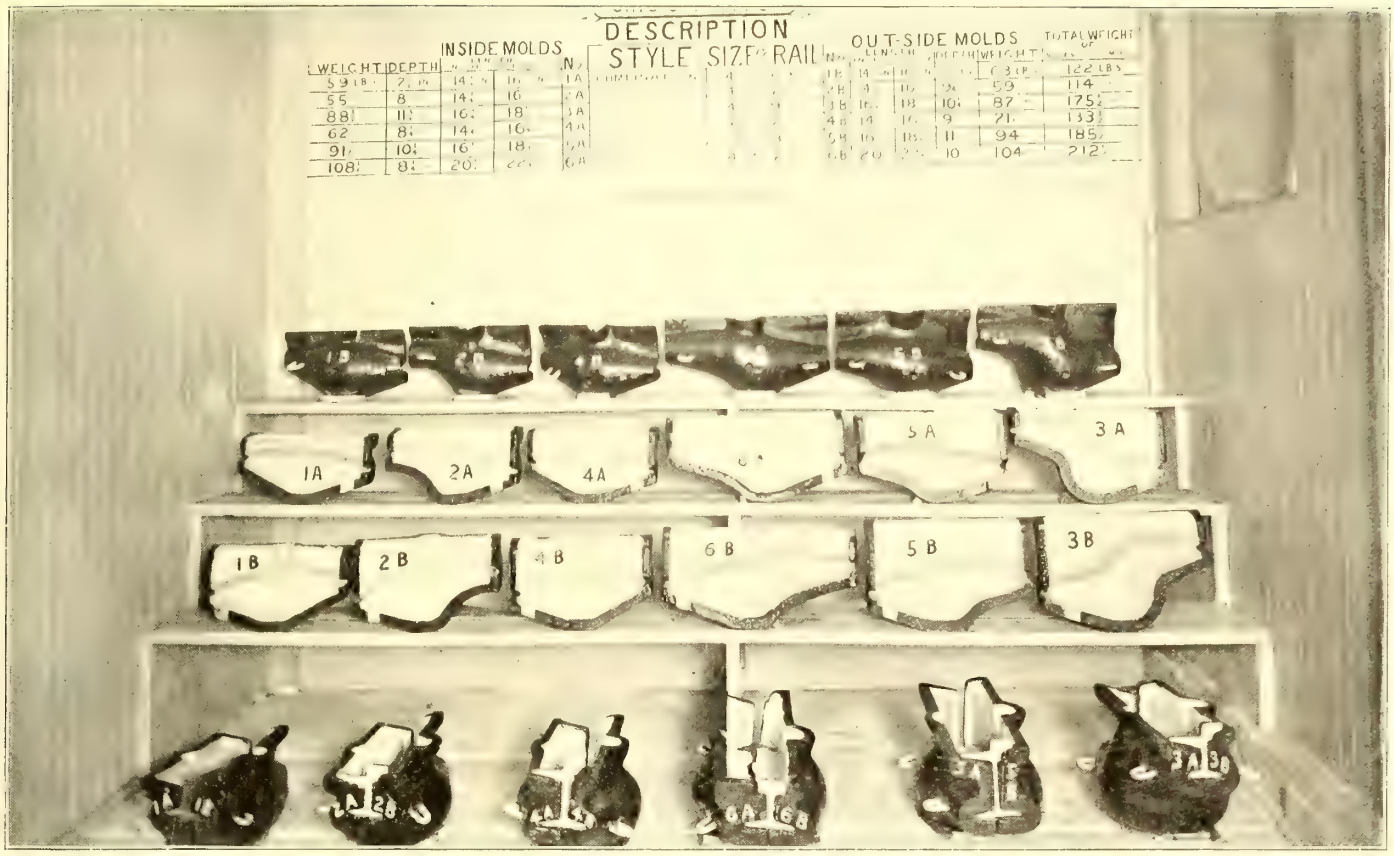


FIG. 33.—CAST WELD COMBINATION JOINT MOLDS



FIG. 34.—CAST WELD RAILROAD CROSSING JOINT MOLDS

The rails of some of the elevated lines are bonded in three ways. At the joints of the third-rail conductor two 0000 Crown bonds are used with stranded wire. This is figured to have about the same carrying capacity as the 45-lb. conductor rail. On the track rails, four, six or eight copper leaf bonds are used, of 350,000 c.m. capacity, and with sweated copper riveted terminals. The entire structure is used as a return and is bonded to the track rails by copper lugs for which a No. 00 stranded copper wire is employed, this wire being 22 ins. long and coiled around three times to take up any vibration.



FIG. 35.—A CHICAGO SURFACE AND STEAM RAILROAD CROSSING



FIG. 36.—CHICAGO CABLE CROSSING

ELEVATED RAILWAY CONSTRUCTION IN CHICAGO

The new Northwestern Elevated Railway, built from the beginning with the intention of using electricity as a motive power, is now approaching completion, and it is expected that it will be in operation by April 1, 1900. It is a two-track structure for the first two miles, and a four-track structure for the remaining five, the intention being that the two inside tracks shall be used for express service, and the two outside for local. The road is thus 7 miles long, with 25 miles of track, including that in terminal yards, and is built on private right of way for most of the distance. At the city end it has a connection with the Union Loop, around which its cars will pass on the outside track, also used by the Lake Street Elevated Railway.

There will be about three stations to the mile, at which the local trains will all stop, and will make an average speed of 14 miles an hour, but the express trains will stop only at every third station, and will make an average speed of 30 miles an hour, with only about twelve seconds dead time for each stop.

All the stations except two are located beneath the structure, and one agent will sell tickets for the four lines. At the express stations the structure swells out to provide for the necessary passenger platforms.

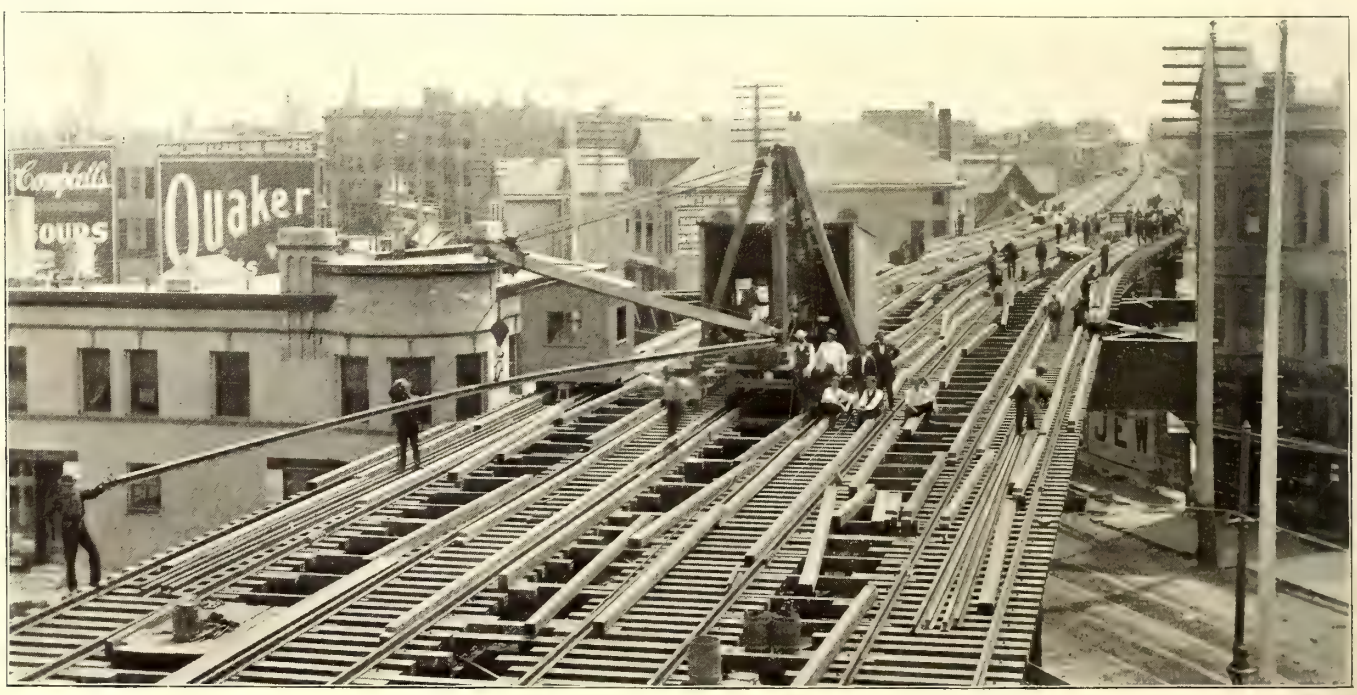


FIG. 37.—LAYING 60-FT. RAILS ON NORTHWESTERN ELEVATED RAILWAY

The supporting structure is mostly of the plate girder

type, but every 200 ft. comes a brace bent, shown in Fig. 45, by which the structure is thoroughly braced, and anchored to the ground, so as to prevent oscillation.

In the process of erecting the structure the braces and unions are riveted by means of pneumatic tools designed by the Chicago Pneumatic Tool Company. For operating the riveters gasoline engines are provided, which drive the compressors, the latter being of the Fairbanks & Morse style. The yokes of the large riveters have a throat of 50 ins., and are made of $4\frac{1}{2}$-in. iron pipe. These are supported by a jib from the car which carries the engine and compressor, as shown in Fig. 39. A pressure of a hundred pounds is generated, and large riveters are capable of heading a bolt from $\frac{7}{8}$ in. up to 1 in. in diameter. The hand pneumatic riveters are provided for the smaller bolts. Compressed air is also provided for the heating forges.



FIG. 38.—SETTING THE RIVETS



FIG. 39.—PNEUMATIC RIVETING



FIG. 40.—REMOVING RUST FROM STRUCTURE

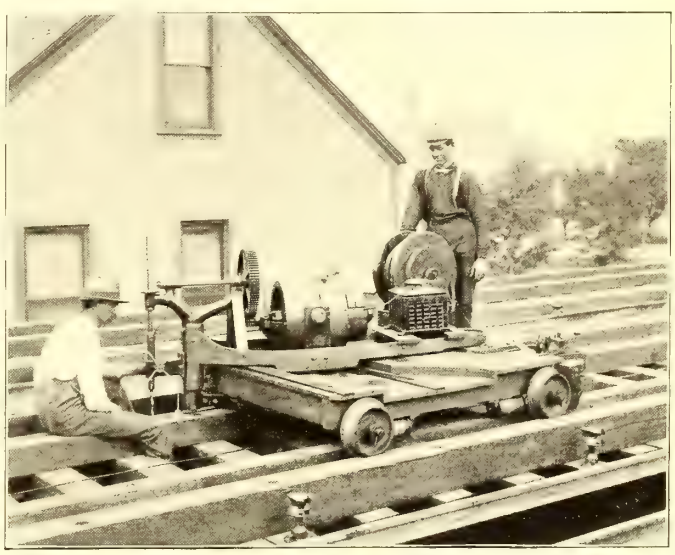


FIG. 41.—DRILLING HOLES FOR BONDS

An interesting feature in connection with the erection of this structure is the method employed for removing the rust from the girders, braces and posts, after being erected. As much of the material had lain for three years on the ground before it was erected, it was naturally well coated with rust, so that it became necessary to remove this before the paint was applied. This work was delegated to C. R. Frederick, formerly superintendent of the Cicero & Proviso Electric Railway, of Chicago, and to accomplish the work, Mr. Frederick devised a system of wire brushes, operated by electric motors. These are shown in Fig. 41. For this purpose three 12-h.p. General Electric motors were secured, and these were mounted on small cars or trucks, which are readily moved along by hand, on top of the girders, as shown. Three of these motors were mounted on each track, and to facilitate the work scaffolding is erected, which is supported by hooks suspended from the structure. The brushes are circular, about 8 ins. in diameter, and 5 ins. deep, and are constructed from No. 18 steel broom wire, which is prevented from spreading too far by an iron band shown in the illustration. The brushes are driven from the motor by means of flexible shafts, manufactured by the Chicago Flexible Shaft Company, and revolve at a speed of 1800 r.p.m. As the brushes revolve the wires bend out against the ring, so they are all brought close together for effective work. These brushes last about two days, and are made by the company's employees. By means of these appliances the gang of men employed is able to clean about eight spans of the structure, or more than 300 ft. a day. For reaching corners and angles that are inaccessible with the brushes, specially designed chisels and wire hand brushes are employed. The

motors are operated from the neighboring trolley circuits by means of feeders laid along the elevated structure.

As fast as the members are cleaned of rust two coats of paint are applied, the first being of a brown color, and the second of graphite paint, composed of 20 per cent of oil,



FIG. 42.—A CURVE ON NORTHWESTERN ELEVATED RAILWAY

40 per cent of graphite and 40 per cent of oxide of iron. This material is furnished by Heath & Milligan, of Chicago.

Another interesting appliance in connection with the equipment of the structure, is an electric drill and reamer, shown in Fig. 41, which is employed for drilling the bond holes in the rails, and in the flanges of the plate girders, to provide for the bonding, the rails being connected with the structure for the return circuit.

The work of track laying in the completed structure is being performed by the North American Construction Company, and in Fig. 38 is shown one of their gangs at work, and also some of their self-propelled steam derricks, by means of which 60-ft. 80-lb. rails are lifted from the street and laid in position on the structure. The work of laying the four tracks goes on at one and the same time. The derrick is mounted on a track which travels on the inside rails of the steel tracks, and is propelled by a capstan, an anchor rope being first thrown out. At the side of the derrick is a portable cabin, in which the supervising engineer has his office, which thus moves along the structure as the work progresses.

The rails are of the 80-lb. American Society section, shown in Fig. 46, and are joined by the Weber joint, which has been so successful on the Manhattan Elevated Railway in New York. Between the joints the rails rest on Serviss tie plates. The special work for the terminal yard, Fig. 30, page 311, is not yet let, but the Paige Iron Works Company, of Chicago, has the contract for all the special work south of the yards. Forty-five-pound conductor rail will be laid by the company's engineers.

The first equipment of rolling stock for this line will consist of twenty-seven motor cars, with two motors each, and ten cars with four motors each, the latter designed for express service. All are built by the Pullman Palace Car Company. The standard motors are G. E. No. 55, rated at 150 h.p. each. The four motor equipments will be geared for high speed. The motors will each haul two trail cars, and the trailers, as well as the motors, are vestibuled. For regular service a maximum speed of thirty-three miles an hour will be reached, with a 600-volt current at the motor terminals. As before stated, express trains will average 30 miles an hour, and local trains 14 miles.

The car bodies, shown in Fig. 44 are 6 ft. wide, with a 40-ft. body length and 47 ft. over all. The motor cars are provided with two cabs, which are located on the left-hand side, as all trains will be run left-handed on account of the Union loop terminus. One cab is built larger than the other in order to provide for the housing of the motor air-compressor for the braking system. This compressor is of the Christensen type, as is also the engineer's con-



FIG. 43.—GENERAL VIEW NORTHWESTERN ELEVATED STRUCTURE

trolling valve, while the brakes themselves are Westinghouse.

In the construction of the motor cars the frame work of the floor is composed of steel beams, reinforced with oak and yellow pine timbers. The corner posts are also of steel of riveted truss construction. The deck framing is

of unusually heavy timber, as are also the braces and structural features of every part.

A complete motor car, including the trucks and motors, will weigh 55,000 lbs., while the trailers weigh 32,000 lbs. The floors are double, with a layer of builders' felt, $\frac{1}{8}$-in. thick, between. The windows are unusually large, and glazed with heavy plate glass. The doors, which are on the sides of the vestibule, take the place of gates, and are designed to be opened and closed by means of a hand lever, with a check closing arrangement. The interior finish of both motor and trail cars is in quartered oak, with ceilings of the same material, the latter being trimmed in delicate figures of aluminum leaf. The deck lights are designed to be operated by a single lever. The seats are rattan, of the Hale & Kilburn manufacture. The motor cars have side seats only, while the trail cars have a combination of side and cross seats, after the regulation New York style. The cars are equipped with Van Dorn couplers, the standard of all the elevated railways of Chicago, and are lighted by means of a row of electric lamps on each side of the deck. The outside color is of the Pullman standard, with gold trimmings and lettering.



FIG. 44.—STANDARD CAR, NORTHWESTERN ELEVATED RAILWAY

The cars are all mounted on Hedley trucks, manufactured by the McGuire Manufacturing Company, of Chicago.

The structure itself was built after designs made by C. V. Weston, the company's chief engineer, and is being erected under his supervision. The third-rail equipment, the bonding, and, in fact, all of the electrical portion of the installation has been in charge of James R. Chapman, the company's chief electrical engineer, who has also designed the power station, which was described in the STREET RAILWAY JOURNAL for July, page 454.

For valuable information and assistance in the preparation of this paper the STREET RAILWAY JOURNAL is indebted to practically all the officers of the Chicago surface and elevated railways, and particularly to D. G. Hamilton, president, George O. Nagle, assistant general manager, and G. W. Knox, electrical engineer, of the Chicago City Railway Company; John M. Roach, general manager of the Union Traction Company; James R. Chapman, electrical engineer of the Chicago Union Traction Company and of the Lake Street and Northwestern Elevated Railway Companies; F. L. Fuller, superintendent of the West Chicago Street Railroad Company; H. M. Sloan, general manager of the Calumet Electric Street Railway Company; C. V. Weston, chief engineer of the Lake Street and Northwestern Elevated Railway Companies; Marcellus Hopkins, general manager, and Sargent & Lundy, consulting engineers, South Side Elevated Railroad Company.

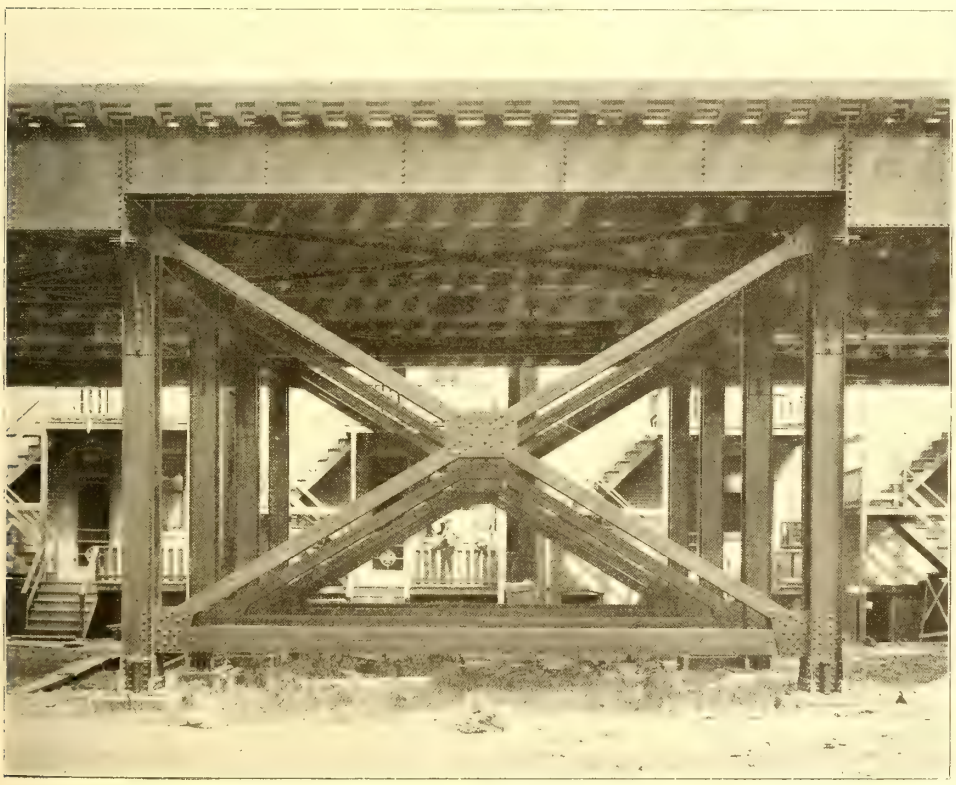


FIG. 45.—A BRACE BENT ON NORTHWESTERN ELEVATED RAILWAY

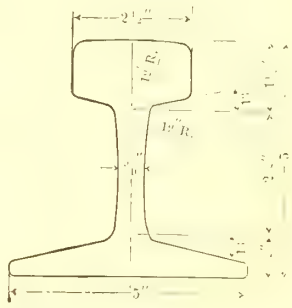


FIG. 46.—T RAIL SECTION, NORTHWESTERN ELEVATED RAILWAY

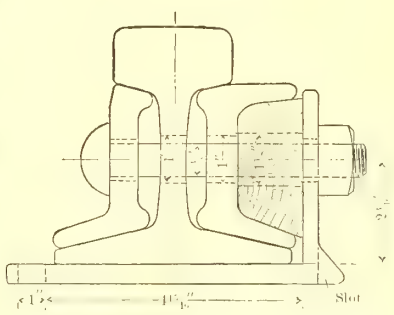


FIG. 47.—WEBER JOINT, NORTHWESTERN ELEVATED RAILWAY

THREE ESSENTIALS IN SUCCESSFUL STREET RAILWAY MANAGEMENT

The valuable suggestions regarding the management of street railway employees and their relations with the public, contained in the following letter, are worthy of most careful attention by street railway managers:

CHICAGO UNION TRACTION COMPANY,
Office of the General Manager,
CHICAGO, Sept. 23, 1899.

EDITORS STREET RAILWAY JOURNAL:

On many occasions I have been solicited by you to give a chapter from my experience, on the practical operation and management of street railways, for the STREET RAILWAY JOURNAL; and I have as often declined, but upon mature deliberation, I am of the opinion that if street railway managers would more freely give the result of their experience, on the important features of the management of great street railway corporations, through the columns of your paper, it would result in great good to the fraternity at large, for I consider the STREET RAILWAY JOURNAL one of the best mediums for distributing the experience of those who are competent to speak upon the various important lines on which employees should be especially educated and trained.

There are three great and important features in the management of street railways, these are: The Lessening of Accidents; Economical Use of Power by the Motorman; Politeness and Attentiveness of the Conductors and other Employees to the Patrons and Public.

I will not attempt at this time to discuss fully the manner in which it is possible to so train employees that accidents will be almost or entirely obviated, thereby saving to the company large sums of money which are now paid out and which are of no particular good to the parties who receive it, while accidents result in a great sacrifice on the part of the employees and their families, from time lost by suspension as a means of discipline, and frequently in loss of position by employees.

A motorman or gripman can doubtless be so trained that he will keep his mind upon all of the possible conditions that may arise in the street upon which he is traveling, so that the carelessness of others can be counteracted by his extraordinary good care and caution, thereby preventing accident. If he will constantly keep a close lookout and refuse to converse with passengers or other employees or refuse to allow his attention to be called to any direction other than the line of duty, he will give an ideal service. The best evidence that this can be done is that we have men in our employ who have not been relieved from duty on account of accident for fifteen years, showing that most accidents are brought about by gross carelessness.

In case the conductor is taught to properly attend to his duty, and to see that each person is entirely on or off the car, as the case may be, especially in the case of aged persons, before he gives the signal for starting, it is possible for him to operate his car for a number of years without being disciplined by suspension and consequent loss of time. He will thus save to the company, by whom he is employed, a large amount of money which in no way contributes for the comfort of the public or employees.

Again, a motorman by the economical use of power in manipulating the controller could save enough to the company so that the management could afford to increase his wages from 25 per cent to 60 per cent a day without losing any more money than they do by the crude and unscientific manner in which he operates his car. If motormen would learn to keep a close lookout for teams and for crossings, and instead of keeping their power on until they are forced to make an emergency stop by cutting the power out quickly and applying the brakes with force (thereby wearing the brake shoes and all the brake mechanism from the handle to the wheel) he would coast along the street where danger is anticipated, and thereby save the current and his own physical power and consequent wear and tear upon the rolling stock, he would save enough to add another per cent to his wages. In the same connection very much can be saved in the wear of the special work at crossings by passing over these sections at a moderate speed, not only preventing accident, but relieving the hammer blow that the wheels deliver at each crossing point of the structure. If all these amounts were added together, including the flatting of wheels and the cost of investigation and suspension, all of which are due to carelessness, either by the motormen or by the drivers of vehicles on the street, an enormous sum could be accumulated in ten years that could be divided between the employees and the company to their mutual advantage.

No one knows better than I the many trying ordeals with which street railway employees have to contend, and no one more fully appreciates the situation, but while riding upon the cars of our own company, as well as on the cars of other companies, I am free to confess that employees do not, as a general thing, conduct their business with the care they should exercise in order to be of the greatest service to themselves and their employer.

I am aware that in some cities there are fewer accidents than in others on account of local conditions, and the manner in which the Police Department conducts its part of the business. In Chicago the conditions are particularly trying, and it is hard to prevent accidents when these are taken into consideration. Compared with Boston, Philadelphia and other large cities where the streets are properly paved, and crossings carefully guarded by policemen who have power to compel the public to obey their signals, Chicago is at a disadvantage, but notwithstanding these considerations as noted above, a certain class of employees never have accidents, so it is doubtless possible to so train men or to get such a class of men that accidents will be entirely obviated.

I suggest the above for the special consideration of employees, and others interested, and hope that they will be able to so train themselves that they will have the advantage of the vast sums now wasted. Very truly yours,

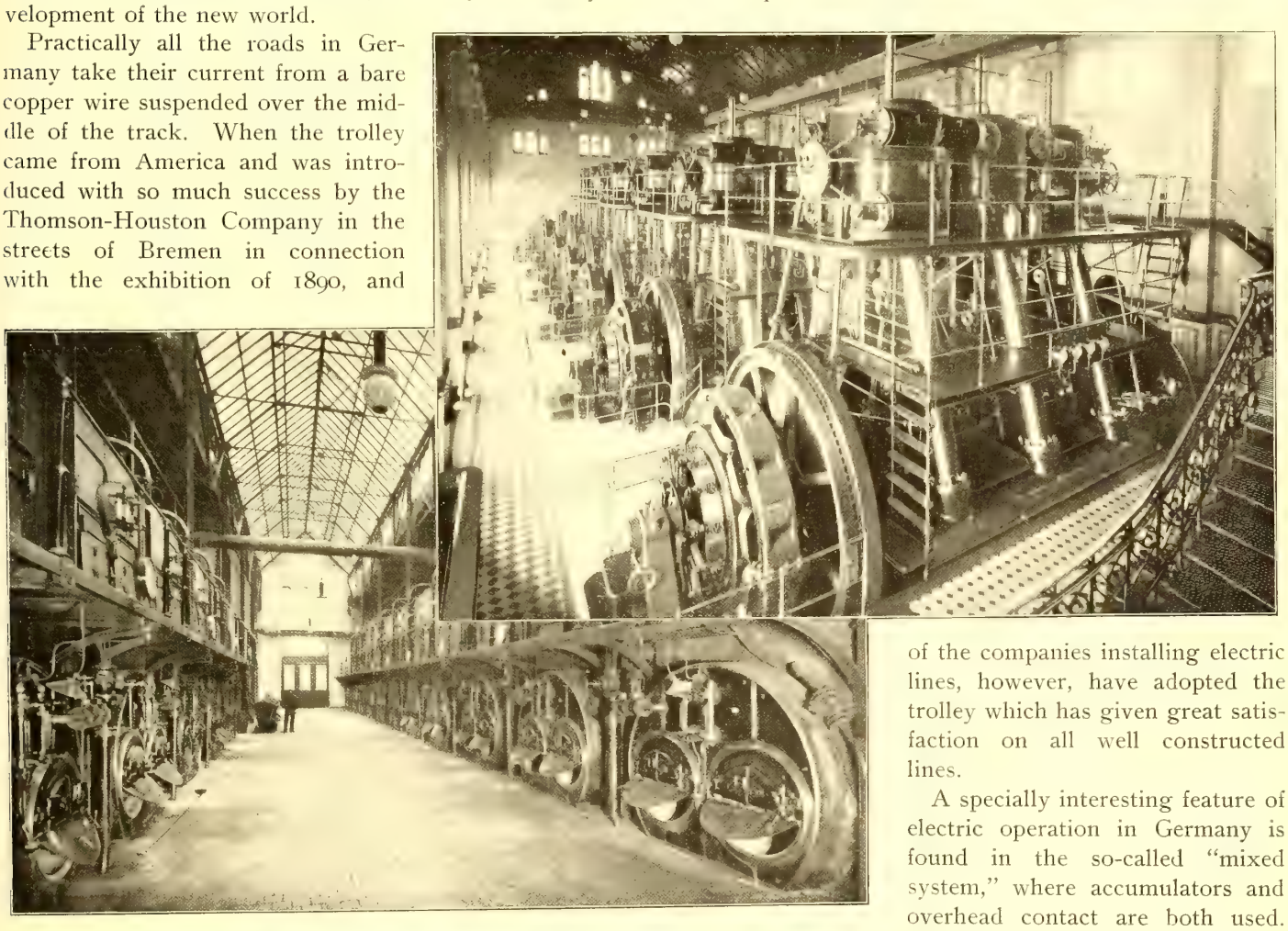
J. M. ROACH.

ELECTRIC RAILWAY PRACTICE IN GERMANY

BY LOUIS J. MAGEE

There is no very important town in Germany to-day where electric cars are not in operation or definitely provided for. The historical road between Frankfort and Offenbach, with its two split iron pipes as overhead conductors was put in operation in the year 1884, long before the trolley boom in America, and has remained unaltered throughout the changes which electric traction has experienced in going from its home in Germany, till the coming back, with the new impulse given it by the trolley development of the new world.

Practically all the roads in Germany take their current from a bare copper wire suspended over the middle of the track. When the trolley came from America and was introduced with so much success by the Thomson-Houston Company in the streets of Bremen in connection with the exhibition of 1890, and by the Allgemeine Elektricitäts-Gesellschaft, who started their road in Halle, in May, 1891, the upward pressure contact system, despite the æsthetic consideration of a people who keep their streets orderly and clean, met with general approval as simple and practical. Siemens & Halske, however, true to the traditions of a firm which laid the very foundations of the electrical industry half a century ago, refused to stake its ancient reputation on the vagaries of the trolley-wheel, and started out on the modern phase of its career in street railway work with its broad bow or stirrup contact piece. This was first installed on the equally historical Siemens' road in Lichterfelde, where, since 1881, current had been sent out through one rail of a track laid on wooden sleepers, and returned to the station through the other. This stirrup method of a moving contact piece, which causes no difficulty with jumping the wire, and does not require the contact wire to conform so closely to the line of the track, is still to-day the standard used by Siemens & Halske in the many roads they have built. The bow, or "Bügel," as it is called in German, is about 5 ft. wide at the top, and has inlaid at that part where it can come in contact with the wire, a strip of aluminum containing, in a groove, lubricating material. This strip of soft metal is renewed from time to time. Most of the companies installing electric lines, however, have adopted the trolley which has given great satisfaction on all well constructed lines.



INTERIOR ENGINE AND BOILER ROOMS, HAMBURG POWER STATION

A specially interesting feature of electric operation in Germany is found in the so-called "mixed system," where accumulators and overhead contact are both used. The batteries are not moved from the car for charging, but receive their charging current while the car is on a part of the line provided with overhead construction, as, for instance, in the less thickly settled districts of a city. As soon as the car comes to the zone, within which no trolley wires are allowed, the contact bar, or trolley pole, is laid down on the roof of the car, and the inner portion of the city is traversed by means of the current from the batteries alone. This system is in use on a large scale in Hanover, Dresden and Berlin, and also in Hagen in Westphalia. Its introduction has brought with it, naturally, the development of a more complicated controller, and the cars and trucks are heavier than would otherwise be the case. Despite first cost and maintenance of accumulators, and the careful attention which they require, it can be said that accumulators used in this way, although much dearer than

simple trolley lines, are sufficiently reliable and economical to bring about paying operation. In the cities where batteries have been introduced, the trolley was not permitted in all the streets; the great number of switches and crossings would have made the operation of a conduit rather complicated, and it was simply a question of the accumulator "mixed system" or horses. Possibly some good closed conduit system may eventually take the place of the accumulators on the comparatively short city lines for which they are required to-day, and the trolley may be allowed to encroach a little further in those streets where it is now forbidden.



BRACKET POLES IN BERLIN



SPAN WIRE CONSTRUCTION IN POSEN

As to Berlin, it would be giving a false impression to say that the accumulators are used for the more closely settled districts of the cities, for, as a matter of fact, the trolley runs through narrow and busy streets, but the distinction is made more especially with reference to a few of the finer streets containing the better shops. In Berlin battery cars have been running on this system since March, 1898. There are now 200 large accumulator cars in operation, and thirty small accumulator cars, and they are constantly increasing in number. The large cars for forty passengers weigh about 16 tons and the battery weighs about 2.5 tons. The latter is made up of 200 cells and has a total capacity of about 30 amp. hours with an average run of 2 miles. The small accumulator cars have batteries of 1.9 tons, with about 23 amp. hours capacity, while the longest course made regularly by one of these cars is 3 miles, going into the accumulator zone and returning to the trolley wire. The battery gets its charge again on about $1\frac{1}{2}$ miles of the trolley line. In most cases, however, the accumulator car runs right through the city so that it gets a charge from the trolley lines on both sides of the accumulator zone. An amusing incident once took place with this system. While an accumulator car was running on the trolley line, the central station met with an accident and the supply of current ceased. The car kept on undaunted, however, being quite independent of the source of supply.



ELECTRIC CARS IN MUNICH

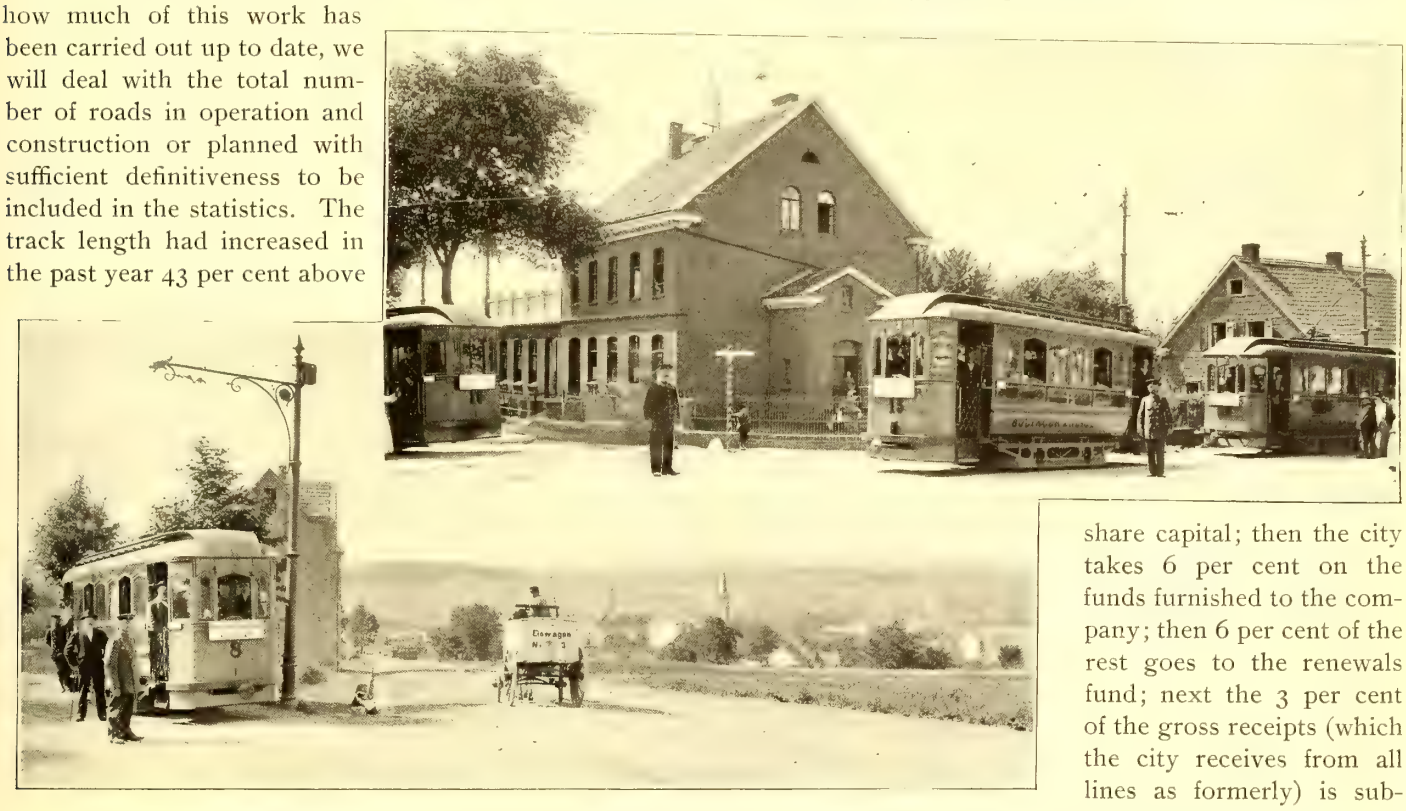
These accumulator cars have, of course, sufficient capacity not only to cover the average distance mentioned, but to do it with all conditions of track and with tow-cars.

On this road in Berlin, and on roads in several small towns, accumulator traction, pure and simple, is carried out, but results as far as known do not recommend this practice for very widespread adoption. There is an interesting case in Frankfort which may be considered to be half way between the "mixed system" mentioned, and out and out accumulator traction. On a line 1 mile long, four cars are running, each equipped with a 2-ton battery of eighty-four cells of the Pollak type. After making its journey over this line and back, the car stands on an average six minutes at a charging mast and then repeats the trip. The average charging current is 60 amps. at 210 volts. In this case, therefore, instead of getting its charge during the longer time while traversing a line provided with a trolley, it accomplishes the same work in a very much shorter time, and at one single point.

In Munich, six accumulator locomotives are to be used

over about 500 yards of line to draw the trolley cars. The locomotives will be charged at fixed points on the track. This experiment will be interesting as showing whether the complications in service, delay, and other objections urged against such a system outbalance the disadvantages of the "mixed" accumulator system or conduits, for short stretches where trolley is forbidden.

At the beginning of this year there were electric roads in seventy-seven principal towns in the German Empire. In addition to these, however, there were many surrounding towns connected by roads running from the principal towns. In these cities electric operation covered about 1313 miles of track, with about 3500 motor cars. Adding the roads which were at that time building or definitely laid out and contracted for, the number of towns or groups of towns increased to 103, and the length of track to 2047 miles,* or of line, 1575 miles. Without trying to determine how much of this work has been carried out up to date, we will deal with the total number of roads in operation and construction or planned with sufficient definitiveness to be included in the statistics. The track length had increased in the past year 43 per cent above the previous year, and the number of motor cars 41½ per cent. As to the more important cities to-day very complete and extensive electric lines exist in Aix-la-Chapelle (Brunswick), Chemnitz, Dresden, Hamburg, Hanover, Leipzig, Munich, Stuttgart; while Breslau, Kassel, Frankfort, Cologne, Magdeburg, Königsberg and Düsseldorf are building, or about to begin. Berlin was late in adopting electric traction, but has been rapidly making up for lost time, having about 550 motor cars in operation at the present date. The Hamburg lines, which were started up in 1894, represent about the best electric road to be seen in Germany in the way of an extensive network well equipped and splendidly managed.



SCENES ON ELECTRIC SUBURBAN RAILWAY, SOLINGEN

There are long lines of interurban roads in operation and under construction in the more important industrial districts of Silesia and the Rhine. There are sixteen roads, with about 10 per cent of the total mileage, which are not in the hands of private capital. Two of these are the property of the Crown, and the other fourteen, with about 8 per cent of the total mileage, are the property of towns or groups of several communes, as, for instance, in Düsseldorf, Barmen, Elberfeld, and a number of towns in that busy district, Frankfort-on-the-Main, and Königsberg. Even in the few cases where towns own the property there is a tendency to let out the operation to private contractors for a long term of years. In Munich the city participates in the ownership of the road, but it is operated entirely by the company. The Munich Company, with M.6,000,000 shares and bond capital, built and owns and operates the horse lines; but instead of lengthening its concession, which runs only till 1907, the city made an arrangement by which it acts as a silent partner with the company. The company thereupon introduced electric traction with the city's money on the following basis: The city guarantees the company M.930,000 per annum to cover interest on its share capital; then the city takes 6 per cent on the funds furnished to the company; then 6 per cent of the rest goes to the renewals fund; next the 3 per cent of the gross receipts (which the city receives from all lines as formerly) is subtracted, and what is left goes, three-quarters to the city and one-quarter to the company. This final quarter amounts to about M. 100,000. The Munich Company has 100 electric cars and fifty-five horse cars, which latter will disappear this year.

As to the question of capital interested in the other 90 per cent of the roads (always reckoning by mileage) it would, perhaps, be fair to say that about 20 per cent to 25 per cent of the work was done on orders given independently to electric companies by existing horse roads, in which cases, however, the electric companies entered into heavy guarantees as to the economical operation. Several unsuccessful experiences with accumulators before the days of the trolley had made many European street railway managers very distrustful as to electric traction, and they figured very carefully before making the extensive changes accompanying it.

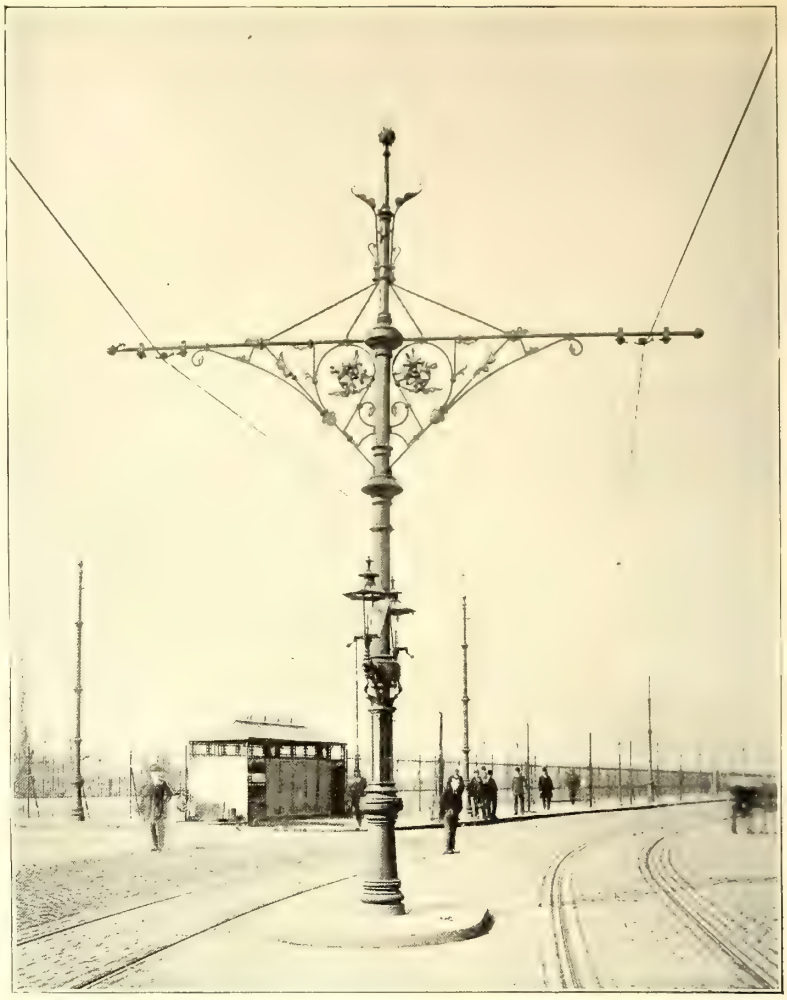
Twenty per cent to 25 per cent more represents existing horse roads bought up, or at least strengthened by capital connected with the electric groups. The remaining 40 per

*Elektrotechnische Zeitschrift, Jan. 5, 1899.

cent to 50 per cent represent comparatively new roads owing their existence almost entirely to the activity of the electric companies. They are owned by the electric companies or their financial backers, or by companies promoted by the latter. In several cases the electric companies have formed special companies for taking over and operating electric roads so as to divide the expenses of expert central management among several smaller roads.

It should be remembered that figures as to electric roads or lighting and power plants geographically confined to the German Empire give no idea of the work done by German firms. They have their agencies and branches all over the world and have cultivated export business. German electric firms have built or are building roads in Cairo, Batavia, Budapest, Vienna, Bucharest, Brünn, Olmütz, Aussig, Prague, Brussels, Liège, Toulon, Bergen, Christiania, Copenhagen, Genoa, Naples, Turin, Florence, Palermo, Leghorn, Kiew, Riga, Lodz, Bilboa, Basel, Seville, Barcelona, Santiago (Chile), Bahia, Para, etc. The roads installed within the borders of the Empire represent, therefore, the technical methods employed in very many lands far distant therefrom.

As has been frequently told in the Street Railway Journal, most of the German banks invest largely in the industries and electrical enterprises, and follow up these investments very closely. Each of the large electric companies has its group of bankers interested in its own direct manufacturing activity and in the enterprises promoted by it for the introduction and use of electric



MODERN CONSTRUCTION—DOUBLE BRACKET POLE IN HAMBURG



EARLY CONSTRUCTION—TUBULAR CONDUCTORS ON THE FRANKFORT-OFFENBACH ELECTRIC RAILWAY, THE FIRST COMMERCIAL RAILWAY IN THE WORLD

apparatus. It is naturally difficult to interest local capital in lighting, power and railway enterprises excepting in the large cities. The electric companies, therefore, make the necessary financial examination and technical studies, and recommend these enterprises to their banks. This led naturally to the permanent union of various groups of banks in the formation of large financial companies for furnishing the capital for electrical enterprises. These companies take responsibilities and furnish sums beyond the power of the electrical manufacturing companies, and at the same time make a large proportion of their profit in working up enterprises into such a condition that they can be presented to the public, and in the reorganization of old companies. If the *haute finance* of Germany has indirectly profited in a vast scale from the development of the electrical industries during the last six or eight years, the electrical industdustries must, on the other hand, admit that the orders would not have been forthcoming without the aid of their financial friends. This applies to the electric roads especially.

The more important financial groups are as follows:

Companies and Groups.	Share Capital	Bonds	Last Dividend
Siemens & Halske, of Berlin	40,000,000	20,000,000	10 p. c.
Electric Light & Power Company, Berlin	30,000,000	...	..
Schuckert & Company, Nuremburg	28,000,000	16,000,000	14 "

Companies and Groups	Share Capital	Bonds	Last Dividend
Continental Company for Electrical Undertakings, Nuremburg	32,000,000	20,000,000	..
Electric Installation Company, Dresden	6,000,000	....	..
Allgemeine Elektricitäts-Gesellschaft, of Berlin	47,000,000	15,000,000	15 "
Bank of Electrical Undertakings, Zürich (owned by A. E. G.)	23,000,000	....	..
General Local & Street Railway Company, Berlin	25,000,000	....	..
Electrical Delivery Company, Berlin	6,000,000	....	..
Union Elektricitäts Gesellschaft, of Berlin	18,000,000	....	12 "
Company for Electrical Undertakings, Berlin	30,000,000	20,000,000	..
Helios Company, of Cologne, (which has recently absorbed the Felix Singer Company)	16,000,000	4,000,000	11 "
Company for Electric Plants, Cologne	16,000,000	....	..
O. L. Kummer & Company, of Dresden	7,500,000	500 000	10 "
Company for Electrical Plants and Roads, Dresden	2,000,000	....	..
Lahmeyer, of Frankfort	4,000,000	3,200,000	10 "
German Company for Electrical Undertakings	15,000,000	....	.. "

These are the chief groups interested in street railway work. Each group represents a finely equipped factory or several factories. The capital involved is about M. 480,000,000 or $114,000,000. Some thirty-eight banks and private banking houses are actively interested in these groups. The capital of these banks may be roughly estimated at M. 1,500,000,000 to M. 2,000,000,000, or about $400,000,000 to $500,000,000.

As to the earnings of the street railway companies it may be said in general that while they (like all share companies in Germany) have a laudable desire to create large reserve funds, and thus provide for unexpected renewals and changes in their mechanical outfit, they pay in dividends everything which they cannot satisfactorily prove to be necessary and reasonable in the direction of special and regular reserve funds. Naturally the share-holding public want as large a dividend as possible. Over-capitalization is not possible according to German practice or under the German laws. Trolley traction has, of course, proved cheaper than horse traction, and in several cases has actually brought moribund railways to life again and made them most valuable properties. In the case of some towns where it seemed hardly possible that a street railway could pay, electricity was installed with good financial results. Statistics as to the increase of traffic upon the introduction of electricity are difficult to establish in a fair way because the introduction of electricity not only brought much better accommodations, better cars, better lighting, fast service, the idea of novelty, etc., but also it is to be remembered that the larger towns of Germany are growing very rapidly, so that horse cars if retained would also have shown an increase. There is to be seen, however, all along the line an increase in car-miles run, the number of persons carried, and the receipts. The receipts per car-mile range



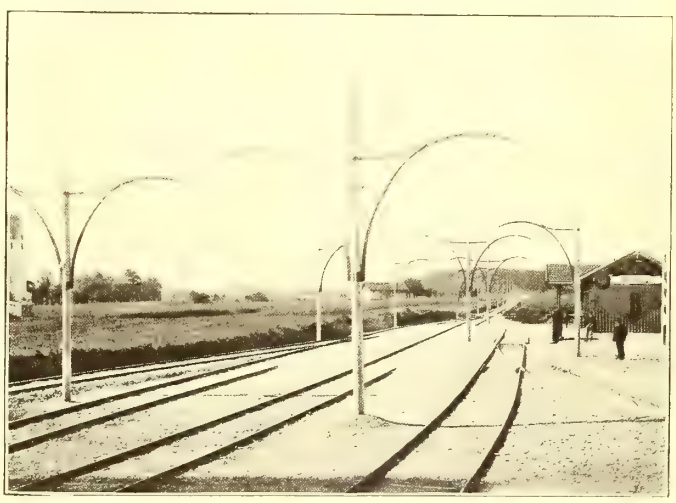
FORSTHAUS-ALEER



BETWEEN OBER-KASSEL AND DEERDT-LORRICK



LUEG-ALLER IN OBER-KASSEL



BAD-AIBLING-FEILENBACH

DIFFERENT TYPES OF OVERHEAD CONSTRUCTION

all the way between 11.5 cents and 19 cents, but average about 13 cents.

A splendid instance of the advantages of electric traction is to be seen in Remscheid, an industrial town near Solingen, and like Solingen a great producer of small steel ware.

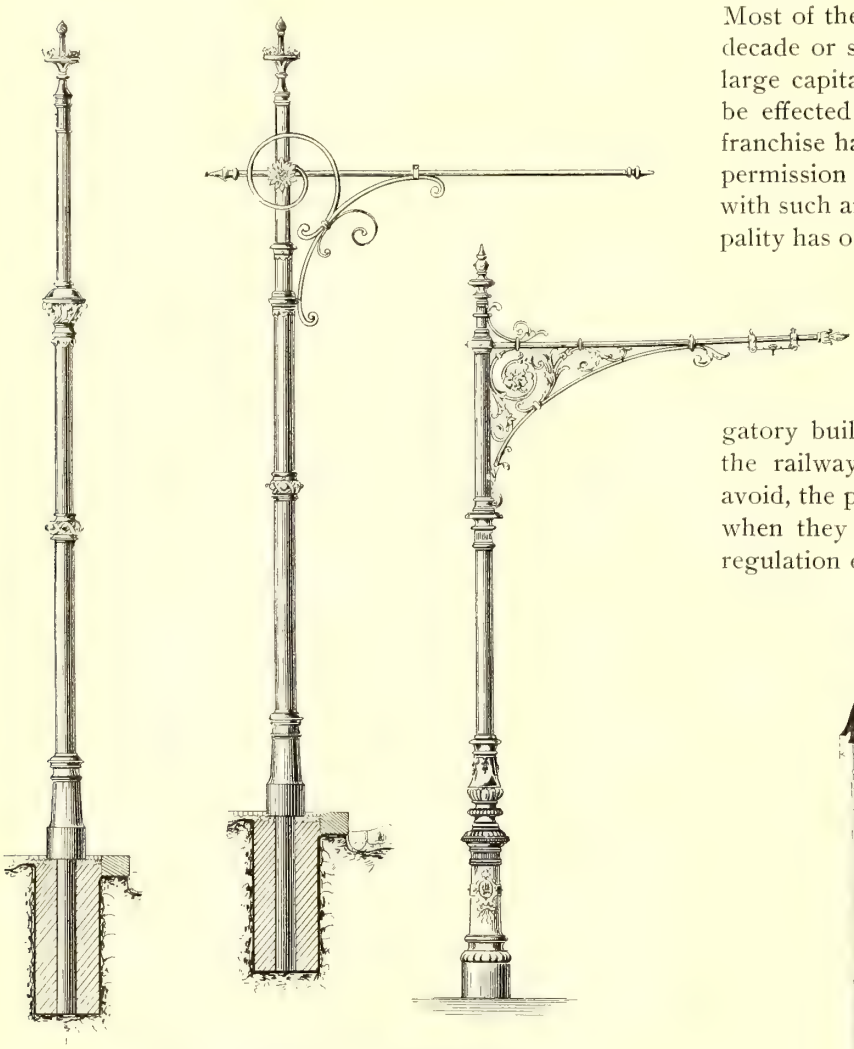
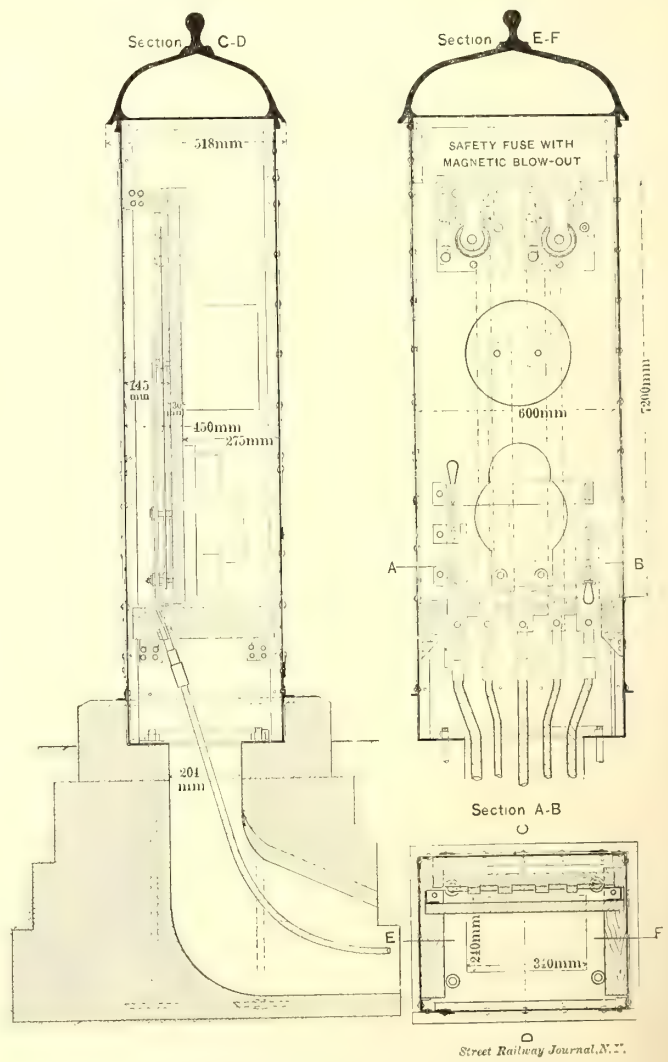


FIG. 1.—POLES IN COMMON USE

The town lies on a hill, and the maximum grade of 10.6 per cent was too much for any other street road traction system, so that this whole district in which the small artisans, working in their own homes, had to carry their baskets of half-finished wares to the larger factories, was entirely without any public transport system. It was one of the first towns to introduce electricity, and the receipts have increased nearly 10 per cent each year, being now over 16.8 cents per car-mile. Barmen-Elberfeld lines also serving a crowded and busy industrial district, show an increase of 44 per cent in the receipts of 1898 above 1896, when electric traction was introduced, that is for the three years 14.8 per cent per year increase. The average receipts in Dresden increased on the line of one company from 14.55 cents per car-mile in 1897, to 15.32 cents per car-mile in 1898. The other large company showed an increase at the same time of 12.25 cents to 13 cents, both companies being active in all improvements pertaining to electric traction and showing very efficient organization. In Leipzig the one large company increased its receipts 28.4 per cent in 1898 as against 1897, increasing at the same time in car kilometers run by 48 per cent. The other large Leipzig company has increased its receipts during the last three years, 14.3 per cent a year. These instances taken at random make a sufficiently good showing for electric traction.

The general franchise and permissions to build are granted by the local city and town authorities. In the case of new roads the franchise rarely exceeds fifty years. Most of the franchises of existing horse roads had only a decade or so more to run, and as the amortisation of the large capital necessary for electrical equipment could not be effected in this period, a material lengthening of the franchise has been granted in practically every case where permission for electrical equipment has been given. Along with such an extension of the railway franchise the municipality has often, though not always, laid down a large number of new conditions more or less burdensome to the companies, and leading generally to its participation in the receipts or profits of the railway company. Among these are included, for example, the obligatory building of lines in less populous districts which the railway companies would naturally be disposed to avoid, the purchasing of current from city lighting stations when they exist, the reduction of fares, the paving and regulation of certain streets, and minor advantages for the



FIGS. 2 AND 3.—SECTION SWITCH AND FEEDER BOX.

city or public, for which the making of a new contract of this character presents an opportunity.

The concession once granted, usually according to the

trolley system, it only remains to get the definite building permission after presenting the plans to the various local technical authorities. The street railway company or its contractors mark out the exact position of poles, feeders, new or altered tracks, etc., and the street engineers or the proper department of the police check up these plans to see if existing street arrangements, such as sewers, gas and water pipes, or prospective alterations in buildings or streets are interfered with. The government postal authorities are naturally consulted as to the effect on telephone and telegraph lines, and the necessary changes in telephone lines, and protecting of same by guard nets, etc., is adjusted, to be carried out by the Post at the expense of the tramway company. In putting through a new law which will grant them more power for long overland lines (right of expropriation, for instance), and relieve them from much petty bother with small communes and land-owners on cross-country routes, the postal authorities have shown great fairness toward the heavy current electricians, in that it is arranged that those who come into a street last shall stand the expense of alterations. An overland power transmission or interurban road can, in this case, keep its own way or in any case, will not have to move at its own expense in case it was there before the telephone or telegraph.

As above said, with the exception of the Post (and, of course, the Imperial railway authorities where crossings, etc., come into question, and the military authorities where fortifications are passed through or approached), the local authorities settle the matter, and no parliamentary act or imperial sanction is required. In case, however, the road runs through several communes and uses good turnpikes, provincial, county and district authorities come into play.

The following examples of franchises in the principal cities, dividends and participation of cities in profits may be of interest:

Street Railway Company	Concession runs until	Dividend	Participation of City in Proceeds
Great Berlin.....	1919	18%	8 per cent of gross receipts.
Berlin-Charlottenburg..	1937	5¾	
Hamburg.....	1922–1928	8%	25 per cent to 40 per cent of profits after 6 per cent dividend up to 10 per cent; over 10 per cent dividend 50 per cent of profits.
Great Leipzig.....	1935	8%	After three years 2 per cent of gross receipts, increasing with time to 5 per cent.
Munich.....	1907	10%	2 per cent to 3 per cent gross receipts.
Breslau.....	1922	8%	3 per cent to 5 per cent gross receipts according to scale of receipts.
German Street Railways, Dresden.....	1939	6%	.....
Dresden Street Railway	1921	8%	.....

In general, the government has a tendency to foster and

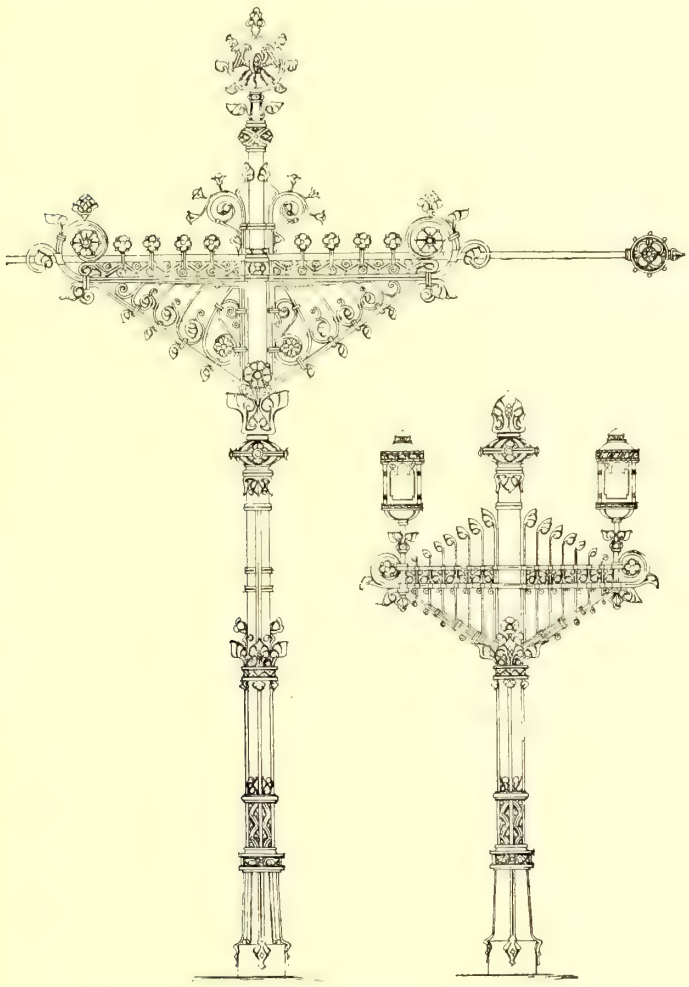


FIG. 4.—SPECIAL DOUBLE ARMS WITH LANTERNS TO BE INSTALLED NEAR THE EMPEROR WILLIAM CHURCH IN BERLIN

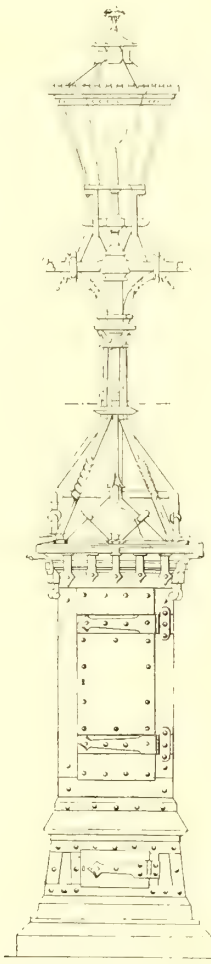


FIG. 5.—EXTERIOR OF LAMP POSTS IN HAMBURG WITH BOX FOR FEEDER SWITCHES AND METERS

aid undertakings of companies or private individuals whose end is to furnish light, power and better means of communication to a large number of communities, any one of which would in itself be too small to offer inducement for the investment of capital.

Street railways connecting several communities were made the subject of a special law in 1892,* the intention of which was to foster such undertakings and give them the protection of the general government, even in opposition, if necessary, to separate communities. According to paragraph 2 of this law, and the official commentary thereon, concessions for light railways of this kind are given by the ordinary provincial district or township authorities, but such concessions may be refused if the railroad is not considered necessary, or if the financial position of the undertaker does not appear sufficiently stable, and also if, owing to the lack of the traffic, such a road could not pay. If such a railroad is to be operated by electricity or other mechanical power, the president of the provincial district has to decide upon the granting of the concession. All rolling material has to be accepted by a special experienced railway engineer in the government service. The special inspectors take pains to inform themselves so thoroughly that, instead of being hindrances to the introduction of a practical system, they have frequently made suggestions which were helpful to those engaged in the enterprise. One of the questions, for instance, which these inspectors have to pass upon is the efficiency of the brake, a detail which, of course, in the interest of the public, must be under strict control. The law also says that if one builds and runs a railroad according to the concession obtained by him, any person or persons who consider that their rights have been interfered with may attack him for damages, but they cannot cause him to cease building or running the road. As far as the public streets are concerned, light railways have the right of expropriation analogous to that already provided for by law for other means of transport. For cases in which the clause regarding public streets does not apply, the right of expropriation must be granted from time to time, as the occasion may require it. It is therefore foreseen, according to this last paragraph, that cases may come up where property may not only have to be seized for running the permanent way, but also where a seizure or expropriation may be permissible for other purposes, as, for instance, a central station, sub-station, a waiting-room, a car or any structure connected with the operation of such a road. The right of expropriation was established recently in the case of a rosette on a certain house in Berlin where the owner had refused permission to attach the span wires to his house and the setting of a pole instead of the rosette was not feasible.



CARS FOR HIGH SPEED LINE BETWEEN DUSSELDORF AND KREFELD



FREIGHT TRAIN ON BAD-AIBLING–FEILENBACH LINE

ROADBED

In Figs. 19 to 22 are shown roadbed constructions in various towns. The track is laid almost universally on concrete. Some lines in Berlin have been laid on asphalt. In the case where lines are laid in streets provided with granite paving blocks, the authorities usually demand that the rail should have the height of the normal block, about 7 ins. In Figs. 11 to 18 are shown the usual types of rail, which vary in dimensions and material according to the wishes of the various companies and the practice of the various steel works. Berlin, for instance, has chosen a rail heavier, but lower than that used in many other cities, because Berlin has such a large proportion of asphalted streets to take into account. One of the great steel furnishers uses Siemens-Martin steel, another Bessemer, another Thomas' patent steel. The Schmidt lapping-joint is considered very satisfactory in Berlin,

*For translation of Kleinbahn Gesetz see Adams' Report on Continental Street Railways for Massachusetts Legislature.

while the Phœnix foot joint is favored in Dresden for instance. The special work such as curves, crossings, etc., has been done to a large extent by contractors especially equipped for that work and not by the furnishers of the rails themselves. The frogs are frequently built of regular rail sections of normal profile, while hardened steel is used for points and centers.

Much attention is given to rail bonding, but plastic and stranded bonds do not seem to have met with great favor perhaps because they are dependent upon the fish-plates, whereas the ordinary ("Chicago") wire bonds are put on entirely independent of the rail joint itself. The fact that the latter bonds have been stolen in several cases, especially in Belgium and Aix-la-Chapelle, would argue in favor of a bond covered by the fish-plate. Fig. 11 shows the type of bond designed and used by the Union Elektricitäts-Gesellschaft in Berlin. About 30 miles of single track in Berlin have been provided with the Falk cast joint, which has given good satisfaction in the case of new rails, but not so good in the case of the old rails. The cast joint has had hardly any further introduction in Germany as yet.

Rail section, Fig. 16, is used chiefly where there are high paving stones. Fig. 17 is the same, but is provided with the Schmidt joint. The section, Fig. 13, is considered very well proportioned and is liked on account of its broad base. Fig. 15 is the accepted profile for the great Berlin lines. The foot is very narrow because of regulations of the city as to a good connection between the pavement and the rail.

The fish-plates vary according to the wishes of the authorities or the companies between 14 ins. and 32 ins. Up to 20 ins. four bolts are used, above 20 ins. six bolts usually. In the case of a fish-plate 32 ins. long the rail bond is one meter (about 40 ins.) long.

ROLLING STOCK

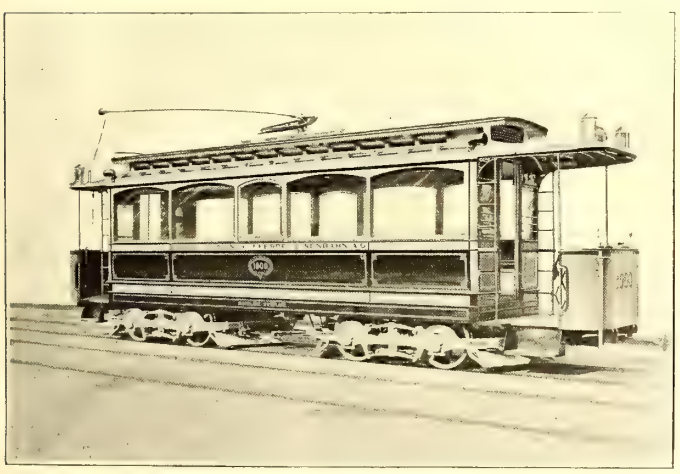
The types of cars are shown in various illustrations.



CAR AND TRAILER IN LEIPZIG



CARS IN DRESDEN



BERLIN ACCUMULATOR CAR



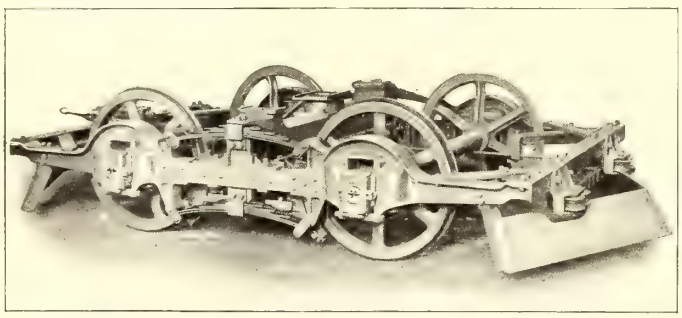
SUBURBAN STATION IN MUNICH

The seats usually run lengthwise, exceptions to this general rule being mostly found in Berlin where a number of modern American cars are in service. The use of trail cars is general, especially on Sundays and holidays. The use of two trail cars is permitted in the city of Berlin.

The chief point of discussion regarding car bodies has been the step. In Saxony the authorities rule on the principle that the step should be high enough to allow it to pass over a body which may have fallen on the rails, and therefore give a certain leeway of braking space before the body is touched by any part of the car. In this case the lower step has to be about 14 ins. above the top of the rails. In contrast to this practice, there is a general tendency throughout Germany to make the lower step as

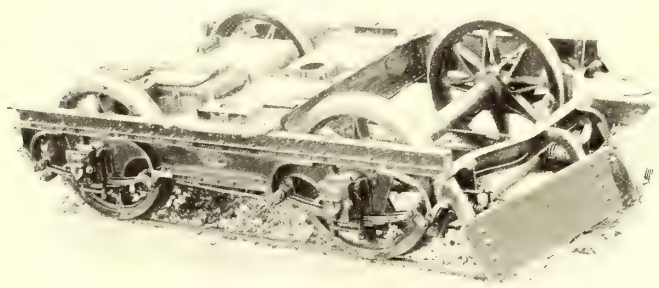
low as possible so that the passenger can get a fast hold, even if the next step is high. But in order to make both steps as easy as possible, the whole platform is kept low and an extra step is provided between the platform and the car floor. The general width of the car is 80 inches.

The distance from middle to middle of track varies greatly, but is usually about 8 ft. The gage is mostly the



BOGIE TRUCK FOR ACCUMULATOR CARS, GREAT BERLIN STREET RAILWAY

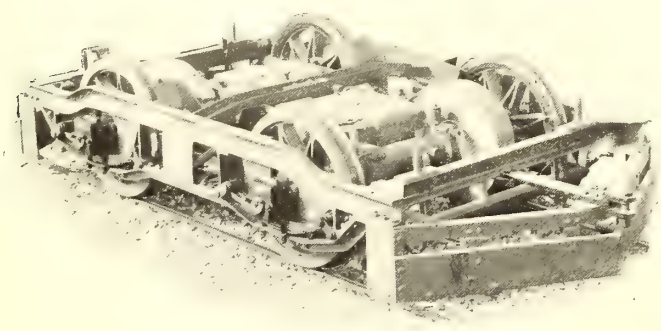
normal gage, 1.435 m. (4 ft. 8½ ins.). If anything below this is chosen it is usually the normal narrow gage of one meter (39.37 ins.). An interurban light railway in Schlesingen has a gage of 75 cm. (30 ins.), and the tracks of the great Leipzig Company having been laid when the



TYPE OF GERMAN MOTOR TRUCK

company was in English hands, has a gage of 1.458 m. (4 ft. 9 4-10 ins.).

The largest cars in use are the accumulator cars on the Berlin lines, weighing about 16 tons and holding forty passengers. Passengers are never allowed to stand in the

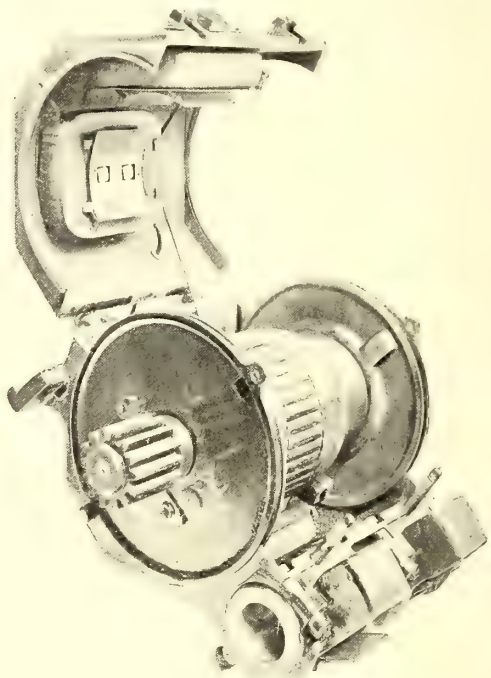


TYPE OF GERMAN MOTOR TRUCK

cars, and only a certain definite number are allowed to stand on the platforms. The front door is kept closed, the forward platform being reached only from the street. Fares from the front platform are passed through a small hand-hole which is covered by a hinged or sliding door. Bell punches and fare indicator dials are not used, but the passenger receives a ticket upon which all the lines are printed, the line which he pays for, or the limiting point to which he may ride for his fare, being indicated by the punch. The ticket is inspected occasionally by a "Controlleur."

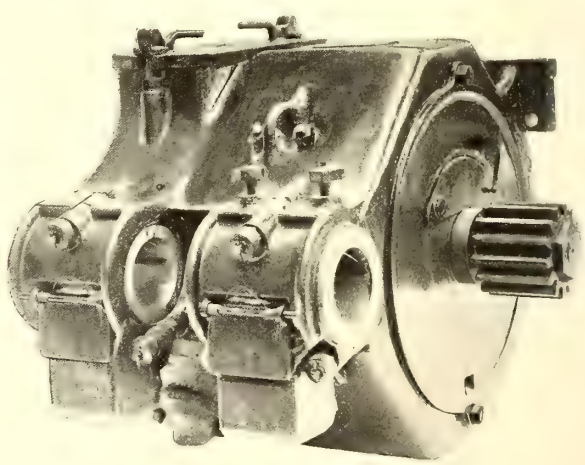
Electric car heaters are avoided as uneconomical. The "Union" has a controller adaptation for electrically-heated cars, whereby the current allowed to pass through the heaters is made to depend upon the intensity of the motor current. When the motors are taking less than their normal full current the heaters may be served, so that the car never consumes more than the maximum necessary for its propulsion, and the heating current does not increase the peaks of the station load.

Heating with "brickettes" of coal in a long tube under



NARROW GAGE MOTOR, OPEN

the bench is the most popular method. The fuel is replenished only twice a day and costs about one cent per



NARROW GAGE MOTOR, CLOSED

hour. Of course, this does not maintain an American sleeping-car temperature.

American trucks served as models at the beginning of the decade but German car builders and one specialist firm, the Bergische Stahl Industrie, are doing good work with standard types of trucks. The latter firm has built and furnished about 3000 trucks (of course, not all for

Germany). Perhaps 80 per cent of the motor cars are equipped with two-axle trucks. Maximum-traction trucks are in use in Munich (page 655), Nuremberg, etc.

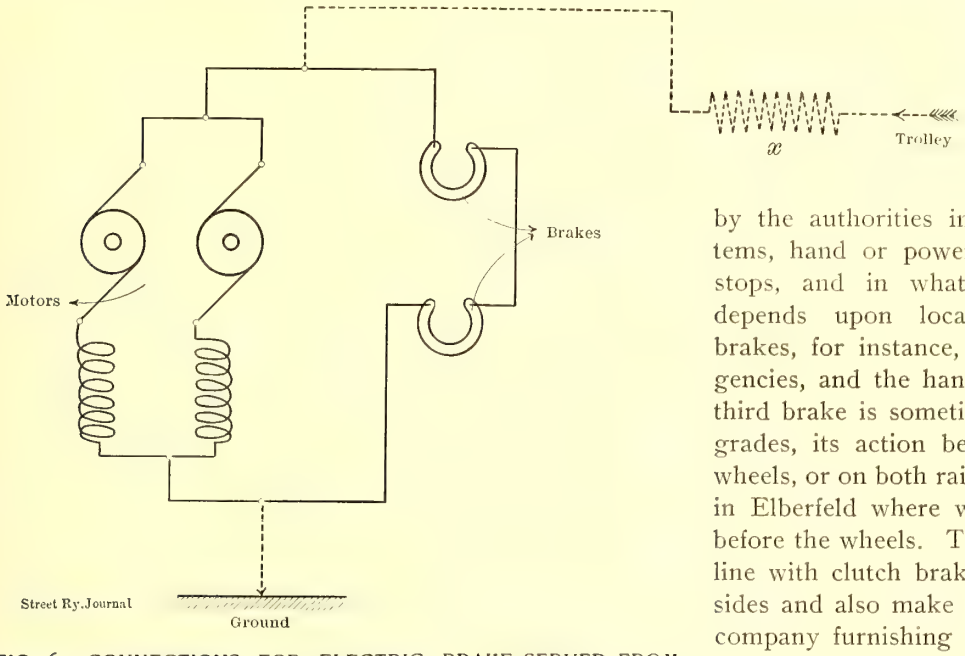


FIG. 6.—CONNECTIONS FOR ELECTRIC BRAKE SERVED FROM TROLLEY WIRE

The bogie-truck of the Berlin accumulator cars is shown on the opposite page.

Preference is divided between cast steel wheels and wheels with renewable tires. The former run some 35,000 miles to 50,000 miles before wearing down to a rim thickness of 18 mm. (.7 ins.).

Brakes have received a great deal of attention in Germany. Every electric car is equipped, first of all, with a hand power brake. This is, in some cases, the old-fashioned crank or wheel type with chain, in others the American ratchet, and in still others a lever working at right angles to the direction of the car and operated in one stroke, or, as a ratchet, in a number of strokes. A second brake, magnetic, or short circuiting, or compressed air, is also installed in many single electric cars, and, latterly, in all cases where the motor cars are expected to draw trailers. In some instances a second brakeman tends the hand brake of a tow-car, but an electric or air brake on the tow-car, served by the motorman, is recognized as a great convenience and safety and is even required by the authorities in Saxony. Which of the two systems, hand or power, is used continuously for regular stops, and in what way their effects are combined depends upon local judgment. The "Standard" air brakes, for instance, in Leipzig, are reserved for emergencies, and the hand brake is employed ordinarily. A third brake is sometimes installed on lines having heavy grades, its action being upon the rails instead of the wheels, or on both rails and wheels as in the case of a road in Elberfeld where wedges are dropped upon the track before the wheels. The "Union" equipped one very steep line with clutch brakes which grip the T-rail from both sides and also make a derailment impossible. The same company furnishing an interesting rack brake on a line where the specifications called for a brake which would act automatically when the speed exceeded a certain limit. Two bosses *o*, (see Fig. 7) on the centrifugal regulator *d*, fixed to the axle *c*, project beyond the periphery as soon as the speed limit is passed, thereby causing the weight *l* to fall. The weight presses the brake shoes *h* against the revolving brake wheels *e*. Between these brake wheels and the toothed wheel *f*, which is not attached to the axle, are placed rubber cushions so that the braking effect is transmitted to *f* with some slip, and without sudden jar.

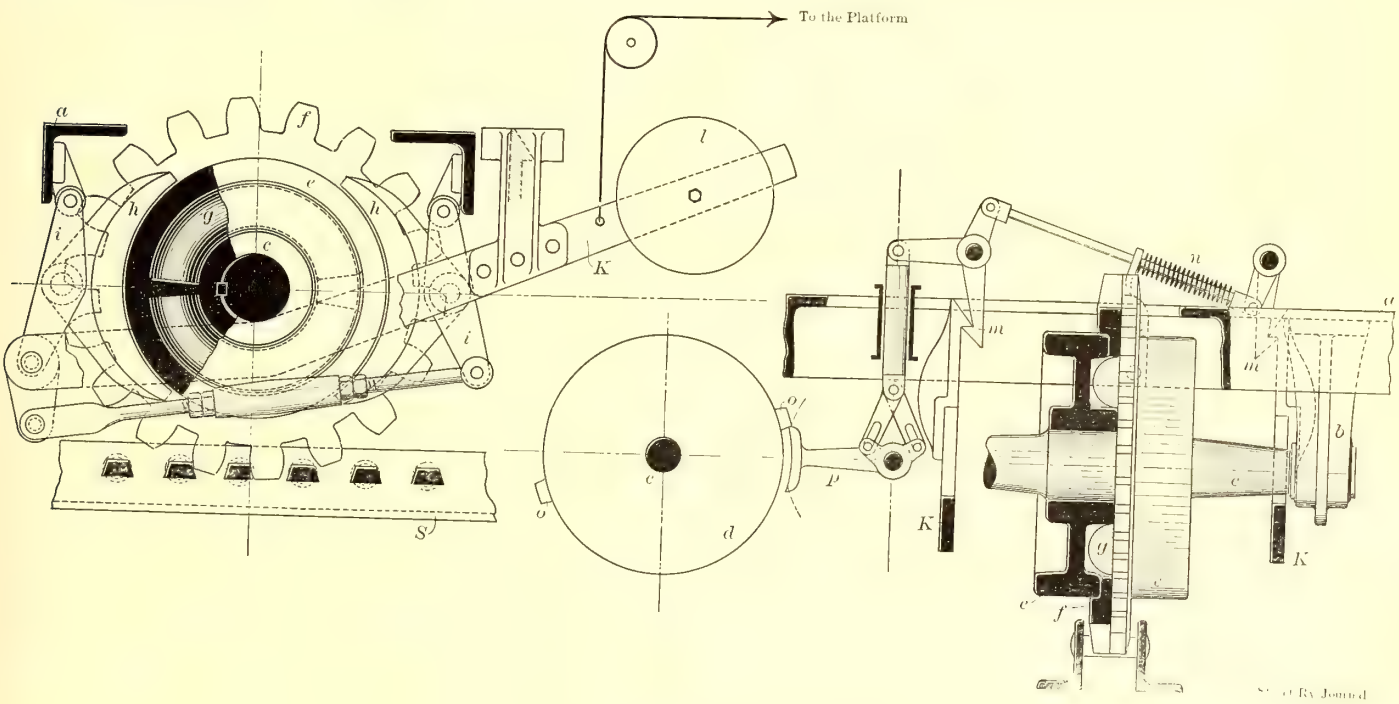


FIG. 7.—DETAILS OF RACK BRAKE

The rack *s* is installed only on steeper parts of the line. The weight is drawn up from the platform and an electric bell sounds until it is drawn up.

To give an idea of the brake systems employed, the "Union," out of 3102 motor cars, installed

398 with simple hand brakes.
461 with hand brake and electric short-circuit brake.
510 with hand brake and air brake.
1733 with hand brake and magnetic brake.

Not to mention a number of cars with rail brakes as above mentioned, magnetic brakes similar to the Sperry are largely used, as are also ingenious types designed by the Union and Siemens & Halske Companies. An interesting combination of a magnetic brake with hand brake on tow-cars is also noteworthy and new. A novelty is an arrangement of the controller whereby, at the last braking notch, the magnetic brake and the motors are

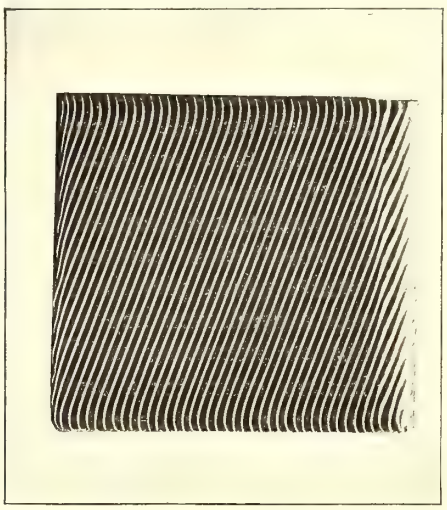


FIG. 8.—MAJERT STORAGE BATTERY PLATE

supplied with current from the line even when the car is standing still—a necessity on grades if one desires to be entirely independent of the hand brake. Fig. 6 shows the connections. The resistance x is to keep the trolley current within limits. The resistance of the motors and brake coils must be so proportioned that the greater part of the current flows through the brakes, otherwise the car will start backwards. The dotted lines show the connections made at the last braking point of the controller.

Series parallel control is general, but space will not permit a discussion of the various types of controllers.

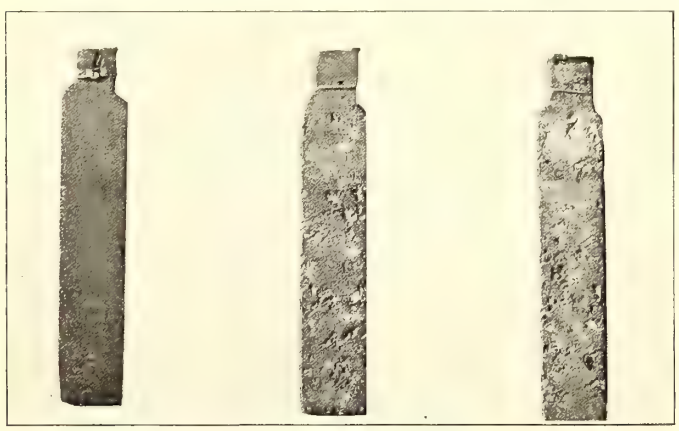


FIG. 9.—CORROSIVE ACTION OF ACID ON THREE KINDS OF LEAD

An interesting divergence from American practice is the double handle controller of Siemens & Halske. One cylinder makes the combinations, and a second is only for cutting out the resistance, step by step. The second cylinder springs back to zero position as often as the first is moved to a new position. It seems rather complicated for the motorman to have to work with two handles.

Another development in controllers is their adaptation

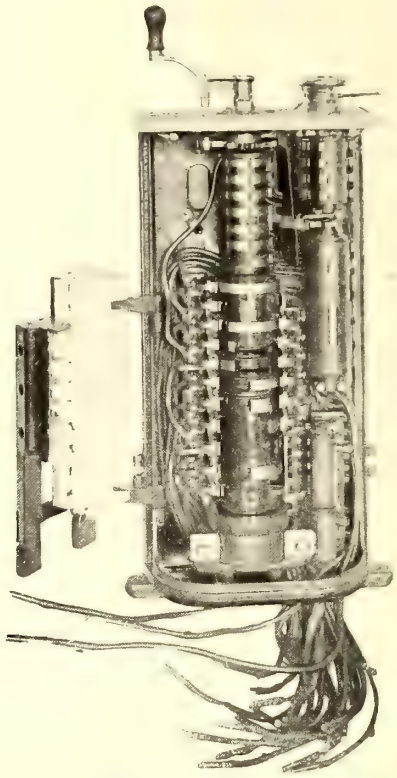


FIG. 10.—CONTROLLER FOR ACCUMULATOR CARS



INTERIOR ACCUMULATOR CAR, GREAT BERLIN STREET RAILWAY

to use with accumulators in the "mixed system." In the barrel of a "Union" controller having contacts for electric braking and series parallel control, the accumulator cylinder is placed below, and coaxial with the reversing

cylinder, and is actuated by the wheel above the reversing lever. This cylinder has three positions:

1. Trolley alone.
2. Trolley with charging circuit.
3. Discharging current.

The lighting current is also modified by this cylinder. A small resistance is placed in series with the battery for a moment at the beginning of its charge to avoid the



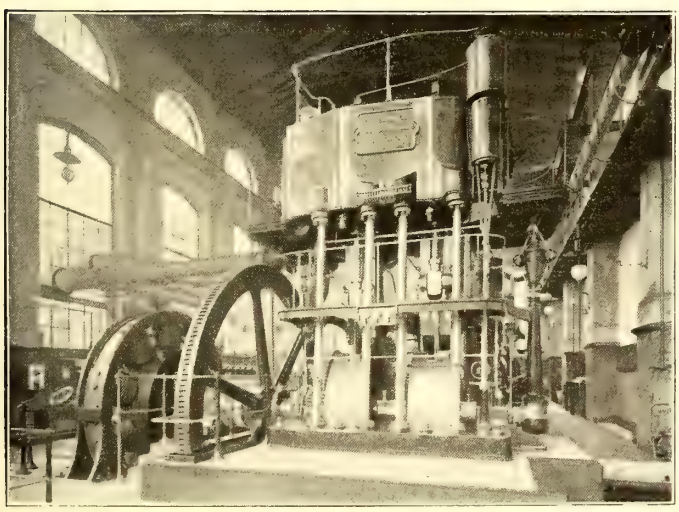
EXTERIOR POWER HOUSE, GREAT LEIPZIG ELECTRIC RAILWAY

otherwise heavy rush of current. A charge indicator is also provided to avoid the loss and disagreeable gas from overcharging.

American practice has been followed with motors as with controllers. On page 656 is shown a motor built by the "Union" for a gage of 75 cm. (29½ ins.).

DISTRIBUTION SYSTEM

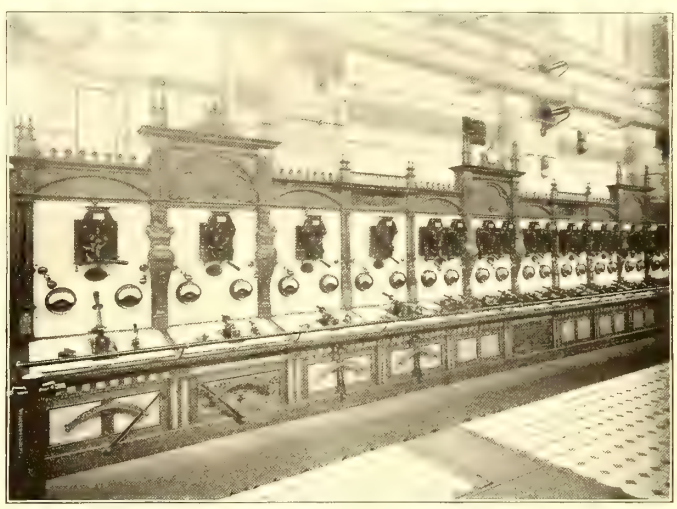
The feeders are, as a rule, underground. Almost uni-



ENGINE GENERATOR UNIT IN POWER STATION, GREAT LEIPZIG RAILWAY

versally lead covered cables provided with an iron ribbon armor are laid directly in the earth without further protection, or, at most, covered with brick or slabs of stone. An insulated return feeder is connected to the rail at the same point at which a feeder is connected to the contact wire in Berlin, but this practice is not very general owing to the great expense, and the traffic is not heavy enough on most roads to make it necessary.

The types of ornamental iron poles generally used do not vary much excepting that the ornamental base, the rings and the cap are designed to suit the taste of various city authorities. Wooden poles are rarely seen, but iron poles of lattice work construction are sometimes met with in smaller towns. Side brackets and double brackets are used wherever possible. Overhead feeders are avoided excepting in the country. The hard drawn copper trolley wire is supported usually by span wire of 2 mm. and 3 mm. diameter. Line insulators, that is, those types which were most serviceable and had a neat appearance, were imported from America for some years, and a good many American supplies are said to be sold now, but the German rubber companies and other manufacturers are delivering overhead supplies to the electrical companies which meet all the conditions at least as satisfactorily as the best known American types, and at a reasonable price. Also several firms of specialists have established themselves for just this line of business. The general character of the overhead construction may be said to be good, and in the larger cities where difficult problems have had to be worked out, some very interesting and exceedingly clever work has been done with overhead construction, and one rarely hears any complaints on the part of the public as to the appearance of the trolley lines.



SWITCHBOARD, GREAT LEIPZIG RAILWAY

The loss in the feeders and difference of potential between different parts of the system, points which are controlled in England by the Board of Trade regulations, are not officially specified in Germany. The electrician of the city of Berlin has interested himself especially in this feature of electric distribution, and has written a good deal about it, but the specification for the installation of electric roads in Berlin does not state any figures, the idea being that measurements, from time to time, will be more efficient to prevent trouble than a stiff rule.

The only conduit system in operation in Germany is a line 1.3 miles long, built by Siemens & Halske for their own road which starts in the best business portion of Berlin, and joins an overhead line later. The conduit line has been running fairly regularly since the spring of '96, with thirty-five cars. As in Budapest, the conduit is placed under one of the rails, an arrangement which every European engineer seems to prefer to the center conduit which requires more iron in the street. When the car

reaches the end of the conduit division, the plow is raised from the conduit automatically by an inclined plane.

POWER STATIONS

The largest street railways are in cities with extensive lighting stations, and the current is usually delivered from the one or more lighting stations at 550 volts. Rotary converters or transforming sub-stations have only been used in isolated cases.

The capacity of the dynamos used for furnishing current for the street railways in operation was, according

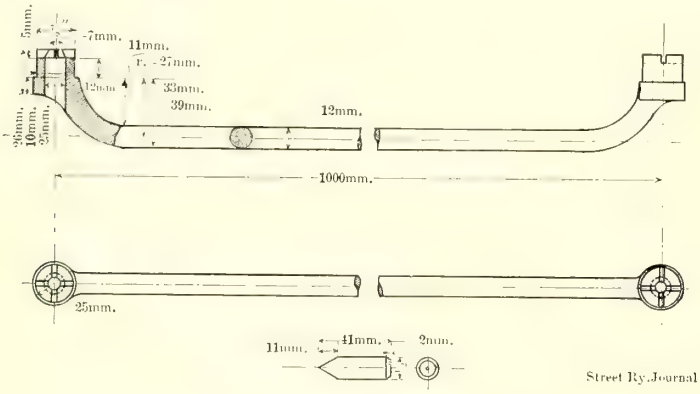


FIG. 11.—U. E. G. STANDARD RAIL BOND

besides those above mentioned the roads get their current from combined light and power stations owned by companies, as, for instance, in Berlin.

One of the most important power stations for street railway supply is that of the Hamburg Electric Company. This company has other stations more especially for lighting. In this station there are seven vertical triple-expansion engines, each for a normal load of 1000 h.p. at ten atmospheres and 100 revolutions; five are from the Augsburg Company and two from Schichau & Company. Five of the engines drive each two Schuckert dynamos of 400 kw. capacity each, while the other two engines each

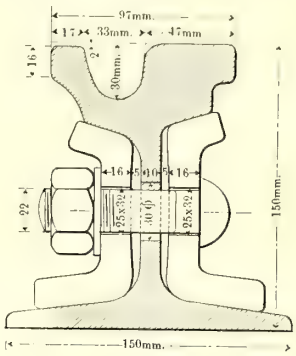


FIG. 12

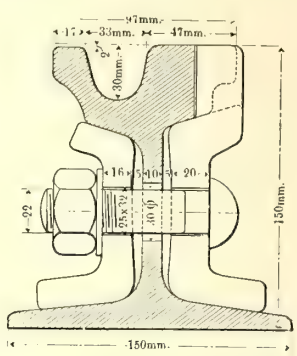


FIG. 13

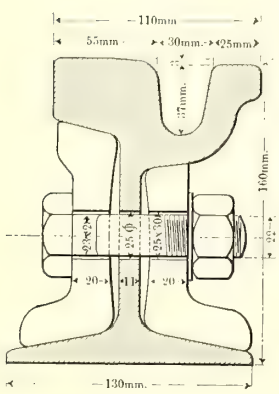


FIG. 14

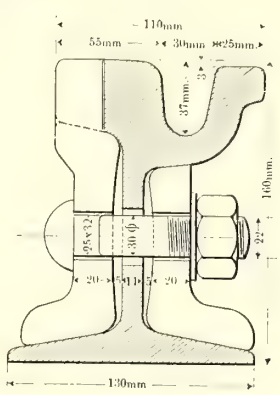


FIG. 15

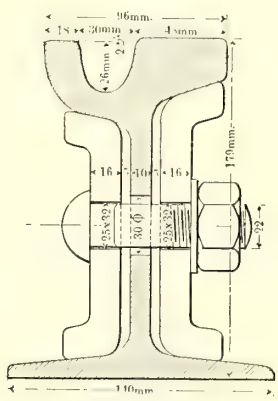


FIG. 16

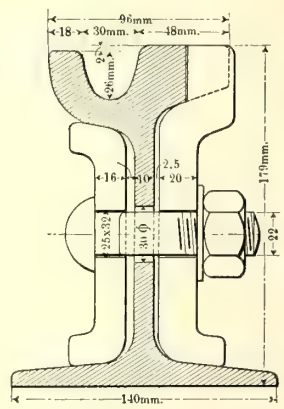


FIG. 17.

GERMAN TYPES OF RAILS AND JOINTS

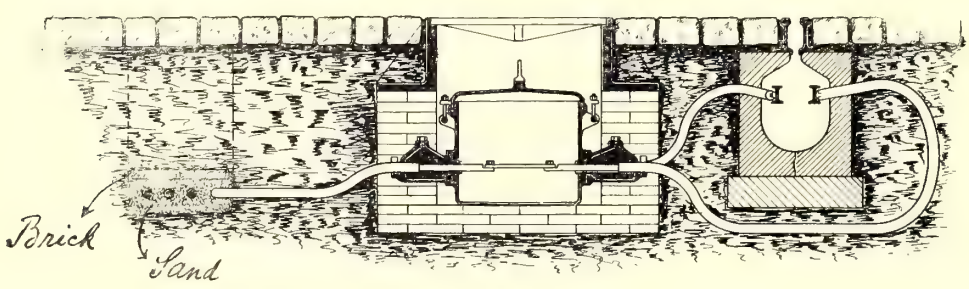


FIG. 19—ARRANGEMENT OF UNDERGROUND FEEDERS

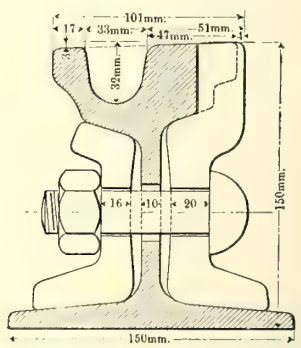


FIG. 18

to the latest statistics, 33,333 kw., to which should be added 5118 kw. in accumulators in the stations. The use of Puffer batteries to equalize the load in street railway power stations is generally recognized as a highly economical feature, and is on the increase. The average kilowatts installed in machines per mile of track is thirty-four, and average kilowatts installed per motor car is 14.2 In the case of the forty-four roads receiving current from special railway power stations, in about a dozen cases current is taken from electric works owned by towns, as, for instance, in Munich and in Dresden, in which latter case the city has in addition to its lighting station a special central station only for the street railways. In all cases drive 800-kw. Schuckert dynamos. While most of the dynamos are wound for 500 volts to 600 volts, four are wound for 250 volts to 300 volts so they can supply lighting current and (two coupled in series) railway current. A battery of 275 elements with a capacity of 2000 amps. discharge is connected in parallel to the railway generators and secures an even load, besides constituting an excellent reserve with the capacity of one steam engine unit during one hour.

STORAGE BATTERY CARS

When three such important cities as Hanover, Dresden and Berlin are dependent on the use of accumulators

for carrying out a successful electric service, one naturally asks what is the novel feature which makes the lines in these cities possible, whereas accumulator traction in general has failed to be satisfactory. The first essential factor is that the cars do not have to stand in the sheds while the batteries are being charged, and the batteries do not have to be removed from the cars, but are charged as above mentioned on the trolley line. The second factor is that instead of trying to use any of the so-called high capacity batteries, the street railways mentioned are using batteries supplied by firms which have long ago recognized that there is not any light weight substitute for lead, and that a sacrifice in weight would mean for a traction battery so much more expensive renewal. Up to date there are no really precise figures to be obtained on the cost of maintenance of such batteries over a long period. A car battery costs about $1,300, and 15 per cent to 20 per cent of the original cost will have to be given out or laid aside in the reserve fund each year for maintenance of the battery for ten years.

Aside from the well known Tudor accumulator, the element which has been installed in a good many of the Berlin cars and is ordered for a large number more has excited a good deal of interest in the technical world as having some points of novelty and some advantages which put it, perhaps, at the head of traction accumulators to-day. It is the invention of Dr. Majert, a chemist in Berlin. The invention relates to a mechanical process of preparing the plate, not from cast lead, but from homogeneous rolled lead. The flat rolled plate is furrowed something like a plowed field. A peculiarly formed cutting tool shaves up a thin leaf of lead and causes it to stand upright at right angles to the core of the plate.

With cast plates the exposed surface is eight to nine times that of the external dimensions of the plate, whereas with the Majert plate, a surface eighteen times as large as the original plate is obtained. With the cast plates of other systems a conical structure is formed which has the disadvantage of weakness on the outer and thinner parts of the ribs, which are consumed more rapidly than the parts nearer the core, and the plate thus loses a part of its useful surface. The manufacturers of the Majert plate attach great value to their being able to use rolled lead on account of its ability to withstand the attacks of the acid much better than cast lead. In Fig. 9, page 658, are shown three pieces of lead "formed" together during the same length of time with the same current intensity and in the same electrolyte. The plate at the left is of rolled lead, the middle one of cast lead, subjected to a pressure of 2500 kg. per square centimeter, and the plate to the right is ordinary cast lead subjected to no pressure. The uniform molecular formation of the latter especially rendered it very much more subject to corrosion than the rolled lead.

The Majert Company claims that during nine months in batteries running on the lines of the Berlin Railway, the plates were charged and discharged 3200 times without showing the least disintegration. The Majert plates described are used for the positive plate and are Planté formed. The negative plate is cast and pasted as in other systems. A great deal of very valuable experience has been gained in lining the car for the reception of the cells so as to avoid any deleterious effect from acid and fumes. A very tightly-fitting double cover had to be provided also. A current of air passes through the battery space through large tubes having funnel outlets on a level with the roof of the car.

Plates which have run 20,000 automobile car-miles seem to be in perfectly good condition, and from estimates by the reduction in the weight of the plates they ought to be expected to run about 40,000 automobile car-miles.

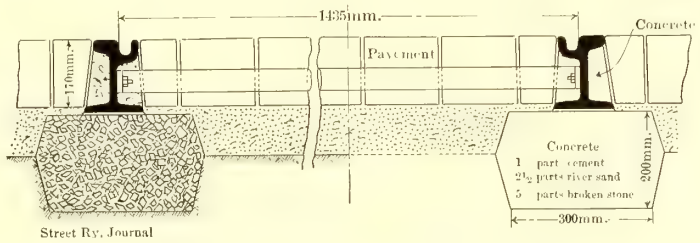


FIG. 19.—ROADBED IN MAGDEBURG

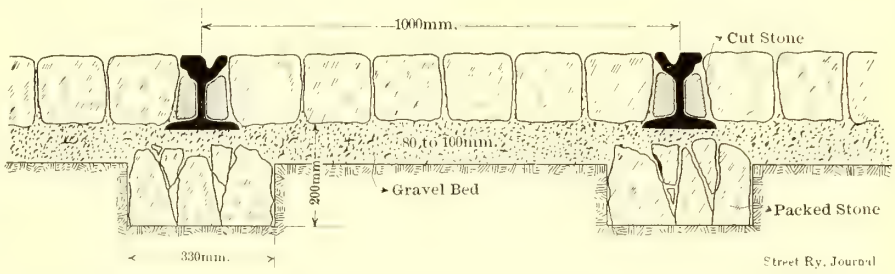


FIG. 20.—ROADBED IN ELBING

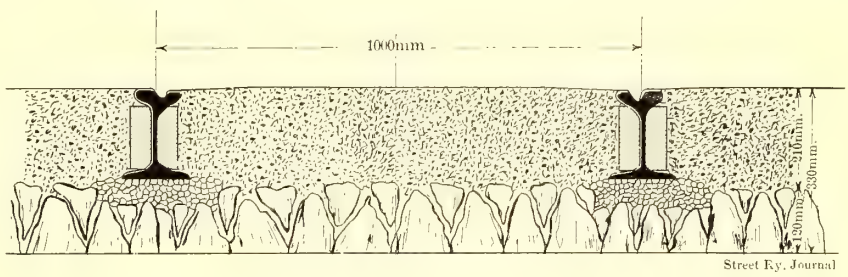


FIG. 21.—SECTION OF TRACK FOR MACADAMIZED STREETS

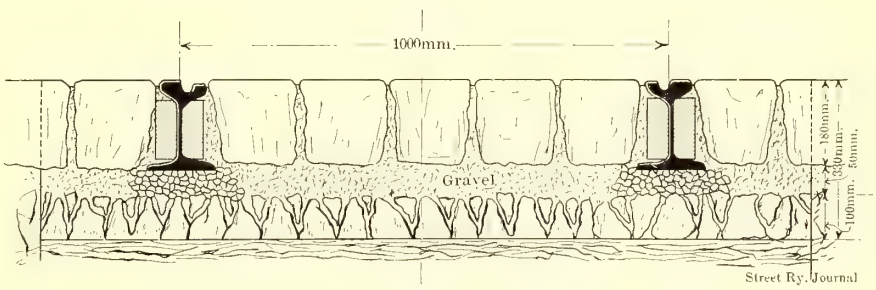


FIG. 22.—SECTION OF TRACK FOR PAVED STREETS

A good idea of the general appearance of the face of the Majert plate can be obtained from Fig. 8, on page 658. Another engraving on the same page shows the method of carrying the batteries on the cars of the Great Berlin Street Railway. The tops of the longitudinal seats are raised, exposing the cells underneath. A view of the inside of the controller used with these cars is also given.

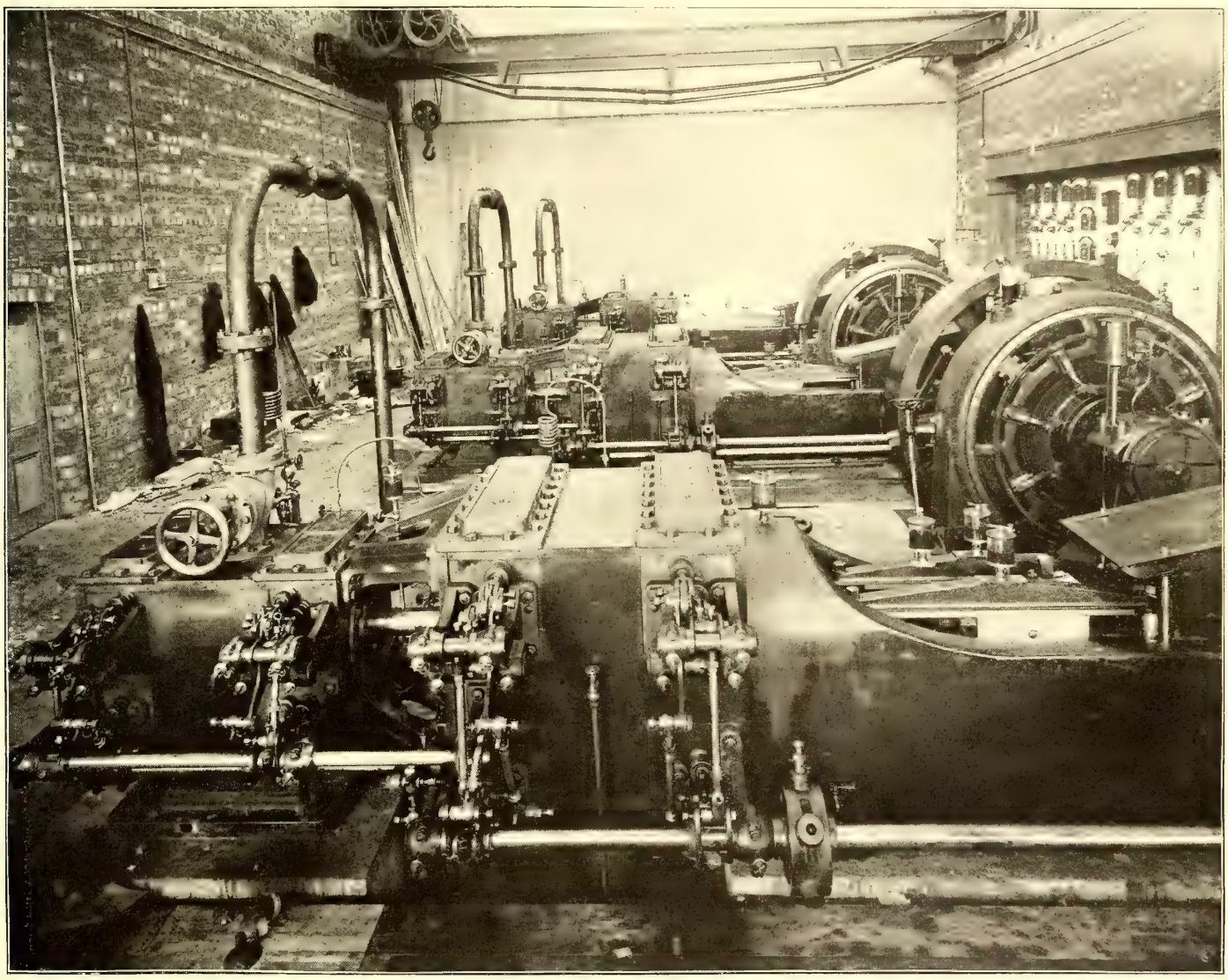


CAR HOUSE IN SOLINGEN

ELECTRIC RAILWAY PRACTICE IN GREAT BRITAIN

BY SIDNEY H. SHORT*

Electricity as a motive power for tramways is fast becoming popular in the British Isles. Had it not been for the fact that most of the tramway concessions in Great Britain were made under the tramways' act of 1870, running for twenty-one years, electric tramways would to-day be pretty general throughout England. In all of the concessions granted under this act there was a provision that at the expiration of the grant the municipal corporations could, if they so desired, take over the tramways. As these concessions have only recently expired, most of the corporations, of which Glasgow is an example, are taking over the tramway systems and are fast converting them into electric lines. Some of the lines have already been equipped and are in operation. The city and town corporation authorities are making every effort to give to their constituents the best possible transportation facilities, and are thoroughly alive to the advantages of electric traction. Municipal ownership of the tramways is therefore the rule in large cities like London, Glasgow and Liverpool, and these cities are being followed by the smaller towns, although there are many that have recently granted franchises to private corporations under the tramways' act.



INTERIOR OF PRESENT POWER STATION, GLASGOW CORPORATION TRAMWAYS

There are now in operation in Great Britain forty-one electric trams having 300 miles of single track, of which 69 miles are owned and operated by municipal corporations, and 231 miles by companies. Twenty roads are in process of construction, having 264 miles of single track,

*I wish to thank the following gentlemen for the information, photos, drawings, etc., which they have so kindly furnished to be incorporated in this article:

C. Challenger, traffic manager, Bristol.
Arthur Ellis, M. I. E. E., borough electrical engineer, Bolton.
Alfred H. Gibbings, city electrical engineer, Bradford.
A. B. Holmes, M. I. C. E., city electrical engineer, Liverpool.
R. E. Quin, electrical engineer, Blackpool.
Henry E. Stilgoe, borough engineer, Dover.
John Young, general manager, Glasgow.

61 miles of which are being built by municipal corporations and 203 miles by private companies. Ninety-two roads are projected, seeking parliamentary powers, twenty-two by municipal corporations and seventy by private companies.

A large number of the tramways within municipal corporation limits are owned or leased by private companies made up of local people; on the other hand, a great many cities and towns have assisted syndicates, formed for the purpose of building and operating electric lines, in securing from Parliament the right to construct and equip lines within their limits. Chief among these private corporations or syndicates may be mentioned the British Electric Traction Company, the New General Traction Company and the General Electric Tramway Company.

The greatest field, however, for the operation of private corporations is in building interurban electric lines. England especially is so thickly populated that the distances between large centers of population is small. Liverpool and Manchester, for instance, are but 30 miles apart, with a population of nearly 1,000,000 people in each place.

It is difficult to say in which branch of electric railroad construction there is the greatest activity. Nearly all the municipal corporations are either building electric tramways or applying for the right to do so, while private capital is seeking parliamentary powers under what is known as the "light railway act," to build interurban and suburban lines in nearly every part of the country.

Where franchises are granted, the term, as provided by the tramway act and also by the light railway act, is for twenty-one years. There are no special burdens attached to these grants in the way of paying to the local authorities a percentage of the gross receipts, or paving entire roadways, unless, indeed, the promoters make propositions to the local authorities containing provisions of this character to secure their consent and their assistance in obtaining the necessary grants from Parliament. Local authorities are usually anxious to secure electric tramways, not only because of their convenience, but because of the reduction of their general tax rates, which the taxation of tramway companies brings about.

In applying for a grant from Parliament for a tramway, either within municipal limits or across country, plans must first be submitted to the Board of Trade and their approval secured. By this board the maximum speed of the cars, the number of passengers to be carried by each car, the location of the tracks, and, indeed, every other detail is carefully regulated. Under the corporations' act periodical financial reports are made and certified to by chartered accountants, so that the financial condition of any tramway company, or, in fact, of any limited company under this act, can be ascertained at any time. These precautions are not limited to the interests of the public, they extend to the investor as well.



MOTOR CAR AND OBSERVATION CAR, DOUGLAS & LAXEY ELECTRIC RAILWAY

In many ways the rights of vested interests are considered. There is no disposition to create unnecessary or disastrous competition. Parallel lines cannot be constructed until it has been clearly shown that the public will be better served by them and the undertaking will in all probability be a financial success.

Under such supervision there is very little possibility of over-capitalization and of success for schemes not based upon thoroughly good financial principles. This fact certainly conduces to the solidity of undertakings in Great Britain, and accounts in a large measure for the good results obtained in almost every instance by tramways, nearly all of which are doing a good business and are paying good dividends.

The field for electric tramways in Great Britain is exceedingly large. London must look in this direction for

relief for the congested traffic of her streets, as the amount of space now taken up by the omnibuses and hansom cabs is altogether out of proportion to the number of passengers carried. It can be demonstrated that if the 'buses of London and a large proportion of her hansom cabs were replaced by rapidly moving tram-cars the streets would be comparatively free.

ROAD-BED CONSTRUCTION

The road-bed construction for electric traction in Great Britain is reduced to standard practice, and it is interesting in that it differs so much from American practice. The conditions existing in the streets of cities in this country permit of a construction which would not succeed in the streets of American cities. The streets and roadways, it must be remembered, are hundreds of years old, and are made of macadam partly cemented together by a natural form of hydraulic cement. This is especially the case in the southern portion of England, where there exists so much lime and flint that the road-beds become hard and solid for many feet in depth. It is necessary to excavate these streets only to a depth of 13 ins., and to lay in a 6-in. layer of concrete made from broken stone and Portland cement. Upon this concrete the rails are laid with tie rods at intervals to keep them to gage. The paving blocks are then set in the usual way, grouted with cement, or filled with coal tar pitch, no sleepers or ties being necessary. In fact, the use of wooden sleepers would be objectionable where such an excellent foundation has been provided by the years of constant care and attention which these magnificent roads have received.

The following is the excellent specification for road-bed construction, recently issued by John Young, manager of the Glasgow Corporation Tramways, and will serve to give an idea of the standard construction for cities. It may be said in addition that specifications are in all cases adhered to closely, the greatest care being taken to follow them in practice.

GLASGOW SPECIFICATIONS FOR TRACK LAYING

Concrete—The concrete under the new tramways, and where renewed for existing tramways, shall be 6 ins. in depth, and shall consist of four parts of clean whinstone, broken to pass in every way through a 1½ in. ring, two parts of sharp sand, and one part of Portland cement. Where concrete may be found already existing, and fit for the purposes of the work, such concrete shall not be interfered with, but it shall be smoothed off, where necessary, with a layer of fine concrete, as after specified. The concrete for bedding pipes to be made with clean, hard clinkers or whinstone, broken to pass through a ¾ in. ring, and mixed with sand and cement in the same proportions as last.

The cement shall weigh 115 lbs. per imperial straked bushel, and shall be so finely ground that at least 90 per cent shall pass through a sieve 2500 meshes per square inch. It shall be kept in a waterproof store near the works for fourteen days, and shall be of such a quality that a sample taken from bulk and mixed neat in a mold immersed in water for seven days shall resist, without breaking, a tensile strain of 400 lbs. per square inch, and it shall not be used until tested and passed, the contractor supplying the necessary samples free of charge. The contractor shall also deliver to the general manager a certificate by the makers of the cement guaranteeing that the cement is conform to specification.

All sand shall be clean, sharp river or pit sand, free from clay, coal or earthy matter. A sealed sample to be submitted before the offer is accepted.

All materials for concrete shall be separately measured in boxes of equal length, breadth and depth, at sight of the inspector; a separate box to be provided by the contractor, free of cost for each of the different materials, of such capacity that one measure of each shall form a batch; it shall be laid on clean, hard boards, carefully mixed and turned over twice when dry, afterwards watered from a vessel or pipe having perforated nozzle; sufficient water, and no more, to be used than necessary to thoroughly incorporate the ingredients, and again turned over, at least twice, by workmen specially chosen and expert at such work.

The upper surface of all concrete, including the upper surface of existing concrete which may be left undisturbed, shall be smoothed off with a layer of fine concrete, composed of four parts of fine clean whinstone shivers, broken to pass through a ½ in. riddle, one part of sand, and one part of Portland cement. The finished surface shall in no case be more than 1 in. below the under surface of the paving stones. The contractor shall also carefully pack the rails throughout with this fine concrete, so that they will rest throughout upon it, and that there will be no hollow or vacant spaces. Where the space under the rails does not exceed ½ in., the rails are to be set in plastic cement formed of two parts sand to one of cement, and where the space exceeds ½ in., it is to be formed with fine concrete packed in with a beater pick. The rate for rail-laying to include the cost of all concrete or cement used for packing rails.

Rails and Fishplates—The rails and fishplates shall be of steel, and will be supplied by the corporation. The rails are of girder section, weighing about 98 lbs. per yard, and the fishplates about 74 lbs. per pair. These will be delivered to the contractor at Coplawill or Kinning Park depots. In the event of there not being a sufficient quantity for the respective sections at the depots named, the balance shall be taken from the quay ex ship or railway station ex wagons as and when they may be received. The contractor shall be responsible for the full quantity received, and have the same weighed on corporation weights, at his own expense, and hand in the weigh tickets at the general manager's office. The contractor shall also provide safe storage for them till required. The majority of the rails shall be in 60 ft. lengths, the remainder in 45 ft. lengths.

Rail Laying—The rails shall be laid on the concrete formation. They shall be tied with twelve tie bars for each rail length of 60 ft., fish-jointed with eight 1-in. fish bolts and nuts to each joint, and laid to a gage of 4 ft. 7¾ ins., measured to the outer edges of the grooves. Cramp gages placed every 4 ft. to be used, and only removed when the causeway is laid. The rails shall be butted close together at the joints, and in any cases where the rails do not exactly coincide, the contractor shall file them fair, the cost of filing to be included in the rail laying.

The joints of all rails on the straight shall be opposite each other for both lines, and on curves the joints shall be squared every 120 ft., and the contractor shall arrange the position of the service crossovers, if any are used, so that there shall be no cutting; 60 ft. rails to be used throughout. Temporary closers must be cut from old rails.

All temporary crossovers required for working the tramways traffic shall be supplied, laid down, maintained and shifted by the contractor. A man, at the contractor's expense, to be placed at each crossover during the hours the cars are running, to attend to the points and crossings. The cost of providing and maintaining these crossovers to be included in the contract price for rail laying.

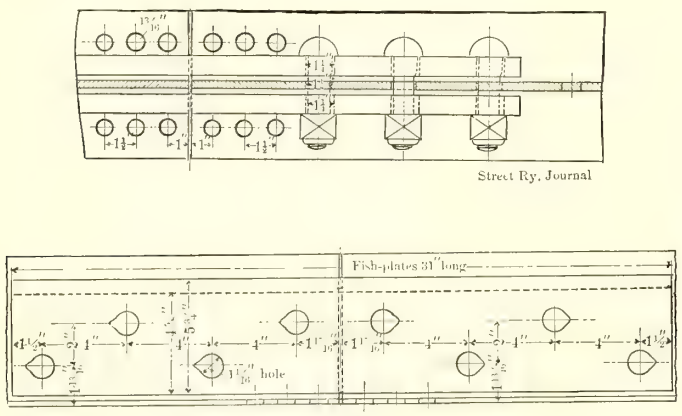
The inner rail of each line shall, as a rule, be laid ¾ in. higher than the outer, but the engineer shall have power to regulate the relative heights. The concrete shall be cut, if necessary, to attain the slope.

The contractor shall bend the rails for all curves on a level floor or platform, which he shall provide for the purpose, to the exact radii of the curves previous to laying, and provide templates of the different curves. The crow used for bending rails shall be made to fit the full section of the rail on both sides, and the power shall be applied at the neutral axis of the rail to avoid twisting or damaging the rail. Not more than 4 ins. at each grip of the crow will be allowed. All unevenness or twist must be taken out of the rails by the crow, whether on the curve or straight line, and the whole rail laying made true, regular and eye-sweet. Any rails, fishplates, or other material destroyed by imperfect workmanship in bending, cutting, or otherwise, the contractor shall be held responsible for, and the difference in cost between new and scrap rails shall be deducted from his account.

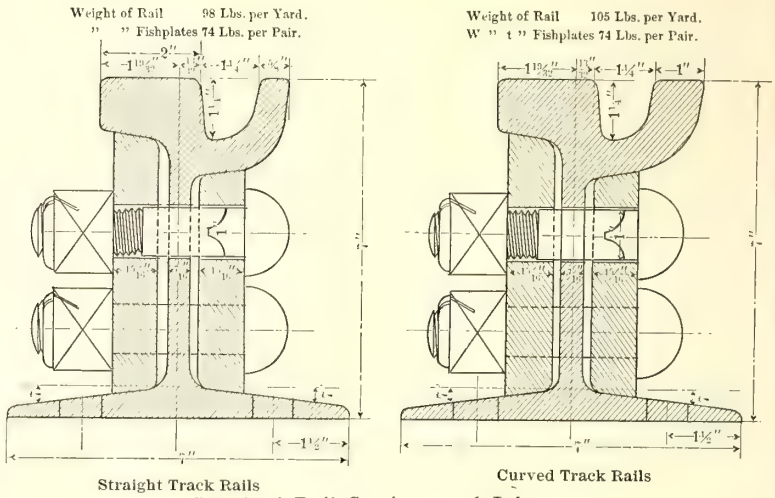
The corporation reserve power to provide and lay all special

work with their own men, and all such work shall be excluded from the contract. Where special closing pieces of rail may be required, the same shall be cut by the contractor with a cold saw. Cutting with the cold chisel will not be allowed.

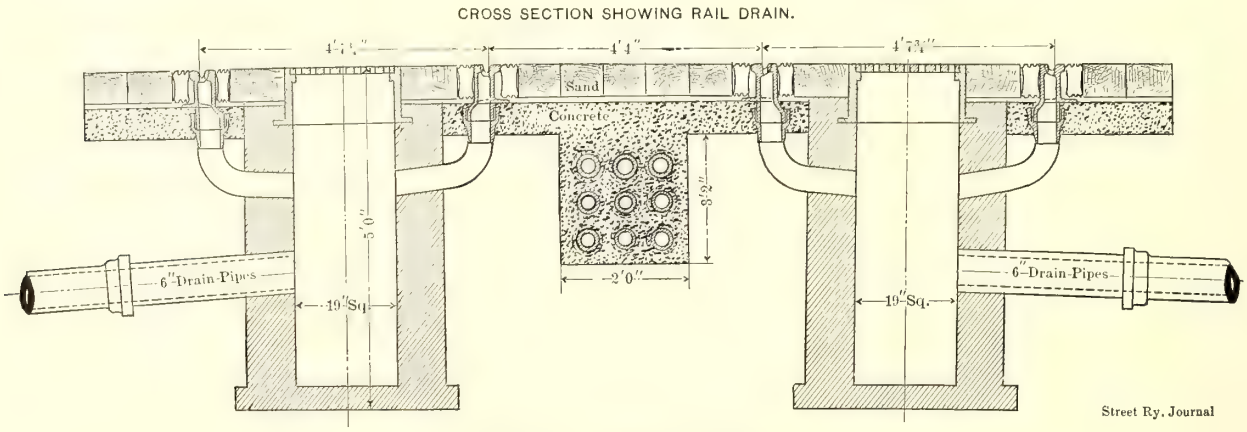
Where crossings, junctions, curves, or other causes require rails to be cut or additional holes for fish bolts or for tie-bars to be bored, these holes shall be bored by the contractor without extra charge; and where it shall be necessary to have longer or shorter tie-bars, the contractor shall make the necessary alterations on the ordinary tie-bars as they are supplied by the corporation; and where, from any cause whatever, the bolt holes do not coincide with those in the fishplates or otherwise the contractor shall cut the rails, bore the additional holes, or enlarge such holes as may be required with proper tools for the purpose, and, in short, he shall do everything requisite for making good all defects and laying the tramways in perfect and proper order, and that without any extra allowance or claim whatsover.

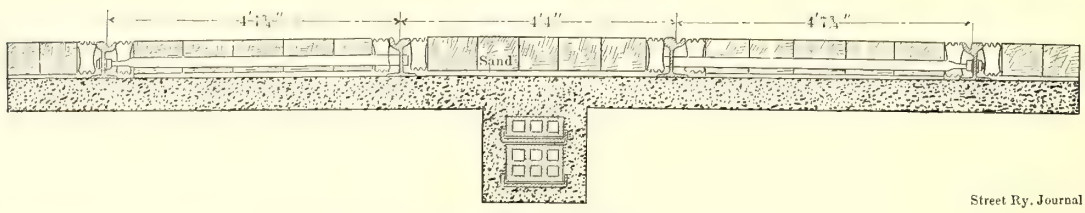


Fish-Plates



Standard Rail Sections and Joints





GLASGOW ROADBED.

DETAILS OF ROADBED PRACTICE IN GLASGOW

Where new rails have to be substituted and laid for existing rails, the original concrete and sleepers forming the substructure shall not be interfered with, excepting where the levels are altered, but the new rails shall be laid in proper line and level. Where the new rails join the existing rails, the contractor shall cut, joggle and bore the rails and fishplates to suit the section of the different rails to ensure a proper connection.

Water Gratings—Water gratings shall be formed by the contractor on the rails where required, and form the connections to manhole and drains, as shown on drawings. Contractor is to cut the trench and build the brick work, and lay and joint the pipes with cement, and make good the brick work and concrete, and fix the rails in position. The pipes, bends, manhole covers and special castings for these will be supplied by the corporation.

Points and Crossings—The points and crossings, and all special work, including gussets or angle blocks for same shall be supplied by the corporation ready for laying, and the contractor shall take delivery of them at any place within the city that may be pointed out.

The points and crossings shall be fished to the rails. The cost of laying and fixing the angle blocks or gusset pieces shall also be included in the price for laying points and crossings.

Bolts and Nuts—The bolts and nuts for fishing rails shall be supplied by the corporation to the contractor at the rate of 16s. per cwt.; he to take delivery at Coplawhill Stores. Weight of 1-in. bolt and nut about 30 ozs.

Tie Bars—The rail shall be held in gage by tie bars, also to be supplied by the corporation to the contractor at the rate of 12s. per cwt. at Coplawhill Stores. Weight of tie bar, about 13¼ lbs.

Chilled Paving Blocks—Chilled paving blocks shall be laid on each side of every rail, alternately with the paving stones, averaging about thirty-two blocks per lineal yard of double line. The blocks to be carefully hard bedded on the sand. Power is reserved to dispense with the chilled paving blocks on all or any portion of this contract.

The paving blocks will be supplied by the corporation to the contractor at their contract price of £5 per ton, delivered at the nearest N. B. railway station. Contractor to take delivery and pay for corporation weighing. The average weight of each block is about 9.26 lbs., and they measure 4 ins. x 3 ins. on the surface.

Weighing Materials—The weight of chilled blocks, tie-bars, bolts and all other iron or steel work taken over by the contractor from the corporation shall be fixed by the measurers in the presence of parties to this contract, by actually weighing a quantity of each to ascertain the average weight, and the weight shall be calculated according to the number of the various articles furnished to the contractor by the corporation—the contractor being responsible for all loss.

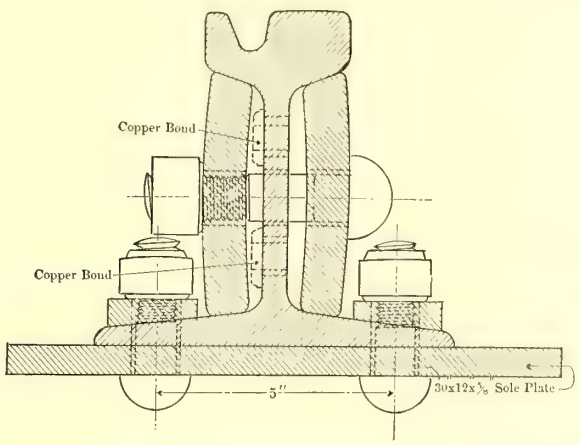
Sand—A layer of sand, not more than 1 in. in thickness, shall be spread over the concrete in which the paving shall be set. The contractor shall be careful to keep the joints of the paving free of sand, and to use no more of it than is requisite for bedding the stones. All sand shall be clean, sharp river sand, free from coal or other impurities. A sealed sample shall be sent in along with offer for approval, and if approved will be held to be an average sample of what is to be supplied for the whole contract.

Causewaying—All new paving setts will be supplied to the contractor by the corporation and charged to him at the rate of 28s. per ton. The contractor to take delivery at such of the following places as shall be intimated by the general manager, viz.: The wharf of the Clyde Navigation Trustees, or of the Forth and Clyde Canal, at any of the railway stations within the city, or at any depot or street in which they may for the time being be stored, and the contractor will be bound to remove the stones from the places so intimated to the streets in course of being causewayed immediately after receiving instructions from the general manager; and in the event of his refusing or delaying to remove the stones, the corporation shall have power to do so, and the contractor will be held liable for all expense thereby incurred, the amount to be deducted from any sums due the contractor. The contractor shall also be bound to weigh every cart of paving setts so removed on the corporation weighs, and deliver up the weigher's ticket to the inspector on the job, with each cart, before it is discharged. The weigher's charges shall be paid by the contractor.

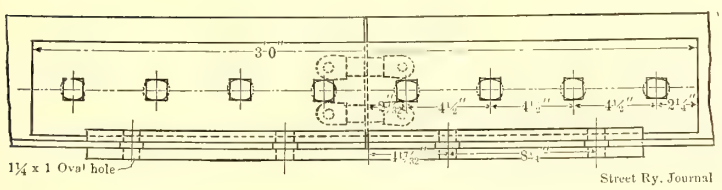
The breadth of paving, including chilled blocks, for the double line of tramways shall be 15 ft. 8 ins., excluding the breadth occupied by rails, and for single line 7 ft. 6 ins., and it shall in all cases extend to 18 ins. beyond the outer edges of the rails.

On the outside of rails the paving shall be properly coursed and jointed with existing paving, and the contractor shall lift and relay so much of the existing paving beyond the formation width as may be necessary to ensure a uniform and properly finished roadway. All the old paving stones which are fit for redressing shall be redressed and used as far as possible, with a proportion assumed, in the meantime, at 20 per cent of new stones laid along each side of the rails. Where there is not sufficient quantity of old stones to pave the track in this manner, the engineer shall determine the portions that are to be paved entirely with new stones. The openings for cross bonding in all new work to be temporarily filled in until after testing is done, thereafter the contractor to open out to admit of fixing cross bonds, and then fill in and grout the same.

All new and old paving setts shall be square-dressed, from 7 in. to 11 ins. long, 6 ins. deep, and 3½ ins. to 4 ins. broad. Power is reserved to lay certain portions of the tramways, and also the crossings, with setts 4 ins. sq. by 6 ins. deep. The paving shall be laid in straight and parallel courses, so that the cross section shall have a uniform course on each side of the center of the street or of the tramway, and the finished level next the several rails shall be uniformly and truly level with the rails. The stones shall be set as close as possible to each other, break bond to at least one-third of their length, and the courses next rails must butt truly and hard against the head of the rail, and rest to the extent of at least 1½ ins. on the flange of rail. A straight-edge to be used for every course; not more than ⅜ in. of round will be allowed between the rails. Where the tramways are laid in Macadam streets, the causewaying outside the rails shall break bond at the outer edges, and shall be of an average width of 18 ins. No extra price will be paid for breaking bond,

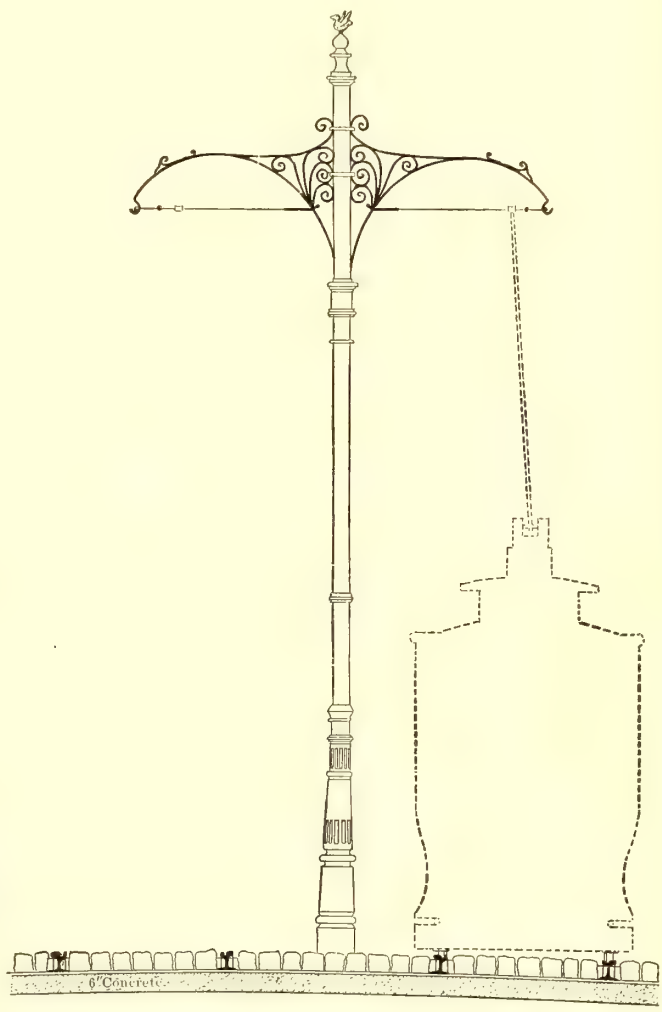


Rail Section and Joint



Fish-Plate and Bond

DETAILS OF ROADBED PRACTICE IN BRADFORD



LIVERPOOL ROADBED AND CENTER POLE CONSTRUCTION

nor for making good the existing Macadam or causeway. All paving stones shall be properly sized before being laid.

Should there be more or less than 20 per cent of new paving stones required for the above work, the same shall be allowed for at the rate stated in the estimate, and the difference in cost added to or deducted from the contract as the case may be.

Grouting—After the paving has been laid and thoroughly beaten all the joints shall be completely grouted and filled, partly with a mixture of best British bitumen and pitch oil, from an approved maker, and partly with granite chips. The bitumen shall be manufactured from pure coal tar pitch, and the oil shall be of 1.035 to 1.050 specific gravity. Sufficient oil shall be used to produce a plastic grout. Each boiler of pitch shall be tested by suddenly cooling a portion of the grout in water, and, after being so cooled, the grout must be plastic and not breakable by bending. All grout must be boiling hot when used. The chips shall be first passed through a ½-in. riddle, then thoroughly kiln-dried, and sand and dust thereafter taken out with ¼-in. riddle, and the chips shall be protected from rain, damp or moisture, until used. In grouting, pitch shall be run into the joints of paving to the depth of 1 in., then one-half of the depth of joint shall be filled with the chips, and pitch run thoroughly into same, and thereafter the remaining depth of joints shall be filled to within half an inch of the surface with chips, and then grouted full with bitumen, but no pitch shall be left on the surface of the paving stones. The chips shall be weighed, and 1 ton shall serve not less than 240 square yards of paving.

Where cement grouting is required, it shall be composed of one measure of best Portland cement to two measures of *washed sand*, all properly mixed in a tub.

Ducts at Tramways Not Renewed—In the case of the tramways already described as not to be renewed, the contractor will cut a track and insert fire clay pipe or other ducts in the 4-ft. way, or in adjoining street, as may be required, and redress and relay the paving with an assumed average proportion of 20 per cent of new stones with a bed of concrete, all as described for the tramways which are to be reconstructed.

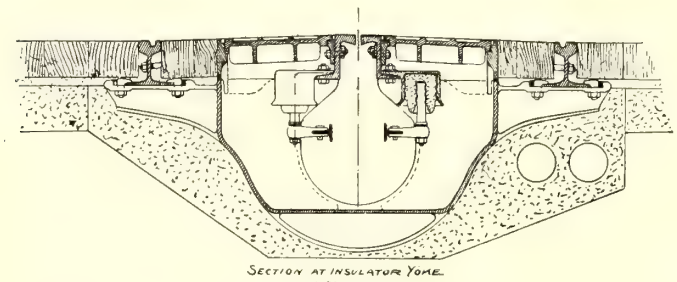
Bonding and Joint Plates of These Tramways—To admit of the corporation bonding these tramways, the contractor to lift so much of the causeway at each joint as may be necessary, these openings being about one-third of a square yard at each joint. These will be afterwards repaved and grouted with bitumen, etc., all as described for the general work. The contractor will also lift a strip of causeway, two stones in breadth, across the full width of the tramway double line, for cross bonding, at every third 45 ft. rail or every second 60 ft. rail. These will be thereafter filled in and grouted as before described. The openings for bonding to be done at such times as the engineer may direct.

All the joints of 89-lb. rails presently laid shall be fitted with sole joint plates, clips and bolts, similar to sample to be seen at engineer's office. To admit of these being fixed, the contractor shall cut out the concrete from underneath the joints of rails, fix the plates, clips and bolts, and thereafter pack solidly underneath in a thorough manner with fine concrete, as directed. The sole plates, clips and bolts to be supplied free of charge.

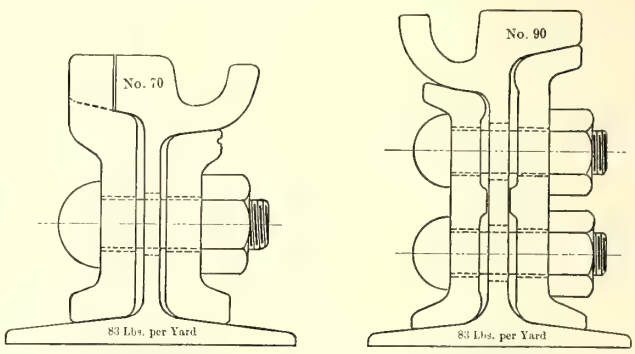
The joint plates shall be fixed at the same time as the street is opened for bonding.

Type of Boilers—The boilers for melting the pitch shall be close covered, with provision for leading the gases from the molten pitch to under the fire grate, similar to the boilers at present in use by the tramways department. No other type of pitch boiler will be allowed. The boilers shall be fired with *coke* only. No coal will be allowed.

Railway Works, Gas Pipes, Sewers, Etc.—The contractor shall be careful not to injure or interfere with any railway works, electric lighting works, telephones, gas pipes, water pipes, sewers, underground telegraphs, or appliances connected therewith, which may

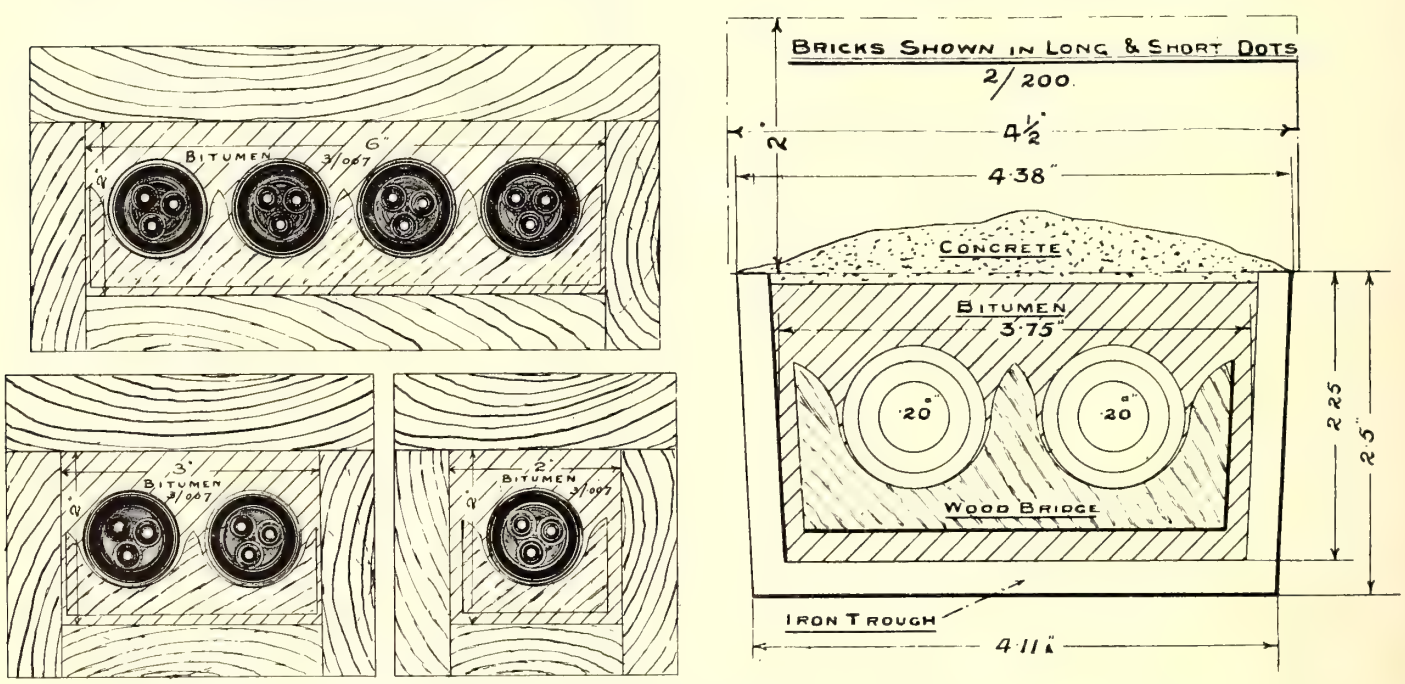


OPEN SLOT CONDUIT CONSTRUCTION, LONDON UNITED TRAMWAYS COMPANY



D.K. New Section D.K. New Section

SOME TYPICAL RAIL SECTIONS



CALLENDER UNDERGROUND CONDUCTOR SYSTEM

be met with on the line of works, and he shall be responsible for and make good all damage, of whatever kind, caused to any of these works by his operations. Should it be necessary to alter or remove any of these works, that shall be done by the respective owners or authorities; but the corporation shall not be in any way responsible for loss, damage or hindrance that may arise to the contractor in consequence of such operations. Such shall be held to be an incident of the contract, and fully covered by the contract price. If the contractor be instructed in writing, he shall remove any sewer, manholes, water or gas stop-cock case, or other works, and reconstruct them, as may be directed, at schedule prices.

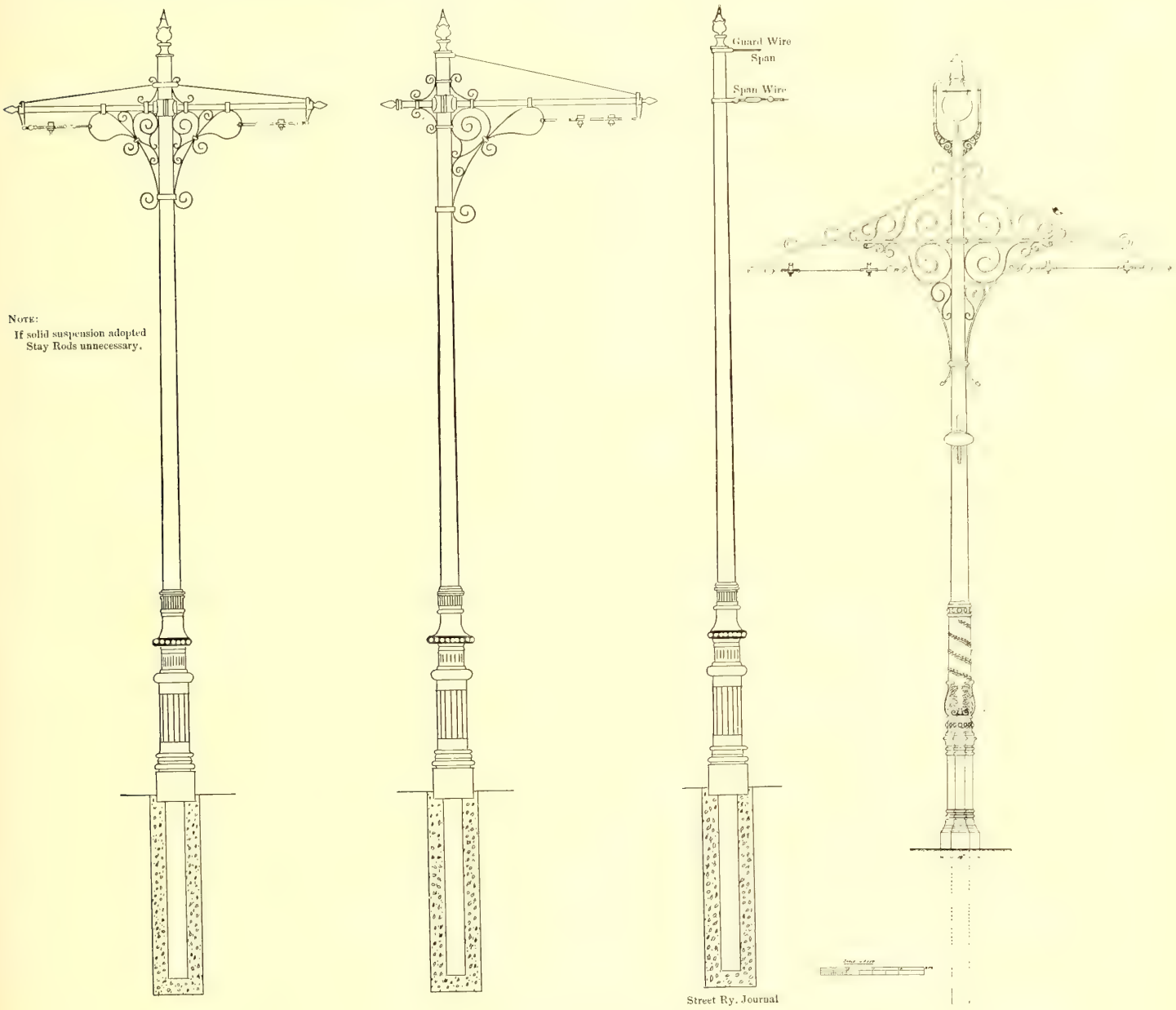
Rail Bonding for Electric Traction—The corporation shall provide and fix the bonds, but the contractor for rail laying shall give every reasonable facility to the corporation for carrying out the work of boring the rails, fixing the bonds, etc. This the contractor for rail laying shall do free of cost, the same being held as incidental to the contract, and the corporation will not be liable for any delay, loss or inconvenience to the contractors in this connection.

Wood Block Paving—Where wood block paving is interfered with it must be replaced on a bed of concrete and grouted in every respect similar to the existing paving.

The accompanying cross sections illustrate the formation of the completed road-bed, showing concrete, rails and paving stones in place:

The rails in general use are grooved girders, weighing from 83 lbs. to as high as 105 lbs. a yard. The chemical composition is carefully specified by the engineers of the various corporations, and the following is a specimen analysis:

	Per Cent
Carbon	0.55 to 0.65
Manganese	0.80 to 1.00
Phosphorus not to exceed	0.06
Sulphur not to exceed	0.05
Silicon	0.15 to 0.20



SOME RECENT POLES IN GREAT BRITAIN

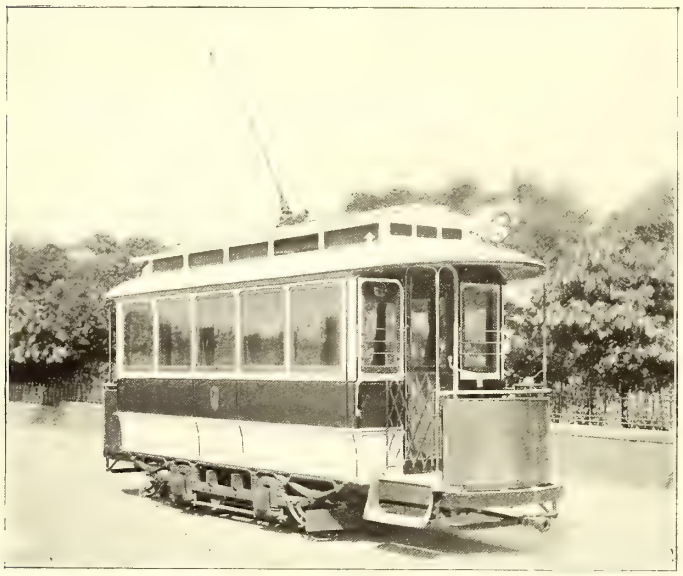
These rails are, of course, subjected to very careful physical tests, and the lengths are specified, being in some cases 30 ft. and in others 60 ft., at 60 degs. Fahrenheit.

The accompanying engravings illustrate the types of rail sections, joints, fishplates, etc., used in the standard practice of Great Britain.

There are but one or two instances of the use of cast-welded joints. One of the most popular rail joints in use at the present time is the Dick-Kerr Company's patent joint, in which the fishplate is allowed to come up through the head of the rail quite to its surface, as illustrated in the drawing on opposite page.

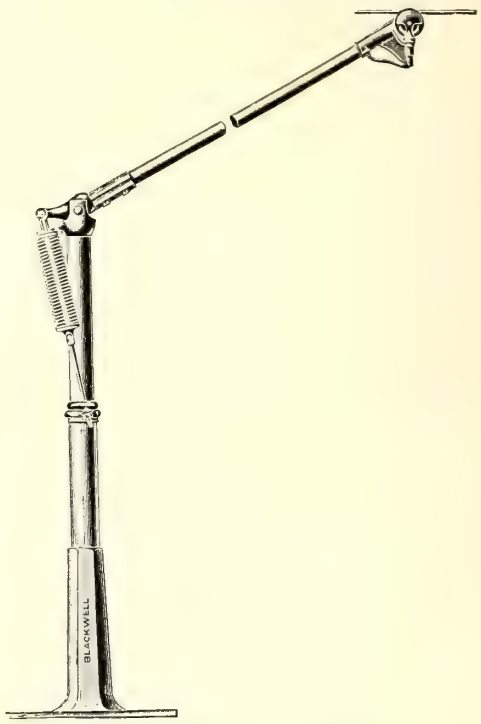
Most of the rails and joints are procured in England or

on the Continent. The Leeds Steel Works, Ltd., is one of the most prominent manufacturers of rails in this country. The special work used in connection with road-bed construction is made either with steel castings, or, in the case of crossings, with built-up sections of the rails. No cast iron special work with special steel points set in is used, except, perhaps, in a few instances where they have been ordered from the Lorain Steel Company. The steel castings for points and crossings are made to present at the street surface the same width as the rail, and the rail itself is of a stipulated width. This, of course, excludes cast iron frogs and crossings. Steel castings and built-up sections are manufactured by English firms almost exclusively.



A MODERN BRITISH CAR BUILT AT PRESTON

Rails are bonded at the joints by the ordinary copper rail bond. The Chicago bond has been used to a large extent, but recently the Columbia bond, made in America, and the Neptune bond, made in Germany, have come more into favor. The bonding of the rails and the conductivity of the return circuit for electric tramways in England must be of the very best character, owing to a rule established by the Board of Trade, regulating the pressure drop in the return circuit, and also providing for constant tests of this drop, the severest condition being that, when the return is partly or entirely uninsulated, continuous records shall be kept by the company of the difference of potential during the working of the tramway, between the points of the uninsulated return farthest from and nearest to the generating station. If at any time such difference of potential exceeds the limit of 7 volts the company must take immediate steps to reduce it below that limit.

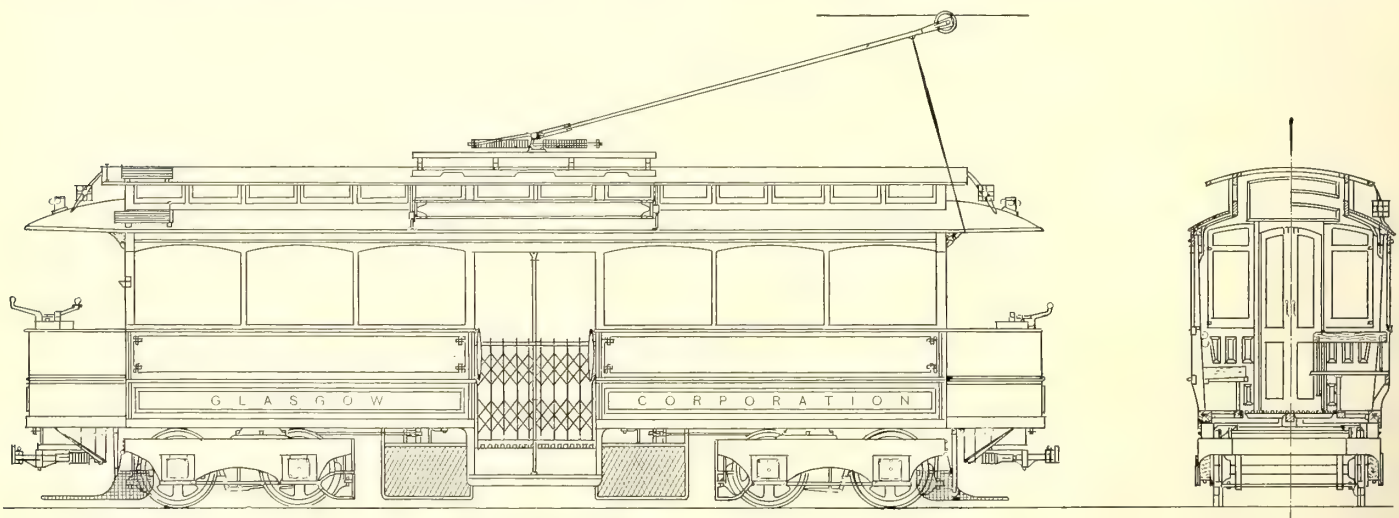


THE DICKINSON TROLLEY

SYSTEMS OF DISTRIBUTION

Underground feeders are the rule throughout all the cities of Great Britain. They are carried in conduits of various kinds. The one most used is the "Callender solid bitumen system," as illustrated in the drawings.

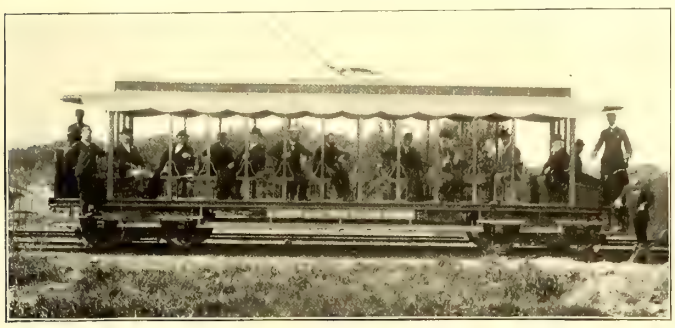
Sometimes wooden troughs are used, sometimes iron, and more recently those of terra-cotta are being adopted. The plan is to lay these troughs at the proper depth in the street, and support the cables upon wooden bridges at



SIDE AND END VIEWS, GLASGOW DOUBLE-TRUCK CAR

intervals throughout the length of the troughs, after which the whole trough is filled with bitumen and a tile cover placed on top, whilst the bitumen is still liquid. Another system, which is a drawing-in system, with manholes at regular intervals, known as the Sykes system, and manufactured by the Albion Clay Company, is much like the American. Another drawing-in system is made by the Doulton Company, which is an arrangement of clay tiles with brick or concrete manholes.

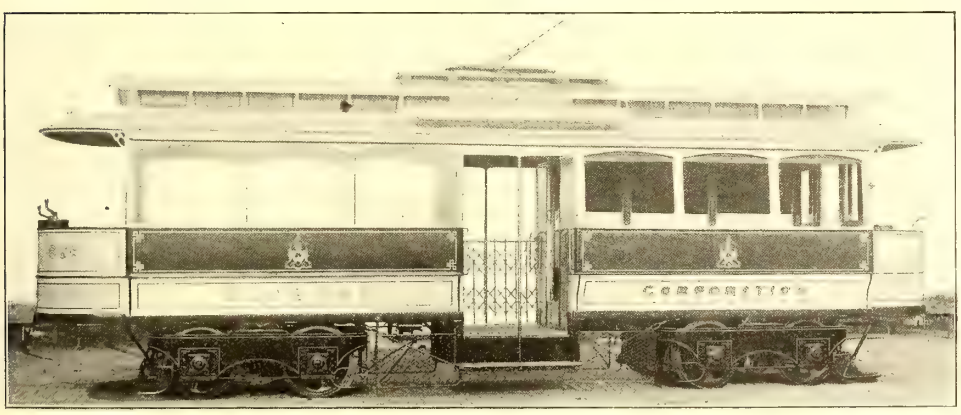
Lead covered cables are generally used with the draw-



DOUBLE-TRUCK OPEN CAR, BLACKPOOL & FLEETWOOD RAILWAY

ing-in system, the insulation being paper or rubber. In a few cases armored cables have been laid directly in the ground, the armor being made of steel ribbon, instead of wire.

Trolley wires are supported both by the bracket and by the span wire systems; no wooden poles are used, very ornamental steel poles being the rule. Where the streets are wide, center pole construction with two brackets is preferred, but in narrow streets the iron poles are placed on one side of the street, a short bracket arm carrying the trolley wire. When double tracks are used in narrow streets, where either of these forms of construction would be difficult, the span wire system is used, and sometimes the span wires are attached to the buildings, thus obviating



GLASGOW DOUBLE-TRUCK CAR

the necessity for using poles. The trolley wire is always hard drawn copper, from .3 to .4 of an inch in diameter, and is carried on standard American line material or its equivalent. Great care is always taken in the construction of an overhead trolley system, in order that it may be substantial with the least possible obstruction in the streets. The overhead trolley wire does not seem to be objected to by the public in smaller cities and towns, but in London it will not, of course, be permitted. The method of distribution here must be by some form of underground conduit, and undoubtedly the open conduit system will be the one eventually adopted. The London County Council have recently appropriated sufficient money to make experiments on their lines with the open conduit and with the surface contact system. The outcome of these experiments will be exceedingly interesting, the surface contact being a serious competitor to the open conduit sys-



GLASGOW SINGLE TRUCK DOUBLE DECK CAR

tem. The accompanying cuts illustrating the types of poles generally used along the streets, and a photograph of street construction will give an excellent idea of the character of the work which is being done.

CARS, TRUCKS AND CAR EQUIPMENT

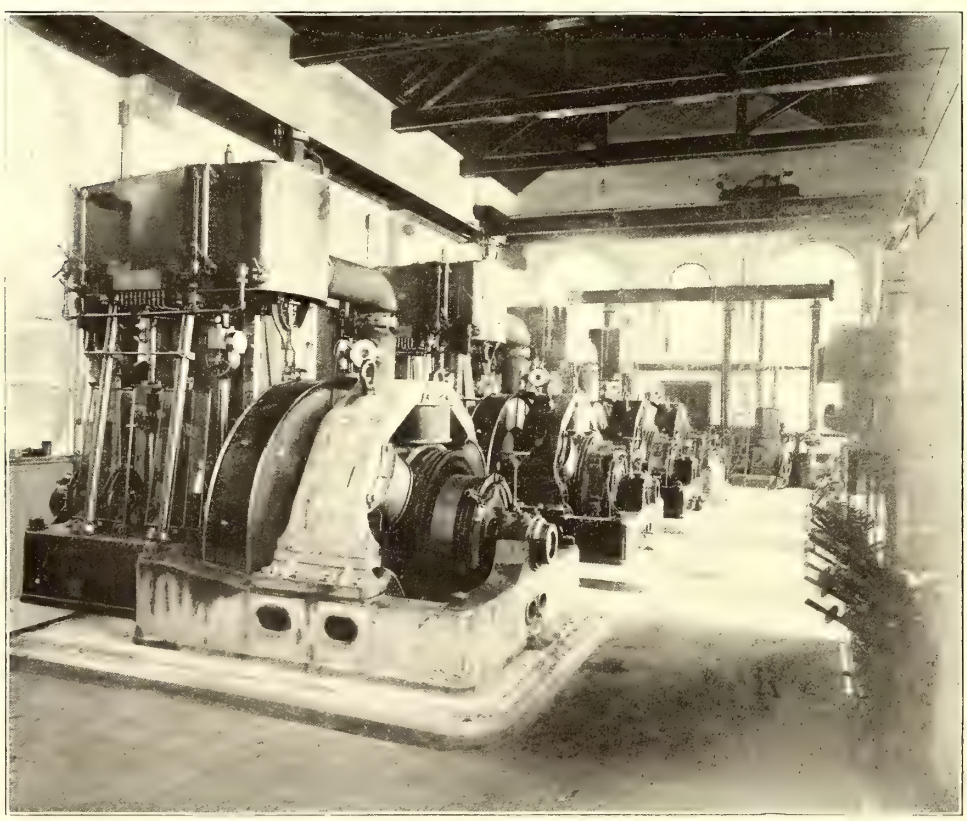
The type of car which has proven most popular and best adapted to tramway work in the British Isles is a top-seat car. These cars are from 25 ft. to 30 ft. over all, with seats running lengthwise inside and crosswise on top.

The reason for the popularity of top-seat cars in England can be readily understood. There are no great changes in temperature and no extreme weather conditions such as are found in the United States. In the midst of winter there are days and parts of days when it is more agreeable to ride out of doors than in a closed car, and even the sudden rains which come up do not drive passengers inside. It is never so cold for long periods of time that it would pay to keep a set of car bodies exclusively for winter use. The open summer car, such as is used in America, is, however, very popular on some of the lines in England during the hot summer months. We find also that a number of corporations are having ordinary single-deck cars built for general use and summer cars in addition. We believe that this practice will grow in favor, or combination summer and winter cars may be adopted.

A number of motor cars have been imported from the United States, but they have been of the cheaper class, and do not represent the best American practice.

Modern motor cars are now being manufactured in England, principally by the Electric Railway & Tramway Carriage Company. This company follows the best American practice, having adapted it to the conditions found here.

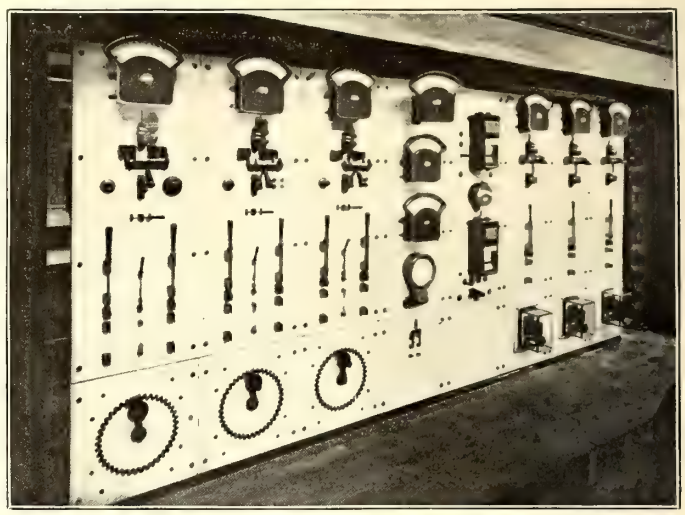
The trucks used for electric cars are, in almost every case, imported from America, and manufactured by the Brill or the Peckham Company. Motor equipments are for the most part imported from America, and are of the Walker, Westinghouse or General Electric types. A few motors have been built in England by the Electric Construction Company, the Brush Company and the Siemens Company, and a few German motors, manufactured by the Schukert Electric Company, have been installed at Liverpool. Controllers are uniformly of the series parallel type and are manufactured by the companies furnishing the motors. The trolley device in general use in Great Britain is the "Dickinson," having a swiveled trolley head. These trolleys, stands and poles are manufactured by R. W. Blackwell & Company. Some of the imported equipments have the ordinary standard trolley of the manufacturer. The great advantage of the swiveled overhead trolley is that in narrow streets the trolley wire can be held on very short brackets attached to side poles, and the trolley arm made to reach over it. This is a very simple overhead construction, and less obstructing than the span wire system or the long bracketed poles. On page 670



POWER STATION, BLACKPOOL & FLEETWOOD RAILWAY

is an illustration of the Blackwell trolley arranged for top-seat cars, also one for single-deck cars.

All sorts of brakes are employed on the cars. The authorities require the best known braking device. Air brakes made by the Standard Air Brake Company, electric brake controllers manufactured by the General Electric Company, and track brakes are used, sometimes all on the same car. We believe that the authorities are complicating the car equipment too much; there is less security



SWITCHBOARD, GLASGOW POWER STATION

when safety devices are multiplied than when but one good one is used.

The number of passengers to a car is always restricted by the Board of Trade. It is intended that each passenger shall have a seat either inside of the car or on top, but in most cases passengers are allowed to stand on the rear platform.

Every bill passed by Parliament granting the right to operate electric tramways places in the hands of the Board of Trade the right to fix the rate of speed at which the cars may run. The speed usually allowed is from 6 miles to 8 miles an hour for surface lines, and this is varied at different points on the same road, depending on local conditions. Some of the interurban and suburban lines are, of course, allowed greater speed, but we do not know of any case in which a higher speed than 25 miles an hour is permitted, and this, where in the United States 50 miles an hour would be made. The Board of Trade will undoubtedly gradually sanction higher speeds, when it has been demonstrated that the cars can be properly handled, and that there is no more danger than with the low speeds now in use.

POWER STATIONS

In many cases where the municipal corporation owns the tramways the power stations for the tramway and for the lighting are combined, part of the machines being arranged to operate at the proper pressure for the lighting circuits and part at a pressure of 500 volts to be used for

feeding railway lines. Where the power station is built to serve the tramway alone the general design is similar to those in the United States, so far as general arrangement is concerned, but there is a great variation in the character of the machinery used. So many of the plants for traction purposes are only temporary at present that it is difficult to say what standard design will eventually be adopted.

It is the uniform practice to use direct connected generators. These are coupled to engines of the high-speed type or to the slow-speed Corliss. Where American engineers have been employed to design the power stations slow running engines like the Allis have been adopted, but English engineers have generally specified either a Willans or a Belliss high-speed machine. There is, however, a growing feeling in favor of engines of the slow-speed type, and several large firms in England, who have for many years been building engines of this type, like Musgraves, Cole, Marchant & Morley and others, are going in heavily for electric traction plants. The Willans Company and other of the high-speed English manufacturers are also quite willing to produce engines of large size, running at slow speeds. Until recently the plants which have been installed have been very small, with only a few hundred kilowatts capacity, therefore it was necessary to use small units of from 100 kw. to 400 kw. capacity each. There was good reason for attaching these small dynamos to high-speed engines, and undoubtedly where small units are required this practice will continue. A number of high-speed American engines have been imported. For instance, in the Glasgow temporary plant, McIntosh & Seymour engines running 200 r.p.m. are installed. In all probability England will in the near future produce all the engines which will be required for her electric traction power stations, as there is no doubt about the good workmanship and excellent performance of all classes of engines built here.

The types of boilers vary in different power stations, according to the preference of the engineers who have designed them. Babcock & Wilcox water-tube boilers are installed in several stations, some with automatic stokers and others without, but the Lancashire boiler, which is internally fired, is preferred by English engineers, and they are not usually fitted with automatic stokers, in fact, there is not much to be gained by using stoking devices, as labor is cheap, and the saving, if any, is insignificant. Economizers are used pretty generally, also feed water heaters, and in almost every case the engines are condensing. The piping between the engines and boilers is generally duplicated. We cannot say enough in praise of the excellent steam piping which is done in England. Steel pipes are used with steel flanges threaded and brazed at the joints, and elbows are turned by actually bending or forging the pipe itself.

Where generators are direct connected to very high speed engines a great many bipolar machines are used, but where the speed is lower, multipolar machines are used. Siemens Brothers have furnished a large number of the high-speed generators. Many machines of the slow-speed type have already been turned out by Mather & Platt and by the Electric Construction Company, and many have been imported from America. Part of these are compound wound, running at 500 volts to 550 volts, but those that are used for lighting and power stations combined are shunt wound only. The largest power station in Great Britain now in active operation has just been completed by the Dublin Tramways Company. In this station there is a capacity of about 6000 h.p. from vertical compound Allis engines. Liverpool is about to install a plant of practically the same size, in which Willans engines will be used. The new station for Glasgow will be fully as large, with slow-speed generators.



A GOOD EXAMPLE OF CENTER POLE CONSTRUCTION

The general practice thus far is to operate a system of tramways with one power house only, located as near as possible to the center of distribution. It is difficult to say at present what the economy of these plants will be, as they are as yet in such an unsettled condition. It is evident, however, from the reports of lighting stations, that the present cost per unit of electrical energy is altogether too high. This is accounted for by the use of small units. When larger plants are put in operation the cost for producing electric power will undoubtedly be as low as in the United States.

The Glasgow power station, an illustration of which appears on page 663, shows the usual arrangement of boilers, engines, etc. This station is, however, only a temporary one, and the corporation is about to let contracts for a large station equipped with three-phase apparatus.

The photographs will serve to show the interiors of the engine and boiler rooms. Altogether, electric railway practice in Great Britain is excellent in many respects, and well worthy of careful study, if not of imitation.

THE CHICAGO CONVENTIONS

AMERICAN STREET RAILWAY ASSOCIATION

The eighteenth annual convention of the American Street Railway Association will be held at Tattersall's, Chicago, Oct. 17-20, 1899. The convention will be called to order at 10 A. M. Tuesday, Oct. 17, by President Charles S. Sergeant. The following papers will be presented:

"Maintenance of Car Equipment." J. H. Van Derveer, Brooklyn Heights Railroad Company.

"The Modern Street Railway Shop: Its Design, Machinery and Shop Practice." B. L. Kilgour, electrical engineer, Cincinnati Street Railway Company.

"Train Service and Its Practical Application." Ira A. McCormack, general superintendent, Brooklyn Heights Railroad Company.

"Construction and Maintenance of Railway Track." Edward Butts, Metropolitan Street Railway Company, Kansas City.

"Investments in Street Railways: How Can They Be Made Secure and Remunerative." Charles T. Yerkes, president, Chicago Consolidated Traction Company and Union Elevated Railroad Company, Chicago.

A great deal of thought and care has been given by the committee on entertainment to the social features of the convention, and although dates are not yet fixed, nor has the programme been made public, it is understood that the following will be included among these features:

A reception by the ladies and gentlemen of Chicago prominent in social life to the delegates and ladies in attendance. This will be given in the Auditorium Hotel parlor.

A trip to the drainage canal to inspect the wonderful engineering work going on there.

A trip to the Stock Yards to see Chicago's greatest industry.

A tally-ho ride through the parks and boulevards system of Chicago.

A theater party.

A shopping trip for the ladies to the great stores of Chicago in order that they may understand the conduct of the modern emporiums of trade as shown in Chicago.

The banquet.

In times past there has been some feeling on the part of manufacturers that the convention has not officially paid them sufficient attention and that there should be an adjournment at some time during the convention for the special purpose of allowing the delegates to inspect the exhibits. In deference to this wish the committee on entertainment has fixed the date of the banquet for Friday night, and there will be no session of the convention on Friday, thereby providing the entire day for the inspection of exhibits, and at the same time furnishing a strong inducement to the members to stay over until Saturday. There will also be no entertainments on Friday.

THE STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA

The third annual meeting of the Street Railway Accountants' Association of America will also be held at Chicago, Oct. 17-20. As at the last convention the meetings will be held in the same building as those of the American Street Railway Association. The badges of the American Street Railway Association will be furnished the members of the Accountants' Association, and in matters of entertainment and admission to meetings, etc., the same opportunities will be enjoyed.

The papers and reports before this convention are to be as follows:

"Materials and Supplies Accounts." W. M. Barnaby, chief accountant, Brooklyn Heights Railroad Company.

"Car Mileage." H. C. Mackay, comptroller and auditor, Milwaukee Electric Railway & Lighting Company.

"Report of Committee on Standard System of Accounts." C. N. Duffy, chairman.

"Report on Department of Blanks and Forms." W. B. Brockway, secretary of the association.

THE EXHIBITS

The Exhibition Hall is at Tattersalls, on Sixteenth Street and Dearborn Street, about eight or ten minutes' ride from the Auditorium, Victoria, Wellington and other hotels in the down-town district. Either the Wabash Avenue or State Street cars running south can be taken, the latter will probably be found the most convenient. It is exceedingly commodious, as shown by the fact that it has been used in past years as a convention hall by the national political parties when making presidential nominations. The building contains 50,000 sq. ft. of floor space, without a post or obstruction of any kind. A diagram of the building, with the spaces occupied by the different exhibitors, is shown on page 680. The headquarters of the STREET RAILWAY JOURNAL are on the main aisle, directly to the left of the main entrance on Sixteenth Street, and cannot be missed by anybody. The meetings of the two associations will be held on different floors from those devoted to the exhibits, so that noise from the latter will not disturb the delegates.

The following is a list of the exhibitors who have already engaged space:

LIST OF EXHIBITORS AT EIGHTEENTH ANNUAL CONVENTION AMERICAN STREET RAILWAY ASSOCIATION, CHICAGO, 1899

No. of Space.	Exhibitor.	Sq. ft.
1.	C. F. Orr & Company	100
2.	"Street Railway Review"	215
3.	STREET RAILWAY JOURNAL	215
4.	K. McLennan & Company	100
5.	The W. R. Garton Company	125
6.	Electric Railway Equipment Company	400
7.	Electrical Review Publishing Company	150
8.	"The Railway World"	150
9.	Safety Insulated Wire & Cable Company	125
10.	Novelty Tufting Machine Company	100
11.	Mica Insulator Company	200



H. C. MOORE



E. WOODRUFF



F. G. JONES



C. S. SERGEANT



A. E. LANG



G. E. YUILLE

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W. H. HOLMES



T. C. PENINGTON



IRA A. McCORMACK



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E. L. R. TIGHE



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F. E. SMITH



W. B. BROCKWAY



H. C. MACKAY

No. of Space.	Exhibitor.	Sq. ft.
12.	Manville Covering Company	300
13.	R. . Nuttall Company	300
14.	Charles N. Wood	100
15.	Protected Rail Bond Company	100
16.	Creaghead Engineering Company	200
17.	Ohio Brass Company	500
18.	Consolidated Car Heating Company	200
19.	Gold Car Heating Company	200
20.	Heywood Bros. & Wakefield Company	300
21.	American Rail Joint & Manufacturing Company	100
22.	A. & M. Brake Shoe Company	100
23.	Hale & Kilburn Manufacturing Company	100
24.	The Pantasote Company	100
25.	The E. T. Burrowes Company	100
26.	The Curtain Supply Company	100
27.	The Adams & Westlake Company	200
28.	General Electric Company	1,600
29.	Harold P. Brown	200
30.	The Standard Paint Company	200

No. of Space.	Exhibitor.	Sq. ft.
62.	Pennsylvania Car Wheel Company	300
63.	The Lorain Steel Company	1,300
64.	The Dorner Truck & Manufacturing Company	300
	Taylor Electric Truck Company	400
65.	Hipwood-Barrett Car & Vehicle Fender Company	600
66.	Cling Surface Manufacturing Company	150
67.	Wm. Wharton, Jr., & Company	300
68.	Chas. Scott Spring Company	165
69.	H. M. Stiles	100
70.	American Brake Shoe Company	100
71.	The Ironsides Company	100
72.	Siegrist Lubricator Company	150
73.	Morris Electric Company	675
74.	Crane Company	250
75.	Cylindorama Railway Company	100
	Star Brass Works	100
76.	American Vitrified Conduit Company	150
77.	New Haven Car Register Company	100
78.	Chapman Valve Manufacturing Company	100

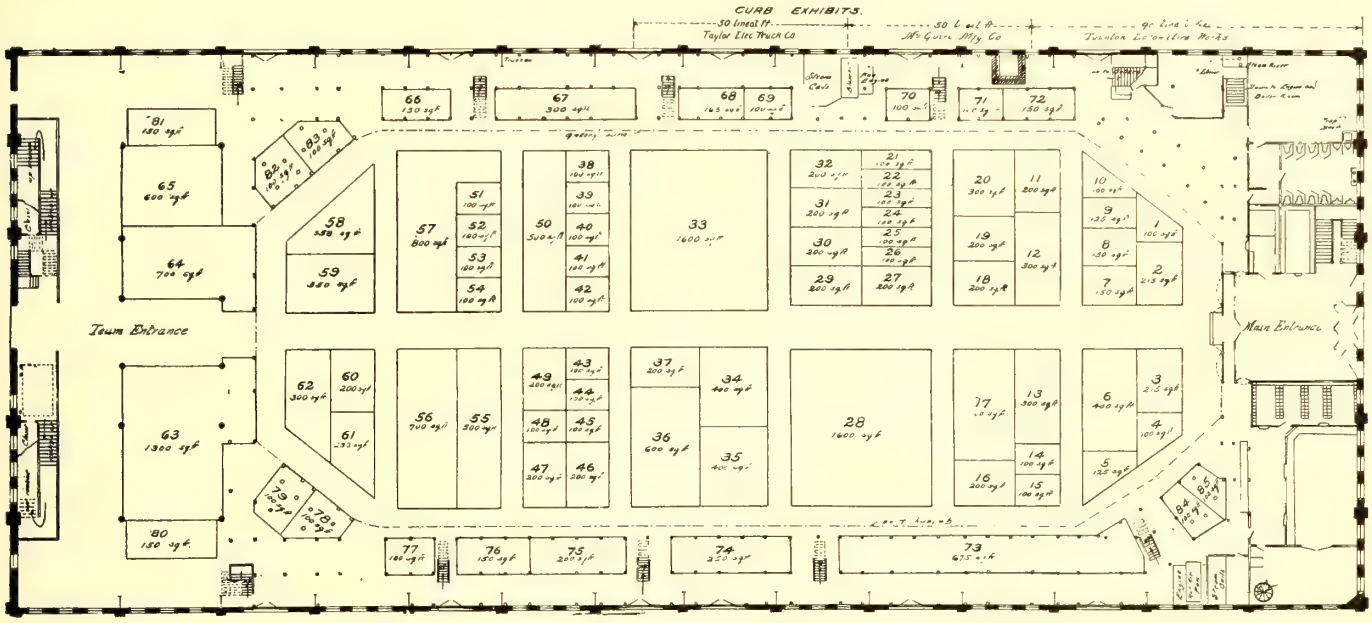


DIAGRAM OF THE "TATTERSALL'S" EXHIBITION HALL IN CHICAGO

31.	Central Electric Company	200
32.	Garton-Daniels Electric Company	200
33.	Westinghouse Electric & Manufacturing Company	1,600
34.	The Falk Company	400
35.	American Steel & Wire Company	400
36.	The Consolidated Car Fender Company	600
37.	Dearborn Drug & Chemical Works	200
38.	American Mason Safety Tread Company	100
39.	Standard Underground Cable Company	100
40.	American Car & Foundry Company	100
41.	Adam Cook's Sons	100
42.	Leschen-Macomber-Whyte Company	100
43.	Albert B. Herrick	100
44.	Continuous Rail Joint Company of America	100
45.	American Railway Supply Company	100
46.	The International Register Company	200
47.	Ohmer Car Register Company	200
48.	The R. Bliss Manufacturing Company	100
49.	Meaker Manufacturing Company	200
50.	The Barney & Smith Car Company	500
51.	Tarl Electric Company	100
52.	Paige Iron Works	100
53.	Milwaukee Railjoint & Welding Company	100
54.	Watson-Stillman Company	100
55.	G. P. Magann Air Brake Company	500
56.	Christensen Engineering Company	700
57.	McGuire Manufacturing Company	800
58.	Standard Air Brake Company	250
59.	Pennsylvania Steel Company	460
60.	Griffin Wheel Company	200
61.	W. T. Van Dorn Company	232

79.	U. S. Rocking Grate Bar Company	100
80.	J. R. McCardell & Company	150
81.	The Baltimore Car Wheel Company	150
82.	Miller-Knoblock Company	100
83.	Major Cement Company	100
84.	Weber Railway Joint Manufacturing Company	100
85.	Joseph Dixon Crucible Company	100

CURB SPACES. WEST SIDE OF BUILDING

Taunton Locomotive Manufacturing Company	90 ft. x 10 ft.
McGuire Manufacturing Company	50 ft. x 10 ft.
Taylor Electric Truck Company	50 ft. x 10 ft.

TRANSPORTATION TO CHICAGO

A special rate of a fare and a third will be granted to attendants at the convention, as usual. Persons purchasing tickets will pay full fare going to Chicago, and ask the ticket agent for a certificate, which, when properly countersigned at Chicago, will entitle the holder to a return ticket at one-third fare.

For the benefit of persons going to Chicago from the East, the Committee on Transportation has made arrangements for a special train via the Boston & Albany and New York Central Railroads. This train will leave Boston 10:30 A. M., Sunday, and New York at 1 P. M. the same day. The times of leaving other cities on the route and full details of the train are published elsewhere in this issue.

STREET RAILWAY JOURNAL

OCTOBER, 1899.

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, BEARD BUILDING, 120 LIBERTY STREET.

BRANCH OFFICES:

CHICAGO.....Monadnock Block.
PHILADELPHIA.....929 Chestnut Street.
LONDON.....39 Victoria Street, Westminster.
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Long Distance Telephone, "New York, 4044 Cortlandt."
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / 25/ / 31 fr

Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

NOTICE.

Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, accounting, finance and invention.

Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

Address all communications to

The Street Railway Publishing Co.,
Beard Building, 120 Liberty Street, New York.

We have brought together in this issue a series of papers describing electric railway practice in the four great manufacturing countries of the world, the United States, Great Britain, Germany and Austria, and in a highly civilized "consuming" country, Argentina. The papers on foreign practice are written by engineers and experts in municipal transportation of high reputation and special ability in this field, and their analyses of the work in their own countries are based upon a wide and accurate knowledge of what has been done elsewhere. We should fail to perform our duty did we not attempt to summarize this valuable engineering symposium by setting forth what seem to be the "best things," as well as the differences in engineering methods to be found in the practice of these five countries.

Europe builds its street railway roadbed with heavy masses of concrete as substructure, considering that the desirable end is *rigidity*. The drift of American practice is, however, rather toward *elasticity*. It is certainly necessary with rigid roadbed to adjust car springs most carefully in order to avoid the peculiar jarring effect in the car which is excessively irritating to passengers as well as destructive to rolling stock, but this can, quite as surely, be done if sufficient pains be taken. In defense of the American method it may be said that it is impossible to ride more smoothly and pleasantly at high speeds than on a rock ballasted steam railway roadbed with rails spiked to wooden ties, but this smoothness of running is attained at the cost of close daily attention on the part of a comparatively large force of track men, and such attention as this in paved streets is physically difficult and financially expensive. The disadvantages of a concrete substructure do not come out so clearly with the low speeds common abroad as with high speeds, and there is no question that a more solid and durable construction from a purely engineering standpoint can be obtained with concrete than without.

* * * * *

The depth and weight of rail in each country necessarily varies with the character of paving, but we believe that Europe is using, as a rule, too light a rail for electric traction, and is still using some sections which are a relic of old horse railway practice, and ought to have no place in modern electric railroading at higher speeds. In many of these sections there is no room for a proper size of wheel flange to provide for safety against derailment, the municipal authorities having apparently yielded more to the demands of carriage and wagon traffic than to those of the far greater number who patronize street railways. There are several rail sections in common use in America which are so well adapted to both, that it seems difficult to understand why they are ruled out by European municipalities. The common foreign practice of mortising, and overlapping rail ends so as to form a more nearly continuous rail, is, in the light of American experience, of doubtful value becaus of large first cost and of heavy annual maintenance charges. The rail can hardly help being weakened at the very point where it should be strongest. Our best American joints, including the cast welded, are well able to hold up rail ends to form a continuous surface. It is impossible, of course, to speak positively in general recommendation of details of roadbed practice. At the end of sixty years of steam railroading, engineers still have wide differences of opinion as to roadbed construction, and it can hardly be hoped that all electric railway problems are to be finally settled in a ten years' experience.

* * * * *

To American eyes, foreign street railway cars look heavy, cumbersome and ungraceful, but there is no international artistic standard for judgment on questions of this kind, the American cars perhaps look light and weak to European managers. Wood being far more expensive in Europe than America, iron enters largely into the construction of European car bodies, which perhaps has something to do with their appearance of weight. The best types of cars in each country are certainly good and are possibly best adapted to the character and habits of local

riders. If, for example, a first and second class division of traffic were to be made in America, it would be necessary to radically change the design of our cars. Speed is so urgent a necessity here that in order to obtain it, travelers are denied the many pleasant features of top-seated cars, for there is nothing which will so interfere with maintaining high speed schedules as the long stops necessary for getting up and down the roof stairways. Moreover, the higher the speeds the less is the pleasure of riding on top, particularly in a raw climate, because of both wind and motion. If European riders wish a view of the streets from the tops of cars they must sacrifice time in transit.

* * * * *

We believe it is well within the truth to say that the American electric motor and car controlling apparatus have set the standard for the world. It is inevitable that this should be so, for when the home market is such that a single manufacturing establishment can turn out 25,000 motors of exactly the same type, as has been done in America, special machinery can be built, labor can be subdivided and attention can be given to each detail to the end of producing motors which are more likely to be perfect and interchangeable in their parts than are the few hundred motors called for to satisfy a narrow local market. Nevertheless, German and British manufacturers are now building excellent machines, which are filling not only the home demand, but are going to many foreign countries as well, so that the scale of production has been greatly increased.

* * * * *

European municipalities are far more careful of life than are American, and, as a consequence, they almost universally require safety appliances and air or electric brakes, or their equivalent, upon electric railways. In this respect their example might well be followed by American companies, for there is no question that the common chain brake is too slow of application to suit modern high speed electric railway requirements, and many an accident would be averted if the motorman were given the power of instantly applying brakes by a single turn of a lever, as can be done with air brakes, electric brakes or with some forms of mechanical brake. It is the emergency stop, however rarely put in practice, which saves a heavy bill for damages amounting often to the entire cost of the equipment of a road with improved braking apparatus, to say nothing of the relief to the manager's conscience in not having the blood of a fellow-being on his head.

* * * * *

American electric railway power stations are using much larger units on an average and as a maximum than are European stations, which still regard a 500-kw. generator as large, whereas 1500-kw., 2000-kw. and 3000-kw. machines may now be regarded as common American practice for stations in the larger cities. Here, again, European practice in this respect is justified in most cases, on the theory of "small beginnings" in electric railroading, which have made necessary the adoption of small power station units. The larger sizes will quite surely be used as the stations grow. Water tube boilers and station auxiliary devices of all kinds are of much the same types in all countries, as the engineering principles in the design of steam plant are the common property of all manufacturing nations.

Overhead electric construction in Europe is probably superior to that in America, judged from the standpoint of the artist and of the engineer, for great pains have been taken, particularly in Germany, to produce highly ornamental designs for poles, rosettes, etc. Nevertheless, there is much to be said in favor of the simpler pole designs, which are usually less conspicuous in the street than are the more ornamental ones, but it cannot be denied that many American street railway companies have erred in imposing wooden poles, feed-wires and other eyesores upon the public in the smaller cities. In line material, America has again set the standard of the world, chiefly, of course, because it was here that commercial electric railroading was first developed.

* * * * *

Germany has been quite successful in adapting storage batteries to the propulsion of electric cars on what is known as the "mixed system," by which means overhead wires have been avoided in the business district. The batteries are charged from a line in the suburbs and carry the car to the city termini without direct current supply. How costly this combined service is we do not know, but it would be difficult to apply it in America for the reason that our street railway lines stretch far into the country and the storage batteries would often have to be carried as dead weight for 90 per cent or more of a round trip in order to work for 10 per cent or less. This would be not only costly in power consumption, but in car and track depreciation as well, while the storage batteries themselves, always a source of expense for maintenance, would add still further to the operating cost of the mixed system in America.

* * * * *

European practice is distinctively more conservative than American in the matter of insisting upon small losses in both outgoing and ground return circuits, particularly the latter. The regulations of the British Board of Trade permit a drop of but seven volts in the ground circuits, seeking thus to prevent electrolysis, and in the best engineering practice this drop is even lower than that called for by the Board of Trade, negative boosters being often used to bring this about.

* * * * *

The policy of American municipalities has always been and is now that of permitting private capital to handle its street railway enterprises. This is true to nearly the same extent also in Germany and in Austria, though latterly there has come into vogue in these countries a plan of municipal ownership of roadbed and private ownership of equipment, which is working to the apparent satisfaction of all concerned. In Great Britain the tendency is very strong toward municipalization of all public service enterprises, and private capital finds it almost impossible to obtain a foothold in tramway development, though still permitted to take some part in the building of "light railway," or interurban lines. Without attempting in this place to comment on the wisdom of this decision, it may be said that it is quite certain to be persisted in to the end, and that ten or fifteen years hence practically all municipal service enterprises of this kind will be owned and operated by the public. As a consequence, tramway development in the British Isles will follow with lagging steps and to a limited extent only, that of Germany and the United States, as has been the case during the past ten years.

FINANCIAL CHARACTERISTICS OF THE LARGE CITY TRANSPORTATION SYSTEMS OF THE WORLD

BY EDWARD E. HIGGINS

In dealing with financial statistics of any kind in different countries, it is usually impossible to make true comparisons and to reduce their varying financial practice to a common basis except upon simple and clearly defined lines, and even when these lines are chosen it is often difficult to present figures which do not involve some anomalies.

I must first, therefore, explain and criticise the accompanying table, which represents the results of careful, but not wholly satisfactory investigation of the financial characteristics and traffic figures of the more or less complete city transportation systems of thirty cities and population centers of the world, of 500,000 inhabitants or more. As there are but thirty-eight of such population centers in all, this presentation is reasonably complete.

The key to the arrangement of a table of this kind lies in the "population served." All things being equal, the million people of one locality require approximately the same transportation facilities as do the million people of another, and if their traffic returns show that they do not obtain or use them, it is the business of the promoter and the capitalist to supply the deficiency, or at all events, to find out why the small traffic city does not come up to the standard of the large. In this table, therefore, the cities are arranged in the order of their populations, the largest first.

As it often happens that city railway systems reach out into independent suburban townships and cities, it is necessary in order to get satisfactory results to find the smallest area which can be isolated from surrounding territory, to get the population of this area, and to combine the reports of all the street railway companies operating therein. In Paris, for example, there must be added to the population of the city proper that of fifteen or twenty suburban towns which can be reached from the heart of Paris by horse, electric or steam railways. For this reason, the population figures given in the accompanying table often seem large. The most recent reliable figures are taken in all cases, those given in the Statesman's Year Book of 1899 being, as a rule, accepted where no figures known to be better are found.

"Miles of track" means total mileage, single track basis (counting 1 mile of double track as 2 miles of single), with switches, sidings, etc. It is upon this figure that the capitalization is properly based, but a better standard for gross receipts would be "miles of road," i. e., miles of streets through which railways are laid, since traffic density measured by gross receipts is dependent upon road mileage rather than upon track. It is, however, almost impossible to get reliable figures of road mileage in all cases.

"Capitalization," as used in the accompanying table, represents, as a rule, the sum total of the capital stock (German, *aktien-capital*, French, *actions*), and the funded debt (German, "obligationen-capital," French, "obligations"), of all the companies in the population area. Were it possible to do so, it would be desirable to obtain the true cash investment in these properties as a basis of determining the percentage return of profits, but in hardly an instance could this be done with any approach to reliability. In the case of French and German companies, the capitalization account as it stands upon the books at present, is often considerably less than the original capitalization owing to the operation of amortization funds.

The attempt has been made to include in the figures of "capitalization" only the stocks and evidences of funded debt actually afloat in the hands of the public, excluding therefrom treasury securities in the form both of unissued capital liabilities and of stocks of controlled companies held in the treasury of the controlling ones. In some cases, however, it has been impossible to do this, notably in New York, where a large or controlling interest in certain companies has been purchased by others. Part of these purchases are represented by floating debt, part may at any time be sold to provide cash for the controlling company, and in Brooklyn, the combined elevated and surface systems have been welded together in such a way that the capitalization shown in the table is not greatly different from that actually outstanding in the hands of the public at the present time. It has also in this case been necessary to estimate the capitalization on the mileage of one street railway line which is the city branch of a large steam railroad system, and has no separate capitalization account.

"Capitalization per capita" is useful from two exactly opposite points of view. Wherever the capitalization per capita is extremely small, it shows that the facilities are inadequate and that there ought to be a chance for a further large investment of capital. Such a case as this is found in the tramway systems of London and Paris, and indeed nearly all of the cities outside of the United States. In cases where the capitalization per capita is extremely large, it indicates, as a rule, heavily watered securities. Taken in connection with the gross receipts per capita, some indication is given as to whether or not a capitalization can be supported, since from 40 per cent to 50 per cent of the gross receipts per capita can usually be depended upon as a return on the capitalization per capita. Of course, it must not be forgotten that a large proportion of the capitalization is in capital stock upon which a return is not obligatory, so that even an excessively overcapitalized company may still be perfectly solvent as far as ability to meet its obligations is concerned.

"Gross receipts" means in practically every case receipts from operation only, including those from passengers, freight, baggage or express matter, car advertising, sales of by products, etc., but not interest on current balances or income other than that arising from operation.

In "net profits," however, account is taken of these miscellaneous sources of income other than from operation, the object being to show the amount of earnings, in the year for which the report is made, actually applicable to the payment of interest on funded debt and dividends on stock.

For the street railway manager, the most valuable col-

umns in the table are those headed "passengers carried per capita" and "gross receipts per mile track—per mile run and—per capita." For the promotor and capitalist, the most valuable columns are "passengers carried per capita," "capitalization per capita," "gross receipts per mile of track and—per capita," and "percentage operating profits to capitalization."

Passing now from the mere mechanism of the table as described above, it will be interesting to point out some of the peculiarities of the different city systems, and to comment upon the opportunities for development which are found therein.

In no large city of the world are the transportation facilities so utterly disproportionate to the requirements as is the case in London. It is, of course, true that in a city of such enormous size, both in area and in population, a railroad suburban train service must and will be relied upon always for considerable distances from the city proper to the suburbs, and there is no question that the suburban service of London is a magnificent one in many respects; but it is almost equally important that the people should be quickly transported for short distances in carrying on their daily work, and it is here that the city transportation system of London fails so completely. Great lumbering omnibuses amble slowly through the streets, taking up an altogether disproportionate amount of street room for the facilities which they give, and it is well within limits to assert that were they all removed bodily from London streets and their place taken by long electric cars, even in such business thoroughfares as Fleet Street and the Strand, the total street capacity and the possible movement of population would be trebled at least, while the physical congestion in the streets would be greatly lessened through the regulating power of the cars in compelling wagons, carriages, etc., to take their proper sides. We may speak on this point with emphasis and conviction, because under exactly similar conditions we "straightened out" Broadway in New York City some fifteen years ago, by building a street railway (originally a horse line) right through that busy thoroughfare, until then congested to the point of suffocation by a combined omnibus and wagon traffic which had become wholly unmanageable. To-day, cable cars pass down this narrow (therefore misnamed) street, at twenty seconds intervals in the busiest hours of the day, and millions upon millions of people are carried upon them who would never in the world have found accommodations under the old regime. Few single acts of public policy have ever been so fully justified by results as the building of the Broadway railway, in spite of the scandals which attended its inception.

It is amazing to find in London but 242 miles of street railway track, an investment of but $3.50 per capita therein, and a gross earning power of but $1.27 per capita. Compare these figures with the corresponding ones for Greater New York, with its 1027 miles of surface railways, capitalized at $58.34 per capita and earning $7.46 per capita. It cannot be objected that this higher earning power in New York is due to the larger fares charged, for, curiously enough, the receipts per mile run are almost exactly the same in the two cities, while the densities of traffic, as shown by the gross receipts per mile of track, are nearly the same, those of London being slightly the larger. Moreover, the fares, based on average distance traveled by passengers, are undoubtedly smaller in New York than in London.

It may be noted in passing as an interesting fact, that the omnibus lines of London are earning nearly as much net profit as are the tramway lines, although the investment account of the omnibus companies is less than one-half that of the tramway companies. These omnibus profits are equal to 9.7 per cent upon the investment as against but 5.5 per cent with the tramways.

The present underground railways of London are enormously costly and their earning power unsatisfactory, being but 2.6 per cent upon the capitalization. The reason for this lies partly in the fact that the principal underground railway is a belt line, which skirts the true business district of the city so that it is somewhat out of the way for much of the travel which is seeking accommodation, while at the same time, it is so extremely disagreeable to travelers on account of the smoke and gas escaping from locomotives, that an immense number of people prefer to pay far more for cab hire or to spend more time on omnibuses than to inhale the bad atmosphere of the tunnels and cuts. The adoption of electricity would doubtless greatly increase the travel on this line, and it is almost inevitable that this step will be taken in the near future. Some experiments have, in fact, been made in this direction.

Greater New York is rapidly completing what will soon be the most perfect and highly developed municipal transportation system in the world. At present its elevated railways are run chiefly by steam, but the decision has been made to convert them to electricity; its surface railways are run in part by the cable system, which will soon, however, disappear from all its lines; in part by the underground conduit electric system, which will shortly be the almost universal system in use on Manhattan Island; in part by the overhead wire electric system, in use in the boroughs of Brooklyn, Richmond, Queens and the Bronx; while there are yet more than 100 miles of track where horse cars are to give way to electricity or compressed air, with which latter power some experiments are now being made with the possibility of adoption on the crosstown feeder lines of Manhattan. Until the past two or three years, the elevated lines have been the only ones where real rapid transit could be obtained, and their earnings were therefore on an increasing ratio from year to year. With the adoption of electricity on the surface lines, however, the gross and net earnings of the elevated roads have turned downward and are now less than for many years past, while those of the surface lines show a more than corresponding increase.

In the table are shown the financial and traffic statistics of the street railways, the elevated railways and the entire transportation system (*a*) of New York City as a whole, (*b*) of the boroughs of Manhattan and the Bronx, and (*c*) of the boroughs of Brooklyn and Queens. The entire system of Greater New York is earning $10.76 per capita, of which $3.31 only is taken by the elevated railways in the boroughs of Manhattan, and the Bronx, and Brooklyn, while $7.46 per capita is taken by the surface railways. The latter are earning 5 per cent upon their capitalization, while the elevated railways are earning but 3.2 per cent upon theirs. The transportation system as a whole is carrying 744,614,000 passengers as against 685,411,000 in London.

Paris, the third largest city in the world, still clings to omnibuses, no less than 139,000,000 passengers having

A TABLE SHOWING THE FINANCIAL CHARACTERISTICS AND STATISTICS OF TRAFFIC

COMPILED BY

Line No.	Population Served	City		No. of Operating Companies Reporting	Report for Year Ending	Miles of Track	Passengers Carried: Total	Passengers Carried: Per Capita	Line No.
1			Street Railways	13	June 30, 1898	242.0	308,730,408	56	1
2	5,500,000	London, England	Underground Railways	2	Dec. 31, 1898	177.0	128,328,798[2]	23	2
3			Omnibus Lines	5[3]	Dec. 31, 1898	None	248,351,480	45	3
4			Total	20	[5]	419.0	685,410,686	124	4
5			Street Railways	23	June 30, 1898	1027.3	516,887,282	146	5
6	3,546,000	New York, U. S. A.	Elevated Railways	4	June 30, 1898	175.0	227,726,552	64	6
7			Total	27	June 30, 1898	1202.3	744,613,834	210	7
8			Street Railways	11	Dec. 31, 1898	230.0	.....	....	8
9	3,065,000[a]	Paris, France	Omnibus Lines	1	Dec. 31, 1898	None	139,065,975	45	9
10			Total	12	Dec. 31, 1898	....	.....	....	10
11		Manhattan–Bronx,	Street Railways	12	June 30, 1898	371.3	320,807,300	149	11
12	2,156,000	(New York City), U.	Elevated Railways	1	June 30, 1898	109.0	183,360,846	85	12
13		S. A.	Total	13	June 30, 1898	480.3	504,168,146	234	13
14			Street Railways	12	Dec. 31, 1898	771.2	259,121,050	138	14
15	1,875,000	Chicago, U. S. A.	Elevated Railways	4	Dec. 31, 1898	73.6	55,177,061	29	15
16			Total	16	Dec. 31, 1898	844.8	314,298,111	167	16
17	1,710,000	Berlin, Germany		2	Dec. 31, 1898	212.4	182,290,230	107	17
18	1,623,000	Vienna, Austria		6	Dec. 31, 1897	186.0	.....	....	18
19		Brooklyn–Queens,	Street Railways	8[7]	June 30, 1898	535 5	183,857,273	139	19
20	1,325,000	(New York City), U.	Elevated Railways	3	June 30, 1898	66 0	44,365,706	33	20
21		S. A.	Total	11	June 30, 1898	601.5	228,222,979	172	21
22	1,267,000	St. Petersburg, Russia		..	No report	....	.....	....	22
23	1,250,000	Philadelphia, U. S. A.		7	June 30, 1898	513.0	252,604,445	202	23
24	1,230,000	Tokyo, Japan		1	June 30, 1898	25.4	24,181,053	20	24
25	1,192,000	Eastern Massachusetts, U. S. A.		3	Sept. 30, 1898	812.1	240,6 3,' 28	202	25
26	989,000	Moscow, Russia		..	No report	....	.....	....	26
27	970,000	Calcutta, India		1	Dec. 31, 1898	19.0	10,883,921	11	27
28	926,000[a]	Manchester, England		1[13]	June 30, 1898	126.6	57,142,920	62	28
29	874,000	Constantinople, Turkey		..	No report	....	.....	....	29
30	822,000	Bombay, India		..	No report	....	.....	....	30
31	788,000[a]	Boston, U. S. A.		1	Sept. 30, 1899	313.9	181,321,295	230	31
32	786,000[a]	Glasgow, Scotland		1	June 30, 1898	72.7	106,344,437	135	32
33	753,000	Buenos Ayres, Argentina		5	Dec. 31, 1898[10]	94.0	90,718,069	120	33
34	689,000[a]	Birmingham, England		4	June 30, 1898	40.7	48,366,802	70	34
35			Street Railways	1	June 30, 1898	49.7	32,196,236	47	35
36	683,000[a]	Liverpool, England	Elevated Railways	1	Dec. 31, 1898	14.0	9,367,862	14	36
37			Total	2	.....	63.7	41,564,098	61	37
38	675,000[a]	St. Louis, U. S. A.		1[11]	June 30, 1898	293.5	116,724,843[16]	172	38
39	638,000	Warsaw, Russia		..	No report	....	.....	....	39
40	626,000	Hamburg, Germany		1	Dec. 31, 1898	144.5	.....	....	40
41	614,000	Baltimore, U. S. A.		1	Dec. 31, 1898	3[illegible]4.0	.....	....	41
42	60[illegible],000	Eastern New Jersey, U. S. A.		11	Dec. 31, 1898	400.0	.....	....	42
43	570,000	Cairo, Egypt		1	June 30, 1898	....	8,459,665	15	43
44	551,000	Brussels, Belgium		1	Dec. 31, 1898	....	37,707,618	68	44
45	504,000[a]	Lyons, France		11	Dec. 31, 1898	206.8	....	....	45
46	536,000	Naples, Italy		.	No report	....	.....	....	46
47	528,000[a]	Pittsburgh-Allegheny, U. S. A.		11	June 30, 1898	391.2	97,194,260	184	47
48	523,000	Rio de Janeiro, Brazil		..	No report	...	.....	....	48
49	520,000[a]	Cleveland, U. S. A.		7	Dec. 31, 1898	330.0	.....	....	49
50	519,000	Budapest, Austria		5	Dec. 31, 1897	[illegible]8.9	....	...	50
51	504,000	Osaka, Japan		..	No tramways	....	....	....	51

a. Including suburbs.

1. Excluding rentals, percentages, etc., received by London County Council.

2. Excluding season ticket holders.

3. No report for one small company.

4. For three principal companies only.

5. Underground railways and omnibus companies, year ending Dec. 31, 1898; tramways, June 30, 1898.

6. Including capitalization New York & Harlem Railroad Company applicable to street railway portion of its entire system estimated at $250,000 per mile of track, or $5,000,000 in toto. A part of the total capitalization of the New York City roads is not in hands of public, but forms part of treasury assets of certain lessee companies.

7. Excluding Brooklyn Rapid Transit Company and its capitalization, it not being an operating company. The true capitaliza-

OF THE PRINCIPAL CITY TRANSPORTATION SYSTEMS OF THE WORLD

EDWARD E. HIGGINS

Line No.	Car Miles Run	Capitalization			Gross Receipts				Operating Profits			Line No.
		Total	Per Mile Track	Per Capita	Total	Per Mile Track	Per Mile Run	Per Capita	Total	Per Cent to Gross Receipts	Per Cent to Capitalization	
1	29,277,626	$19,271,070	$79,632	$3 50	$7,039,350	$29,088	$ 240	$1.27	$1,051,115[1]	14.9	5 5	1
2	.....	142,204,065	803,412	25.85	7,556,420	42 691	....	1.37	3,735,505	49.4	2.6	2
3	38,477,605	9,466,575	.....	1 72	9,181,305	.....	.199[1]	1.67	917,330	10.0	9.7	3
4	.....	170,941,710	.. ...	31.08	23,777,075	.....	....	4.32	5,703,959	23.9	3.3	4
5	109,508,728	206,879,100[6,7]	201,381	58.34	26,442,711	25,740	.241	7.46	10,255,204	38.7	5.0	5
6	.....	115,930,988	662,520	32.70	11,727,065	67,583	....	3.31	3,760,445	32.1	3.2	6
7	.....	322,810,088[6,7]	268,494	91.04	38,169,776	31,755	....	10.76	14,015,649	36.7	4.3	7
8	....	23,169,774[8]	100,738	7.56	6,928,821	30,125	....	2.26	997,117	14.4	4.3[9]	8
9	14,489,772	.....	.....	....	5,144,873	.....	.355	1.68	723,511	14.0	..	9
10	.....	.....	.. ...	....	12,073,694	.....	....	3.94	1,720,628	14.2	..	10
11	60,476,908	129,366,000[6]	348,387	60.00	16,302,228	43,906	.270	7.56	6,730,436	41 3	5.2	11
12	....	69,546,000	637 945	32 26	9,395,258	86,195	....	4.36	3,312,957	35.4	4.8	12
13	.....	198,912,000[6]	414,141	92.26	25,697,486	53,502	..	11.92	10,052,393	39.1	5.1	13
14	.....	91,259,400	118,334	48.67	13,087,791	16,970	....	6.97	5,787,795	44.2	6 3	14
15	.....	64,269,800	873,231	34.27	2,858,567	38,839	....	1.52	1,251,181	43.8	1 9	15
16	.....	155,529,200	184,102	82.95	15,946,358	18,873	....	8.50	7,038,976	44.1	4.5	16
17	25,339,933	15,827,950	74,708	9.25	4,927,999	23,201	.194	2.88	2,207,877	44.8	13.9	17
18	.....	12,314,150	66,205	7.59	3,467,728	18,644	.. .	2.14	1,123,225	32 4	9.1	18
19	46,109,394	63,763,100[7]	119,072	48.12	9,188,006	17,158	.199	6.93	3,337 080	36.3	5.2	19
20	.. ..	46,384,988[7]	702,788	35.01	2,331,807	35,330	....	1.76	447,488	19.2	1.0	20
21	.....	110,148,088[7]	183,122	83.13	11,519,813	19,151	...	8.69	3,784,568	32.9	3.4	21
22	.....	.....	.....	....	.....	.....	....	...	.....	....	..	22
23	.....	136,209,816	265,510	108.97	11,690,091	22,788	....	9.35	5,759,039	49 3	4.2	23
24	.....	375,000	14,764	.31	256,065	10,081	....	.21	See text.	..	..	24
25	45,939,967	50,327,850	61,972	42.21	12,302,210	15,149	.268	10.32	2,994,569	24.3	5.9	25
26	.....	.....	.....	....	.....	.....	....	...	.....	.	..	26
27	1,796,068	2,037,040	107,213	2.10	381,830	20,096	.213	.39	53,395	14.0	2.6	27
28	9,176,194	3,561,200	28,130	3.84	2,434,100	19,227	.265	2.63	762,255	31.3	21.4	28
29	.....	.....	.....	...	.....	.....	....	....	.....	....	..	29
30	.....	.....	.....	....	.....	.....	....	....	.....	.. .	..	30
31	32,209,150	31,583,000	100,615	40.01	9,257,254	29,491	.287	11.76	1,982,307	21.4	6.3	31
32	8,483,012	3,988,780	54,866	5.08	1,970,560	27,105	.232	2.51	502,650	25.6	12.6	32
33	17,461,841	24,619,325	261,908	32.72	4,161,670[12]	44,273	.238	5.52	946,825[12]	22.8	3.8	33
34	4,316,193	4,812,620	118,244	7.00	1,336,605	32,840	.309	1.94	397,895	29.8	8.3	34
35	5,072,221	4,696,350	94,494	6.88	1,242,975	25,010	.245	1.82	245,515	19.8	5.2	35
36	.....	3,700,000	264,286	5.42	389,375	27,812	....	.57	148,930	38.2	4.0	36
37	.....	8,396,350	131,811	12.29	1,632,350	25,626	....	2.39	394,445	24.1	4.6	37
38	.....	90,000,000[14]	306,644	133.33	5,417,123[14]	18,457	....	8.03	1,960,479[14]	36.2	2.2	38
39	.....	.....	.....	....	.....	.....	....	....	.....	.. .	..	39
40	14,476,673	6,986,834	48,351	11.16	1,862,441	12,888	.129	2.98	664,560	35 6	9.5	40
41	.. ..	60,559,000	171,071	98.63	4,062,358	11,476	....	6.62	1,757,532	43.3	2.9	41
42	.....	88,552,393	221,380	113.69	5,254,495	13,136	....	8.71	.....	....	..	42
43	1,875,344	2,087,800	.....	3.66	238,600	.....	.127	.42	92,391	38.7	5.4	43
44	4,210,897	4,337,720	.....	7.87	1,062,286	.....	.252	1.93	382,933	36.0	8 8	44
45	.....	9,563,235[8]	46,244	18.98	1,483,069[11]	7,171	....	2.94	546,143	36.8	5.7[9]	45
46	.....	.....	.....	....	.....	.....	....	....	.....	...	..	46
47	.....	76,943,995	196,687	145.73	4,600,718	11,760	....	8.71	2,236,312	48.6	2.9	47
48	.....	....	.....	....	.....	.....	. ..	....	.....	....	..	48
49	.....	31,873,000	96,585	61.29	3,386,000	10,261	....	6.51	....	....	..	49
50	.....	15,522,716[8]	263,543	29.91	2,642,366	44,862	....	5.09	1,146,223	43.4	7.4[9]	50
51	.....	.....	.....	....	....	.....	....	....	.....	....	..	51

tion of the Brooklyn system as represented by securities in the hands of the public is somewhat larger than figures given herewith, which represent original capitalization.

8. This figure represents "investment," not capitalization proper.

9. This figure represents percentage on "investment," not capitalization.

10. Report of one company is for year ending March 31, 1898.

11. After deducting taxes.

12. One company's report covers ten months only.

13. Including lines owned by Corporations of Manchester, Salford and Moss Side, operated by Manchester Carriage & Tramway Company.

14. Excluding figures of St. Louis & Suburban Railroad Company, which has a mileage of 28.5 and gross receipts of about $600,000 per annum.

15. Including all St. Louis companies.

been carried by this means in 1898. These omnibuses are actually earning $0.355 per mile run, an extremely large figure even for street railways, while $1.68 per capita is the measure of their gross earnings. The 230 miles of street railways in Paris and suburbs, many of which are steam and but few electric, are earning $2.26 per capita and 4.3 per cent upon the capitalization, the percentage of operating expenses to gross receipts being 85.4. What an immense opportunity exists here for the introduction of electric railways, a consequent reduction of the operating expenses per passenger, to between 50 per cent and 60 per cent of the gross receipts, and a heavy increase in profits!

Elsewhere in this issue will be found a map clearly showing the street railway and elevated railway systems of Chicago, together with a more or less complete description of their engineering and financial features. Taken as a whole, the entire transportation system (reporting) is carrying the city's population 167 times per annum, and is earning $8.50 per capita gross, while the return upon the relative investment accounts is 6.3 per cent for the street railways as a whole (five principal companies), and 1.9 per cent on the elevated railways.

The two German cities in the table, Berlin and Hamburg, are earning $2.88 and $2.98 per capita respectively, on a capitalization of $9.25 and $11.16 per capita. Berlin is carrying its population 107 times per annum. These are excellent examples of well managed and successful German properties. The two Berlin companies, reporting, earned 12.6 per cent on their capitalization, and the Hamburg company 9.5 per cent. Nevertheless, the traffic figures seem small as compared with the corresponding figures of Chicago, which is nearest the size of Berlin, and of St. Louis or Baltimore, which are nearest the size of Hamburg.

Much the same reports come from the Austrian city of Vienna, but Hungarian Budapest verifies its reputation for Western progressiveness by showing an earning power of $5.09 per capita, and $44,862 per mile of track, while its capitalization account reaches the respectable figure of nearly $30 per capita. In this case the twin cities of Pittsburgh and Allegheny and of Cleveland with suburbs, are the cities nearest Budapest in size, and both have larger receipts per capita.

One city only in the entire list can boast of having no street railway service whatever, and that is Osaka, Japan. That this is not from profit earning possibilities is shown by the results of a little 25-mile tramway in Tokyo, which earned in 1897-8 about $256,065 gross on a capitalization of only $375,000 (gold), while the net earning power (not given in the table) was equal to more than 35 per cent upon the capitalization. Dividends to this amount were declared, and the dividends for several years past have been on an almost equally large scale. The entire gross receipts amount to but $0.21 per capita, and it would seem as if there ought to be no difficulty in persuading capital to undertake tramway construction in Japan under existing conditions, provided only that concessions can be obtained.

Aside from London, there are three English cities and one Scotch, exceeding the 500,000 population limit, Manchester, Birmingham, Liverpool and Glasgow. The systems of these cities are carrying their population 62, 70, 61, and 135 times per annum respectively, and are earning $2.63, $1.94, $2.39, and $2.51 per capita respectively. These are all low figures, showing great possibilities of development, and this feature is especially brought out also by the figures of capitalization per capita, which amount is but $3.84 for Manchester, $5.08 for Glasgow, $7 for Birmingham and $12.29 for Liverpool.

It would seem as if there should be an opportunity for further tramway development in Calcutta, India, whose 19-mile system is at present earning but $0.39 per capita gross on an investment of but $2.10 per capita.

In the city of Buenos Ayres, Argentina, a city nearly every street of which is occupied by railways, the gross receipts per capita of five of the companies amount to $5.52, and per mile of track $44,273. These five companies are carrying the population of Buenos Ayres 120 times per annum.

Lyons, a commercial and manufacturing company of considerable importance in France, is earning $2.94 per capita for city and suburban lines, and 5.7 per cent on a capitalization of $18.98 per capita.

Finally, it is evident from the table that in the American cities with population centers of 500,000 inhabitants or more, street railroading is carried to a far higher degree of development as tested by public patronage than is the case abroad. Arranged in the order of traffic secured per capita, including all kinds of transportation systems within city limits, American cities stand as follows:

	Passengers carried per capita	Gross receipts per capita
New York (Boroughs of Manhattan and the Bronx)	234	$11.92
Boston	230	11.76
Greater New York	210	10.76
Philadelphia	202	9.35
Pittsburgh-Allegheny	184	8.71
St. Louis	172	
New York (Boroughs of Brooklyn and Queens)	172	8.69
Chicago	167	8.50
Baltimore (approximate)	130	6.62

The leading foreign cities appear in the following order based on gross receipts per capita:

	Passengers carried per capita	Gross receipts per capita
Buenos Ayres	120	$5.52
Budapest		5.09
London	124	4.32
Paris		3.94
Hamburg		2.98
Berlin	107	2.88
Manchester	62	2.63
Glasgow	135	2.51
Liverpool	61	2.39
Vienna		2.14
Birmingham	70	1.94
Brussels	68	1.93

One curious fact may be noted in this table. In spite of what are generally, though to some extent mistakenly, supposed to be lower fares in foreign countries as compared with the American five-cent fare, the gross receipts per car mile abroad are quite as high as they are in this country, which would seem to indicate either a better average travel throughout the day, a much shorter distance run per passenger, or overcrowding of cars. The latter cause is not the principal one, at least, and we believe that the average passenger in America rides considerably longer distances for his five-cent fare than is generally thought to be the case.

ELECTRIC RAILWAY PRACTICE IN AUSTRIA-HUNGARY

By E. A. ZIFFER

The first electric railway in Austria was for passenger service, and was built for the K. K. priv. Südbahn Gesellschaft by the Siemens-Halske Company, of Berlin. It extended from Mödling to Vorderbrühl, a distance of about 4 km. It was opened Oct. 22, 1883, and the system employed was the overhead, with split tube conductors, a method now antiquated and out of use.

The first electric railway in Hungary was opened to public traffic on July 3, 1889. It was 2.52 km. long, and was the first conduit system with slot rails to be so practically successful as to be continued in service. This same system, though with various improvements, was applied in 1879 to more than 31 miles of track. It is illustrated on page 687. The same system is also employed on the Ringstrasse line and elsewhere in Vienna.

Electric railway construction, so auspiciously begun ten years ago, made, for a long time, but little progress, as the authorities in the various towns resolutely opposed the installation of the trolley system. While the arguments advanced for this course were in some cases valid, pure business reasons and policy made them partial toward other systems at various times. It has been only during the last few years that expert opinion in this empire has leaned manifestly toward the introduction of the overhead system, which has shown marked advantages over all others in efficiency, reliability and low first cost. The fears expressed of this system in its early days have not been realized, so that now companies operating with animal power in Vienna, Buda-Pest, Prague, Graz, Brünn and Trieste have decided on the substitution of the trolley. The permission of the authorities has been secured, portions of the lines in these cities are already partially equipped and the rest is now in course of construction.

In Austria the electric railways are owned, not only by private companies, but also, in many cases, by electrical manufacturing concerns, as well as financial institutions. In addition, the municipalities have recently interested themselves to a considerable extent in the construction of new, and re-equipment of old lines.

This has been the case in Vienna, Prague, Lemberg, Brünn, Czernowitz and Olnmetz. These municipalities either manage the systems themselves or lease them, as is the case in Vienna, to private companies. The initial ownership of all franchises, however, is vested in the State, to whom all applications have to be made. By authority of a statute passed Dec. 31, 1894, the State authorities may grant concessions to either municipalities, for roads within their jurisdiction, or to private individuals or corporations. The life of the former is limited to ninety years and the latter to sixty years, but the State has the right to resign the right of ownership in case of municipalities, while railroads owned by private corporations become the property of the government or the State at the end of the franchises. The present mileage of the independent railway enterprises, compared with the municipal ones, is as two to one in Austria, and in Hungary, where this law is not in force, as four to one.



TYPICAL PASSENGER STATION ON THE GUNTRAMSDORF-BADEN ELECTRIC RAILWAY (VIENNA LOCAL RAILWAY)

The following firms are those which have principally been identified with the construction of electrical plants in Austria: Siemens-Halske, the Oesterr. Schuckert Works, the Vereinigte Elektricitäts-Actien-Gesellschaft (formerly B. Egger), the Elektricitäts-Gesellschaft, Felix Singer & Company, the Allgemeine Elektricitäts Gesellschaft, the International Elektricitäts Gesellschaft, and General Repräsentanz of the Continental Gesellschaft for electrical enterprises, all of Vienna; and the electro-technical establishment of Fr. Krizik in Prague. Accumulators are supplied by Wüste & Rupprecht in Baden, near Vienna,

the Accumulatoren-Werke, the Pollak works in Liesing, near Vienna; Böse & Company, in Vienna; Burger, in Vienna, and Deckert & Homolka, also in Vienna.

All railroads of secondary importance are free from State taxes in Austria for a period of twenty years, and at times are also free from city taxation. Frequently, however, private railroad enterprises have to pay considerable sums to the community, and also have to undertake other duties. The same rights and privileges also hold where communities obtain franchises themselves, a matter which was described by the writer in the STREET RAILWAY JOURNAL (International Edition) last December, in connection with the operation of the street railway company in Vienna, which is under obligations to build over 150 miles of track. As a rule the community imposes on the railroad companies certain conditions for operation, to which the latter have to submit, in conjunction with the rules laid down by the railroad commissioners. The gross and net incomes of all railroads are published weekly or monthly in the local papers in Austria-Hungary, and must be submitted by the companies in a form satisfactory to the government; moreover, complete statistics must be given of the condition of the property, etc., with all annual reports of the board of directors, to the stockholders and to the government. The latter also has a delegate to inspect the reports and be present at the meetings of the boards and at the general meetings of the stockholders. The government and the municipalities usually agree on the determination of the dividends and over-capitalization in the construction of new railroad lines is not likely to occur.

The older electric railroad companies in Austria-Hungary are generally prosperous, and divide annually dividends up to 10 per cent. Gross, as well as net, earings are constantly growing. The status of the electric railways in Austria-Hungary, Bosnia and Herzegowina up to the end of June, 1899, is found in the following table:

A.—AUSTRIA	Average Length in Kilometers.	Gage in Meters.	Passengers Carried.	Increase in Florins.
1 Baden-Vöslau	8.03	1.435	193,962	19 656
2 Bielitz-Zigeunerwald	4.84	1.000	183,175	16,367
3 Czernowitz railway	6.79	1.000	565,200	27,902
4 Gmunden railroad depot to city	2.53	1.000	39,600	4.769
5 Graz-Maria Trost (Pölling).	5.24	1.000	231,140	29,080
6 Lemberger electric railway.	8.33	1.000	2,241,565	129,169
7 Linz-Urfahr-Pöstlingberg	6.25	.900	817,789	70,919
8 Mödling-Brühl	4.00	1.000	164.885	19,952
9 Olmütz electric railway	5.27	1.435	322,519	24,536
10 Prag street railway	12.85	1.435	3,948,519	204,515
11 Prag-Vysocan with branch to Lieben	6.45	1.435	895.894	56,456
12 Prag-(Belvidere) Bubenc (Zoological Garden)	1.37	1.435	4,430	354
13 Prag (Smichow)-Kosir	1.69	1.435	450,587	14,152
14 Reichenberg electric street railway	3.41	1.000	501,586	27.892
15 Teplitz-Eichwald (1)	9.93	1.000	553,276	44.806
16 Wien-Kagran	5.40	1.435	284,431	25,248
17 Wiener Tramway Gesellschaft (2)	17.27	1.445	6,662.752	612,486
Total	109.65		18,001,310	1,328,259
B.—HUNGARY				
1 Buda-Pest street railway	57.40	1.435	19,503,070	1,569,473
2 Buda-Pest electric street railways	27.40	1.435	9,503,044	717,129
3 Franz Josef electric underground railway	3.70	1.435	1,513,149	155,235
4 Buda-Pest-Neupest Räkospalsta electric street railway	12.70	1.435	1,495,039	102,615
5 Buda-Pest suburban electric railway	5.40	1.435	133,496	8,457
6 Miskolcz electric street railway	6.60	1.435	282,945	21,195
7 Pressburger electric street railway	6.20	1.000	582,742	42,402
8 Szabadka (Maria Theresiopler) electric street railway	10.00	1.000	153,878	14,431
9 Szombathely (Steinamanger) electric railway	1.60	1.000	143,081	8,240
Total	125.		33,310,444	2,639,177
C.—BOSNIEN-HERZEGOWINA				
1 City railway in Sarajevo	5.70	0.76	586,193	23,538
Grand total	240.35		51,898,047	3,990,974

(1.) Also carry freight, the income for which was 24,087 fl.
(2.) Of the total 5.309 km. are operated on an accumulator system.

REMARKS TO THE PRECEDING TABLES

To this total length of 240.35 km. has to be added the horse car line in Graz whose electric operation was commenced on July 24 of this year. The re-equipped, standard gage, double track railway has a total length of 12 km. and the Grazer Tramway Company is under obligation to build about 25 km. of track within the city and the suburbs.

On July 1, 1899, the following standard gage roads were in course of construction:

1. Branch to Traiskirchen of the Guntramsdorf-Baden Road, 2.3 km. The main road was opened May 10, 1899.
2. Belt line in Baden, 2.287 km. Opened Aug. 30, 1899.
3. Smirchow, with central station, 6.445 km.
4. The existing horse roads in Vienna, Brünn, Trieste and Prague are being transformed into electric roads.

In general, it should be added that no standard method of construction or installation exists; that local conditions, as well as the wishes of the companies, govern greatly the method pursued; that, furthermore, the conditions imposed by the city and State government are to be observed, and that their approval of all methods of construction and installations must be obtained. Finally, there are the patents for the machinery and supplies owned by the large electrical manufacturing concerns, who, in many cases, undertake the construction of the railways, and this makes the different roads vary widely in character. On account of the conditions mentioned, it is well to describe here the principal types and methods of construction.

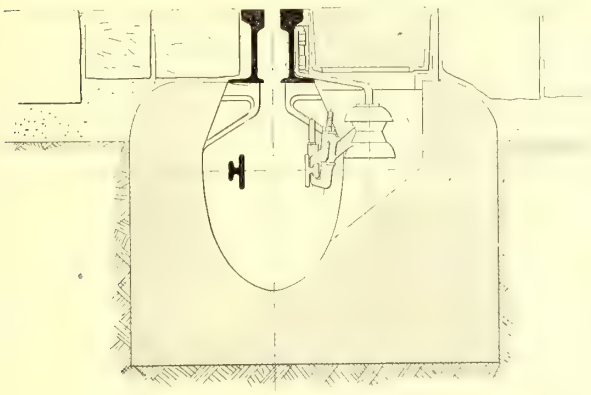
TRACK CONSTRUCTION

The rails in city streets are laid either on a foundation of concrete or on a broken stone or gravel bed of about 30 cm. thickness. The street surface on paved streets is generally paved between the rails and ½ meter to 1 meter on the outside of the tracks with stone blocks or silicified wood. This paving is usually done by the street railway company or at its expense. Where the streets are asphalted stone sets are usually laid along side the rails. On suburban roads the rails are frequently laid on 25 cm. to 30 cm. of concrete. No standard rules are followed in this method of construction, except that special methods are sometimes specified by the authorities granting the concessions.

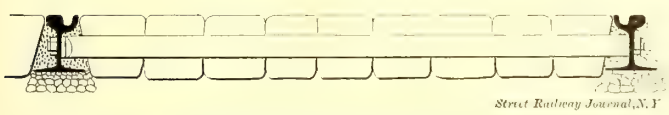
The rails for city service, especially in paved streets, are usually of the grooved type, made of Bessemer or Martin steel, are 12 meters long and weighing from 34 kg. to 43 kg. per meter. Tie rods of angle iron and fastened by bolts and nuts, are usually used every 2.5 meters. Under these conditions the track weighs from 74 kg. to 96 kg. per meter.

Besides the grooved rails, the Haarmann twin rail (155 mm. high), as well as the Demerbe rail, is used on short stretches. Above is shown the cross-section of a standard gage track, as well as several rail sections in general service. On the electric section of the Ringstrasse-Prater Road in Vienna grooved rails, 41 kg. per meter, are used, with points connected by wedge-shaped plates, which are driven home and held with spikes. On the Buda-Pest Franz Josef underground electric road the rails are 9 m. long, 115 mm. high, weigh 24.2 kg. per meter, and are laid on ties .928 m. apart. The joints are of the Haarmann grooved plate type, held with one bolt, and are laid on a concrete bed.

In the electric conduit road in Buda-Pest slot rails form one service rail, the other being of the ordinary type. The slot is 35 mm. wide. Further particulars of this construction were given in the STREET RAILWAY JOURNAL for July, 1897.



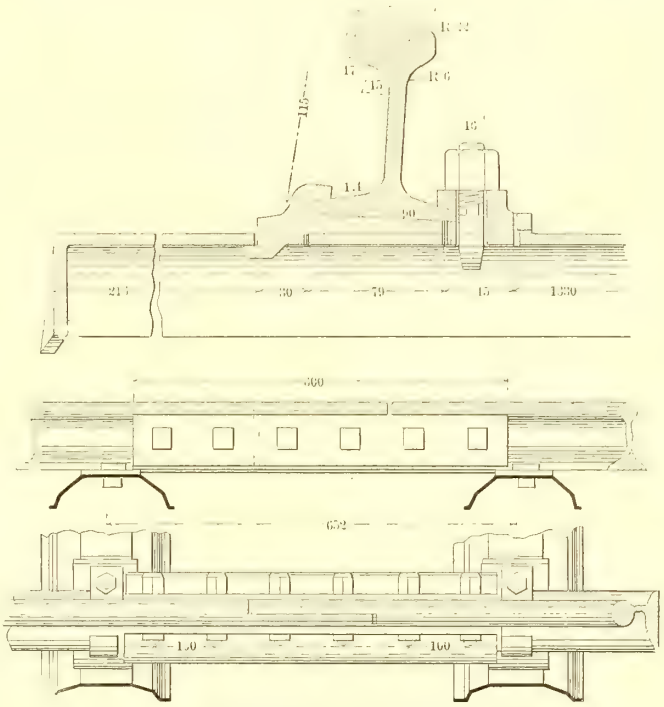
SECTION OF CONDUIT—BUDA-PEST



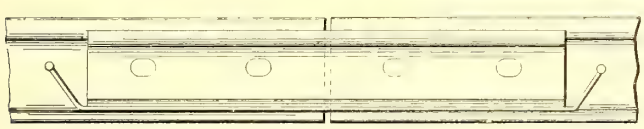
STANDARD TRACK CONSTRUCTION FOR TRAMWAYS

Outside of the city limits proper and in the suburbs, Vignole, or T rails, weighing from 21 kg. to 23.5 kg. per meter, are generally used. These are usually mounted on wooden ties, or, as is the case on the Pöstlingbergbahn, have wedge-shaped bases which fit into tie plates. This construction was described in the STREET RAILWAY JOURNAL (International Edition) for January, 1899. Rails are usually obtained from the Oesterreichische Alpine Montan-Gesellschaft, the Phœnix Actien Gesellschaft at Rührort, or the Hörder Bergswerks-und Hüttenverein in Hörde. The railway company is usually allowed to select its own rail section, but its choice is subject to the approval of the authorities. Switches, crossings and other special work are furnished in Austria by the ironworks Wittkowitz, Teschen, Zeltweg, Teplitz, etc., and in Hungary, by Ganz & Company, and are of chilled iron or cast steel, principally the latter. Made up special work is also used.

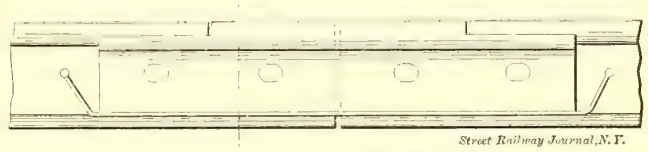
The rail bonds are usually copper strips (so called, Union bonds) of 107 sq. mm. cross-section, and connected to the rails by galvanized iron rivets, though in some cases continuous copper bonds are used. For a description of the bonds of the Ring-Prater line in Vienna, the



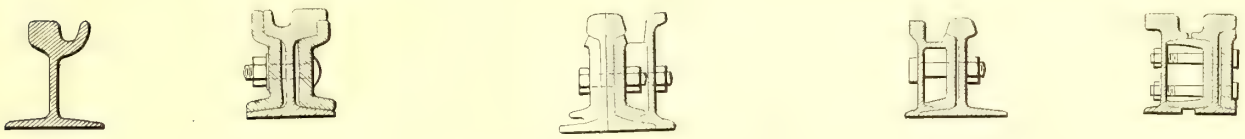
TRACK CONSTRUCTION OF FRANZ JOSEF UNDERGROUND RAILWAY—BUDA-PEST



Side elevation of ordinary joint



Side elevation of renewable head joint



Phœnix (No. 7) rails

Section at joint of renewable rail

Haarmann rails

STANDARD FORMS OF TRACK CONSTRUCTION

reader is referred to the Street Railway Journal for January, 1899 (International Edition).

The feeders are carried overhead on short roads only. They are usually from 7 mm. to 8 mm. in diameter, of bare copper, and are supported on porcelain insulators, which are attached to poles 5½ meters to 6 meters in height. The underground feeders are imbedded in wooden boxes, and consist of rubber-covered, iron-armored and lead-covered cables. Their cross-section varies from 53 sq. mm. to 140 sq. mm. These cables are furnished by Felten & Guilleaume, Kabelfabrik Actien-Gesellschaft (formerly Otto Bondy), Siemens & Halske, Franz Tobisch, Otto Steiner and Josef Feller, all of Vienna.

OVERHEAD CONSTRUCTION

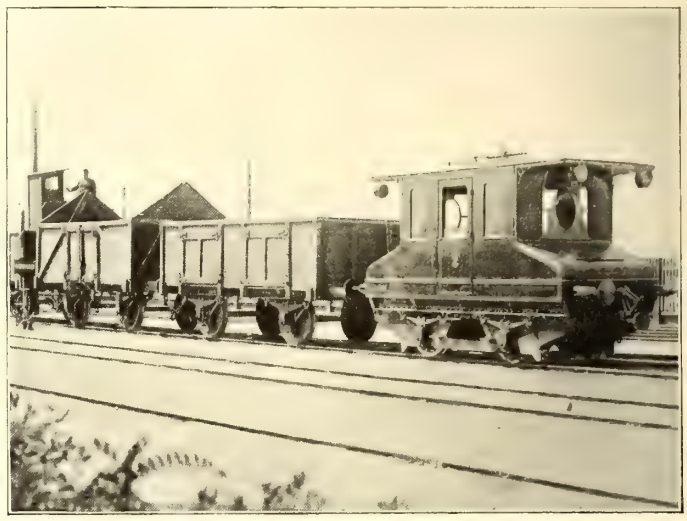
It is needless to say, the trolley system has been principally employed in Austria as well as Hungary. In the interior of the city ornamental iron poles are used, manufactured by the German-Austrian Mannesmann Tube Works at Komstau, or latticed poles with single or double brackets 2¼ m. in length. Outside of the city limits and in suburban districts wooden poles with wrought iron brackets are used. Several of these poles are shown in the accompanying illustrations. In streets of from 20 meters to 30 meters width, where span wire construction is used, the span wire is of galvanized steel wire 5.6 mm. in diameter, and of a tensile strength of 75 kg. per square cm., with its lowest point about 5.5 m. above the track. In general, the size of the span wire is made to depend upon the width of the span, *i. e.*, the distance between the poles or wall



MOTOR CAR AND TRAIL CAR, PRESSBURG ELECTRIC RAILWAY

rosettes. These latter are of galvanized soft iron, and are insulated by hard rubber plates. To prevent the transmission of noise, soft rubber bushings are also inserted between the rosettes and the wall. Where heavily loaded span wires have to be attached to light buildings special iron armored rubber cylinders are employed to serve as noise dampeners. The wall rosettes used by the Vienna Ring-Prater line were described in the January issue (International Edition).

The trolley wire consists usually of hard drawn, bare copper wire, from 7 mm. to 8¼ mm. in diameter (53.5 mm.²), and with a tensile strength of 40 kg. per cm.² The conductivity of this wire is about 97 per cent that of pure copper. On the Baden-Vöslau electric road silicon



ELECTRIC LOCOMOTIVE WITH FREIGHT CARS--BUDA-PEST-NEUPEST-RAKOSPALOTA RAILWAY

bronze wire, 7 mm. in diameter, is employed. The distance between the poles along the tracks is usually from 30 m. to 40 m. On the Franz-Josef underground electric road in Buda-Pest all the trolley wires in the tunnel are attached to the roof, and those in the open stretches to span wires carried by the poles.

Guard wires are in common use where there is danger of the telephone or telegraph wires coming in contact with the trolley wires, and, in some instances, the bare trolley wire is covered by roof-like narrow wooden laths, which are held in place by means of metal clamps. This device is regarded with great favor by the postal and telegraph authorities, and undoubtedly has considerable utility. The insulators are manufactured by several Bohemian porcelain firms.

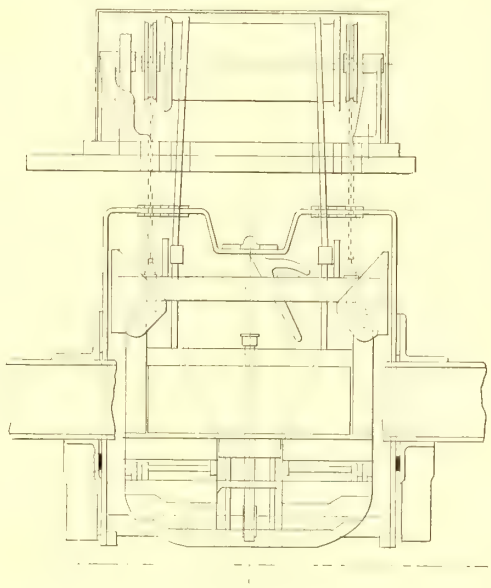
In general, it may be said that the trolley system has overcome the original prejudice which existed against it from æsthetic reasons, and is now popular with the city authorities and general public.

ROLLING STOCK

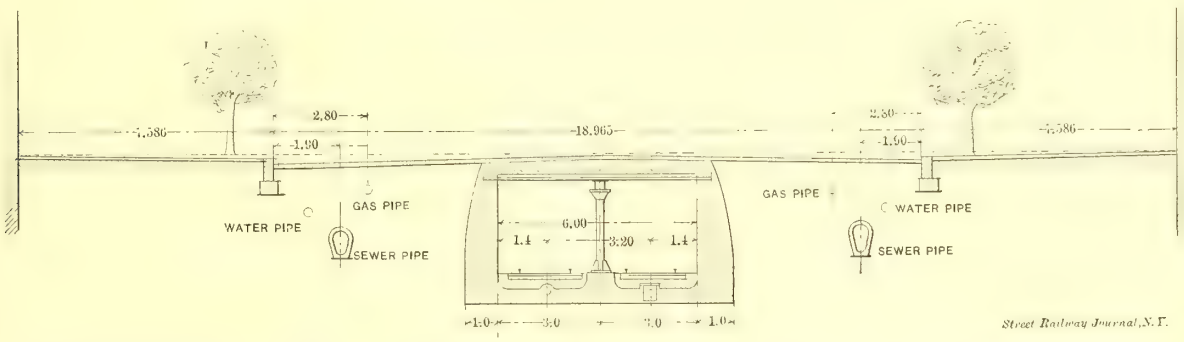
Of the various types of cars in use, the most popular is the so-called Hamburg type. This car has a long platform at each end, and three windows on each side, two with permanent sash and a central one which may be lowered and raised. Longitudinal seats are used, and the cars have a total seating capacity of twenty with no interior standing room. On the front platform four persons and on the back platform seven persons are permitted to stand, giving the car a total capacity of thirty-one passengers, not counting motorman and conductor. The

length of the car, outside buffers, is 8.4 m.; the greatest width is 2.02 m., and the platforms have each a length of 1.2 m. The car bodies are of wood, covered in places with sheet iron and strengthened in all directions by iron braces. The two side sills are lined with sheet iron, and are reinforced by angle irons; the entire car body is electrically insulated from the truck. The motor cars, illustrated in the January, 1899, number (International Edition), page 46, are typical of standard Austrian practice. On page 42 of the same issue the motor car belonging to the Praterstern-Kagran electric road, and on page 41 that of the Pöstlingberg road, were illustrated. Besides these, the motor cars of the Buda-Pest road were described and illustrated in the July, 1897, issue; those of the Czernowitz Railway, in May, 1899 (International Edition), and those of Graz-Maria Trost, in November, 1898.

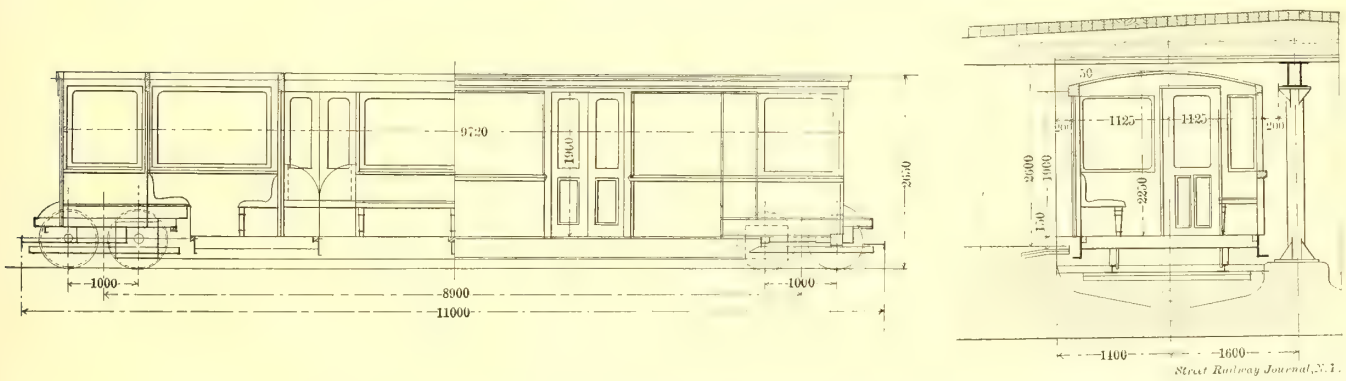
In smaller cities, or in cities where there are two classes of fare, as in Lemberg and Czernowitz, cross seats are provided in the cars. Such cars have a seating capacity of from eighteen to twenty and standing room on the platforms and the interior for twelve to twenty persons, exclusive of the motorman and conductor. In other words, thirty to forty persons can be accommodated. These cars are from 5.8 m to 7 m. in length, inclusive of the platforms, and have a width of 2.1 m. The wheel base is from 1600 mm. to 1800 mm. The diameter of the wheels is 750 mm., and the cars have a net weight of from 3.6 tons to 7.7 tons. The weight of the motor car of the Vienna belt line for mixed service, that is, accumulators and trolley, is 12.3 tons. Closed motor cars only are used for both summer and winter service. There are no open motor cars anywhere, but both closed and open trailers are employed. For a time the motor cars were furnished by the Hamburg Street Railway Company, of Hamburg, and the Actien Gesellschaft Elektricitäts Werke, formerly O. L. Kummer & Company, of Dresden, but at present most of the motor cars and trailers are obtained from the Wagen und Waggonbaufabriks Actien-Gesellschaft, formerly Weitzer, of Graz, the Simmering Waggonfabrik, T. Rohrbacher, of St. Veit, Ganz & Company, of Buda-Pest, and the Wagenfabrik, of Arad.



ELECTRIC PLOW, WITH DEVICE FOR RAISING AND LOWERING, BUDA-PEST



SECTION OF ANDRASSY STREET, SHOWING FRANZ JOSEF UNDERGROUND ELECTRIC RAILWAY—BUDA-PEST



DOUBLE TRUCK CAR, FRANZ JOSEF UNDERGROUND ELECTRIC RAILWAY—BUDA-PEST

The trucks have not been of a uniform type up to the present time, as each of the firms Siemens & Halske, Schuckert, the Berlin Union, Felix Singer, Ganz & Company, of Buda-Pest, and Franz Krizik, of Prag, have had their own particular types. For a time the trucks were obtained only from the Bergische Stahl Industrie, of Remscheid; at present, however, they are manufactured by all the above mentioned firms. Single trucks always carry fenders at each end.

Motors are furnished by the above mentioned firms, as

well as by the Vereinigte Elektricitäts-Gesellschaft, of Vienna, formerly B. Egger. They have a capacity of from 15 h.p. to 25 h.p., with a speed of 550 r.p.m., but those in use on the Buda-Pest underground road have a slightly higher capacity, i. e., 28 h.p. Power is transmitted to the axles by means of chains or ordinary gearing in a ratio of 1 to 3.8. On the Vienna tramway four-pole motors of 20 h.p. and 500 revolutions are used, connected to the axles by means of steel gears.

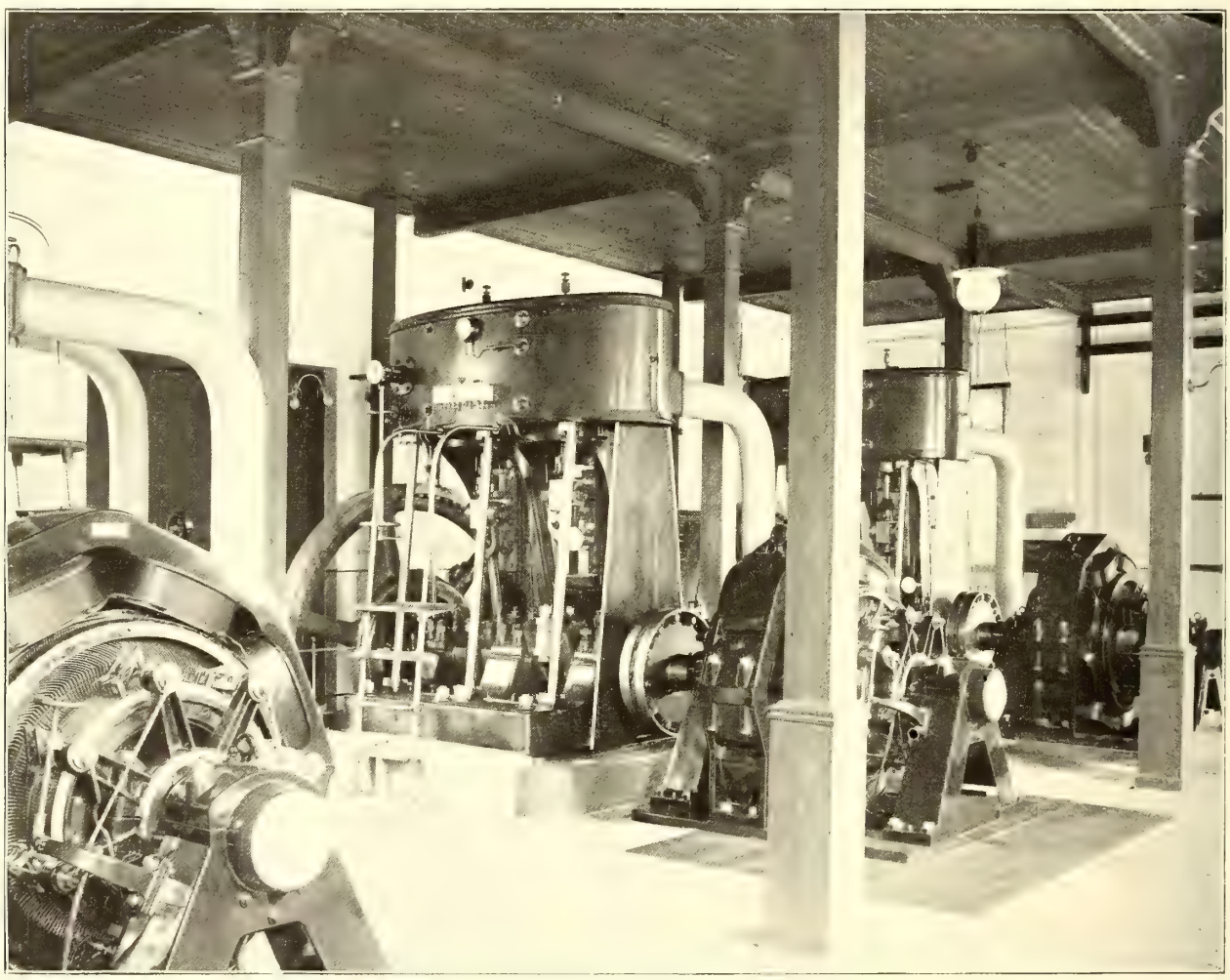
Each of the above mentioned firms, which furnishes electrical equipment, has its own type of controller, except the firm of Felix Singer & Company, which uses the Walker controller on the Prag-Kozir road. In most cases the controllers are the series parallel type. The best controllers are generally considered to be those of the Union Elektricitäts-Gesellschaft.

For current collectors in the overhead system the Union Elektricitäts-Gesellschaft, Ganz & Company, and Felix Singer & Company, use the trolley wheel, while Siemens & Halske and Schuckert make use of the sliding trolley, or bow system, which is manufactured in Europe. On the Prag-Kozir road the current is collected at the side, according to the Dickinson system, which was described and illustrated in the Street Railway Journal for September, 1898, page 564. In the bow system the collector consists of a horizontal aluminum U-shaped piece, the groove of which is filled with a semi-solid fat, which continually lubricates the wire. This form of collector has certain manifest advantages over the wheel, and these are apparent particularly in Vienna, where the cars change from the accumulator to the overhead system and vice versa. The setting and reversing of the bow is accomplished in the simplest and most certain manner.

On the Buda-Pest conduit road the current conductors are symmetrically shaped T irons, the broad faces of which are turned toward each other. The contact shoe, which is located beneath the car, can be lowered into or raised from the conduit through the 35-mm. slot within a few seconds. An appropriate mechanism effects the automatic opening and closing of the contact pieces as the shoe is lowered and drawn out of the slot, as shown on the preceding page.

Besides hand brakes, the authorities prescribe the use of electric brakes; the short-circuit brake is generally employed and is operated by means of the controller cylinder. Air brakes are not in use.

The speed, which in all cases is regulated by the authorities, is usually 15 km. per hour; this may be increased to 18 km. in streets with comparatively light traffic, but must be reduced to 10 km. in streets which are narrow and where there is considerable traffic. In the suburbs and in tunnels a speed of from 25 km. to 30 km. per hour is permitted.



ENGINE ROOM OF GUNTRAMSDORF-BADEN-VOSLAU ELECTRIC RAILWAY (VIENNA LOCAL RAILWAY)

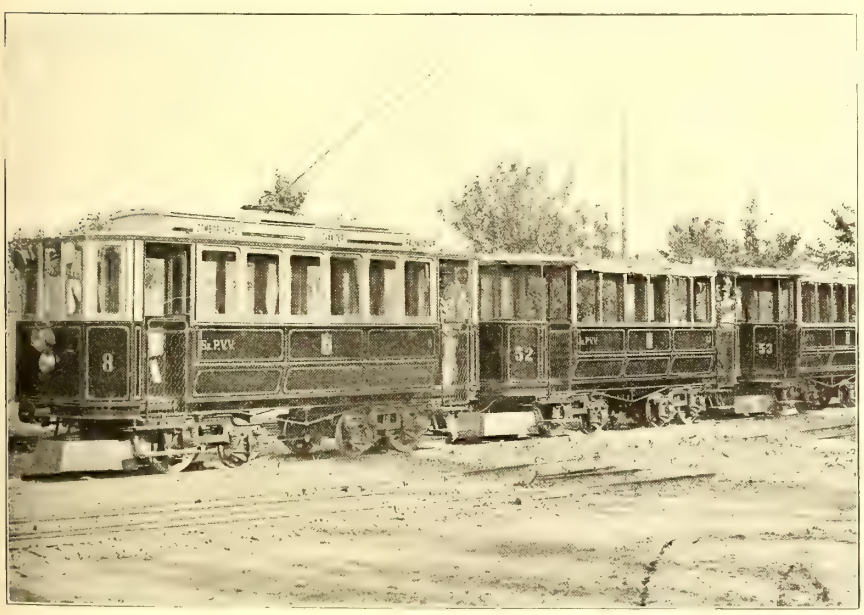
POWER STATIONS

In the design of power stations no uniform rule has been followed, as so much depends on local conditions and the amount of traffic. Upon these points every engineer

and each company has its own views and experiences, on which the design is generally based.

The boilers are usually built parallel to the engines. The latter are usually direct connected to the generators, and only in small installations is belt transmission used. The engines are mostly built by European firms, such as I. Brünner Machinenfabrik, the Prager Machinenfabrik, F. Ringhoffer, of Prag, F. X. Komarek and E. Lenz, of Vienna. In respect to the amount of power used, as well as length of track (172 km., 55 km. of which are conduit), Buda-Pest, with the exception of Hamburg, leads all European cities. The power stations (Gärtnergasse, Palfygasse and Damjanichgasse) generate current for the operation of the city street car lines, city railways and the Franz Josef electric underground roads. The power station in the Gärtnergasse, which furnishes current for the Stadtbahn Actien Gesellschaft, has a capacity of 2800 h.p., and consists at present of three 100-h.p., four 200-h.p. and three 500-h.p. tandem compound engines, which drive thirteen generators. The station in the Palfygasse, which supplies the system of the Buda-Pest Street Railway Company, contains four horizontal tandem compound engines, two of 750-h.p. capacity and two of 350-h.p. capacity. The station in the Damjanichgasse, for the operation of the conduit and overhead lines, is built very similar to the Palfygasse station, and contains four tandem engines of 800 h.p. each. At the smaller stations low-speed engines of from 100 h.p. to 200 h.p. are employed. The size of the fly-wheel depends upon the design of the engine.

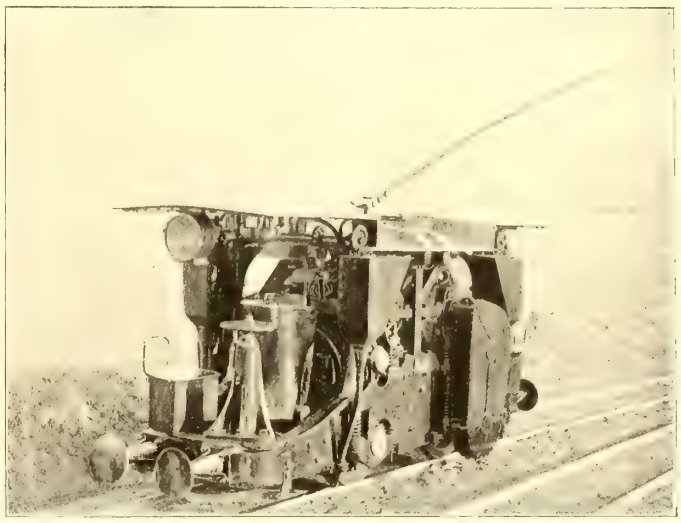
In general, water tube boilers of the Babcock-Wilcox type are used. The station in the Gärtnergasse has thirteen water tube boilers, with a total heating surface of 2578 sq. m.; there are six boilers, each with a heating surface of



MOTOR CAR AND TRAIL CARS ON SZABADKA MARIA THERESIOPEL ELECTRIC RAILWAY

262 sq. m., in the Palfygasse station, with a pressure of 10 atmospheres and equipped for the odorless burning of the fuel with step grates and Eggenberg furnace. In the Damjanichgasse station are six water tube boilers of 305 sq. m. heating surface each. The feed water for the boilers is chemically purified before it is used by means of the Dervaux system. In the stations where water is abundant condensers are used, though this is not the usual practice in small stations. The coal consumption per kw.-hour varies, according to the quality of the coal, from 0.8 kg. to 5.0 kg. per kw.-hour.

Boilers are built by the I. Brünner Machinenfabriks Actien Gesellschaft, Dürr & Gehre, of Mödling, L. & C.



ELECTRIC MINING LOCOMOTIVE—NORDUNGARISCHE KOHLENBERGBAU AKT. GES.

Steinmuller, of Gummersbach; Josef Pauker, of Vienna; Breitfeld, Danek & Company, of Blansko; Simmeringer Machinen u. Waggonbaufabriks-Actien Gesellschaft, Th. Schultz & L. Goebel, of Vienna; Prager Machinenfabrik, F. Ringhoffer, of Prag; F. Wannick & Company, of Brünn, etc. According to the size of the stations the heating surface varies between 100 sq. m. and 300 sq. m. The steam pressure is between 8 atmospheres and 10 atmospheres. Labor-saving devices for the transfer of the coal to the boilers have found no employment up to this time. Economizers are sometimes and feed-water heaters are always used.

The generators employed are the standard types of the various electrical companies, and have two or more poles and a comparatively low speed, the two-pole machines being used in small stations only. In Buda-Pest the small steam engines are connected to 400-volt generators, having a speed of 115 r.p.m. and an output of 500 amps. The eight-pole dynamos, driven by the larger engines, have a speed of 110 r.p.m and an output of 1250 amps. at 400-volts pressure. The 800-h.p engines are connected to inwardly-projecting, twelve-pole dynamos of the Siemens & Halske type, having a capacity of 150 amps. at 400 volts, and a speed of 110 r.p.m. The maximum pressure is usually from 500 volts to 550 volts. The electric roads Graz-Maria-Trost and Szombathely are equipped by the Thury system, i. e., high-tension direct with a constant current.

The power stations are generally built as close as possible to the point of utilization of the current, but this depends largely on local conditions. In several cities, for example, in Buda-Pest, where each power station supplies separate lines, the several stations can be connected to-

gether in case of necessity, so that one or the other plant may supply the entire system.

SPECIAL INSTALLATIONS

Special mention should be made of the street railway of Sarajewo, opened on May 1, 1895, and built by the Siemens & Halske Company. It is 4.9 km. in length, has a gage of only 0.76 m., uses the overhead system and serves passenger as well as freight traffic. The latter is carried on by means of electric locomotives and the former by motor cars. The locomotives are equipped with two



ELECTRIC LOCOMOTIVE ON LUMBER ROAD IN MAROS-SZLATINA

20-h.p. motors and the motor cars with one 20-h.p. motor. On both the power is transmitted by means of a chain to one axle on the motor car, and both axles on the locomotive. The Buda-Pest Neupest Rakospalotaer electric, normal gage road, 12.28 km. in length, with overhead trolley, is also of more than ordinary interest. It also serves both classes of service, and for freight haulage electric locomotives are used, which are equipped with two 25-h.p. motors, and have a draw-bar pull of 1200 kg.

Of special interest also are the industrial roads equipped by Ganz & Company, of Ofen, such as the electric mining roads in Bleiberg, Kärnten, Cribay-Mizsérfa, Bagbyasaja, Palfalva-Ettes and Resicza, all in Hungary, as well as the mountain road at Maros-Szlatina. The first of these roads, which is 2.6 km. in length, was built in 1892, and the current is furnished by a turbine-driven generator at 220 volts pressure.

On page 691 is shown the electric mining locomotive of in use at Csibay-Mizserfa and Bagliasalja. The engraving above shows the two-truck locomotive of the 20-km. mountain road at Maros-Szlatina, having a 1.1 m. gage, each truck being equipped with a 16-h.p. motor.

In conclusion it should be stated that on the normal-gage Arader and Osanader local road experiments with accumulators are being carried on, which will be continued by the directors of the Hungarian State railways. Trials were also made by the firm Krizik, of Prague, on the branch line Nusle-Modran with accumulator cars, seating forty persons, and the cost for the total trip of 26.6 km., in spite of a heavy grade, was only 38 kreutzer. Further experiments for trunk-line service will be made on the contemplated local road Tabor-Beckyn, in Hungary, and trials will soon be made on the Vienna Stadtbahn with eight cars to test the efficiency of a system by means of which the current is conducted by a rail laid midway between the tracks. According to the officially approved plans of Siemens & Halske groups of four cars are run at a time, and the four motors in each group are distributed over the four cars, so that each group contains four cars with one motor each, and the first and last cars are equipped with switches and current collectors. By means of a single controller cars in a train can be dispatched and braked synchronously, so that the couplings and buffers are seldom used. The train will be equipped, besides an electrical brake, with a vacuum brake of the Hardy type, for which Siemens & Halske have designed a new electric vacuum attachment.

There can be no doubt that the advantages of electric motive power for the operation of street cars, industrial roads, and at an early date railway trains on local and main roads will be in evidence, and that this will exercise a most beneficent effect on conveniences of public travel.

For a great deal of the above material the writer is indebted to Messrs. Braun, Schwieger and Hohenegg, whose important and interesting papers before various societies have been most valuable to advancement in the railway field.

An instance of the economic possibilities of power station apparatus is shown in the case of the Birmingham (Eng.) Cable Railway. This plant was originally equipped with two single expansion engines of 287 maximum h.p., with no special heat saving appliances. The increase in traffic on the road made it necessary to increase the engine power, and as a result, two compound condensing engines of 400 h.p. were installed, and condensing water was obtained from a well in conjunction with a tank and cooling tower. The result was that the consumption of fuel was reduced from about 325 tons per month, or 8.9 lbs. per car mile, to 6.5 lbs. per car mile, and the introduction of economizers further reduced the consumption to 4.7 lbs. per car mile, or about 3 lbs. per h.p. hour. As the line is not a large one, the total saving was not very considerable, but the case is a good one to bear in mind on other roads. Even with the fluctuating loads on an electric railway, the consumption of coal for compound condensing engines of 400 h.p. or more should not exceed from 3 to 3½ lbs. per kw.-hour, and for smaller engines, say from 2½ to 3 lbs. Where these figures are much exceeded, the station engineer should look carefully to his generating plant, independent of other conditions, and see where the leak exists.

The Indianapolis Street Railway Company has begun the building of new winter cars at its shops. The bodies of the new winter cars will be fitted to the new double trucks now used under the summer cars.

ELECTRIC RAILWAY PRACTICE IN ARGENTINA

By E. MANVILLE

In the following description of the initiation of electric street railways in Argentina, the Republic of Uruguay may also be included, since the principal city in that Republic, Montevideo, is so near to Buenos Ayres, the capital of Argentina, that the practice pertaining to Buenos Ayres is likely, in many respects, to be largely followed in Montevideo. Of the cities and towns of Argentina, the various tramway systems of Buenos Ayres represent such an overwhelming proportion of the entire tramway mileage in Argentina that, so far as the author is aware, no consideration has yet been given to the electrical equipment of the tramway systems in the other towns, the energies of all interested in electric railway practice in that country having been devoted to Buenos Ayres.



PASSEO DE JULIO, THE CITY TERMINUS OF THE BUENOS AYRES AND BELGRANO TRAMWAY CO.

The tramway systems of Buenos Ayres, in comparison with the population, are most extensive. Probably few, if any, of the cities of the world have a greater length of tramways per head of population than is that of Buenos Ayres. Practically every street and road within the city proper has a tramway line installed therein. The principal parts of the city, having been built on the lines of the more ancient Spanish cities, are singularly ill-adapted for tramways. The streets are excessively narrow—so narrow, in fact, that, with the exception of a few of the more modern avenues, there is only room for one line of tramways in one street, the return track of the same section having to be carried down an adjoining street. The city, as a whole, is laid on the American system, *i. e.*, the streets in both directions are parallel to each other, dividing the city up into blocks of about 120 metres square. The tramways are entirely owned by companies. The concessions granted to the three original companies, viz.: the City of Buenos Ayres Tramways Company, the Anglo-Argentine Tramways Company and the Buenos Ayres & Belgrano Tramways Company, were not granted by the municipality of Buenos Ayres at all, but by the provincial government of the Province of Buenos Ayres, and are held to be unending; but the tramway concessions granted to the newer companies by the municipality provided for the transfer of the whole under-

taking to the municipality at the end of a considerable term of years. In no case yet, however, have these concessions lapsed, and since it is extremely likely that all the tramway companies will avail themselves of the facilities afforded by electric traction, the dates of these concessions are likely to be considerably extended when powers for the use of electricity are granted by the municipality.

Of the three original companies, the Buenos Ayres and Belgrano Company, to which the author is electrical engineer, is the only one, so far, which has obtained the right to equip its tramways electrically, and in this case the concession for the use of electricity provided that at the end of a term of about ninety years from the date of the new



IN FRONT OF RAILROAD STATION IN BELGRANO

concession the whole of the tramways of the company should revert to the municipality, free of all cost, thus putting an end to the interminable concession for horse tramways originally possessed by this company. The Anglo-Argentine Company—another of the three original companies with interminable concessions—is at present applying for electrical powers, and no doubt one condition will be the substitution of a similar limit of time to the unending concession belonging to this company. Of the newer tramway companies, some of which have obtained concessions for electric traction, the term for which the electrical powers have been granted, at the end of which time the tramways will revert, free of cost, to the municipality, is generally sixty years, although this term is varied in individual concessions.

The tramway companies of Buenos Ayres have so far been entirely independent commercial concerns, uncontrolled by manufacturing companies or great syndicates, and each company has operated its system without regard to the other companies. For those companies installing electric traction on their systems fresh capital has been provided by tramway shareholders, principally in England, unaided by manufacturing companies or large syndicates. One exception, however, is that of the Anglo-Argentine Tramways Company, the capital for the electrical reconstruction of which system is, it is understood, being provided by a powerful syndicate backed by one of the large electric railway manufacturing companies. The apparatus so far employed in the electrical equipment of these tramways has been invariably imported from abroad, no part of the equipment having been made locally, and the electrical apparatus so provided for this purpose has been principally obtained in the United States. It is, however, probable that in the immediate future further apparatus required for the equipment of these systems may be imported partly from Germany and partly from England.

The companies owning the tramway systems of Buenos Ayres are nine in number, and are as follows:

The Anglo-Argentine Tramways Company.
The City of Buenos Ayres Tramways Company.
The Buenos Ayres & Belgrano Tramways Company.
The Grand National Tramway Company.
Buenos Ayres (new) Tramway Company.
La Capital Tramways Company.
Metropolitan Company.
Rural Tramway Company.
Electric Tramway of Buenos Ayres Company.

Of these, the La Capital Company, the Buenos Ayres & Belgrano Company and the Electric Tramway of Buenos Ayres, have actually equipped their systems electrically, or are engaged in doing so, and the Anglo-Argentine Company and the Metropolitan Company are obtaining, or have obtained, concessions for the same purpose. The other companies are likely to follow suit, and concessions have been granted for several new tramways, which propose to construct electric tramways from the outset.

All the tramway companies, whether working by horse or electricity, are very much under the control of the municipality. This body imposes a tax of 6 per cent of the gross receipts for the maintenance of the paving of the roads in which the tramways are situated, and further, enforces a payment of from a quarter to a half of the cost of newly paving any street in which existing tramways run. In granting concessions to these companies for electric traction a further tax has been imposed upon the com-



ON ROAD TO BELGRANO

panies in the shape of the gratuitous service of a certain number of electric arc lamps, one per block in the case of some concessions and two in the case of others. Furthermore, the municipality reserves to itself the right, which is frequently exercised, of giving powers to any tramway company to run for a distance not exceeding three consecutive blocks over the tramways of another company, on the payment to the owning tramway company of a

variable sum per block per annum. The municipality further reserves to itself the right to stipulate the headway of the cars on the various systems and to regulate the fares charged, though, on the other hand, it does not in any way supervise the accounts. As a result of the right of the municipality to regulate the fares the prosperous companies are not anxious to show large dividends upon their capitals. Owing, however, to the considerable overcapitalization of most of the horse tramways, few companies show good financial results. Furthermore, the proportion of working expenses to gross receipts usually exceeds 70 per cent, notwithstanding the low price of horses and fodder, and it is hoped that the introduction of electrical traction will materially improve the dividend earning capacity of the various systems. The development of electric railroading will undoubtedly be largely in city and suburban traffic, there being no settlements of any importance within easy distance of the capital to encourage the development of interurban electric railways.

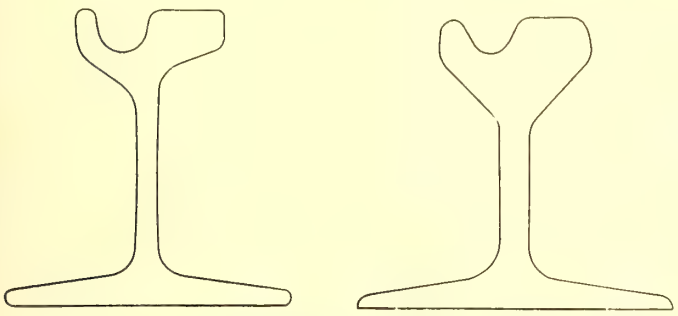


FIG. 1.—OLD HORSE RAILWAY SECTIONS IN BUENOS AYRES

The municipality has persistently refused, in granting concessions for electric traction, to allow the use of overhead wires within a considerable portion of the center of the city, and has stipulated that, while overhead wires may be used without this portion of the city, either the conduit or the surface contact system, or accumulators must be used within. The tramway companies at present operating within this prescribed district have thus been prevented from carrying their concessions into effect so far as this area is concerned. The streets of Buenos Ayres Ayres are peculiarly ill-adapted for an open conduit system, owing to their extreme narrowness and the fact that within these narrow streets are contained the pipes of four gas companies, four electric light companies, the city's water system, and the sewers, and it is questionable whether room could be found for the reception of these various pipes if a portion of the road were occupied by the tramway conduits. Furthermore, the expense of altering the positions of so many pipes and the sewers, which is quite an unknown quantity, could not be estimated. It has been felt by the tramway companies that the surface contact system has not yet had sufficient trial to warrant its use to meet the conditions of the concession, and accumulators are also regarded by these companies as too expensive to be seriously entertained. It is hoped, however, that the municipality will shortly remove this restriction—at least so far as the bulk of the inside of the city is concerned, with the exception of the central square, around which most of the tramways pass, where either an open conduit or surface contact systems might be installed without regard to the cost. Until this alteration in the decision of the municipality is arrived at it is unlikely that the electric tramway systems will be extended through the principal internal streets of the city.

ROAD-BED PRACTICE

The early method of constructing horse tramway tracks in Buenos Ayres has been primitive in the extreme. Girder rails of heavy weight, but of very bad running section and external section, have been universally adopted, the sections used by almost all the companies being of the two types shown in Fig. 1, weighing 103 lbs. and 75 lbs. respectively per yard. These rails were laid direct upon the road without any foundation, either of cross ties or concrete, with the result, after a very short time of running, that may be easily imagined. In the reconstruction of the tramways for electrical purposes Fig. 2 shows the

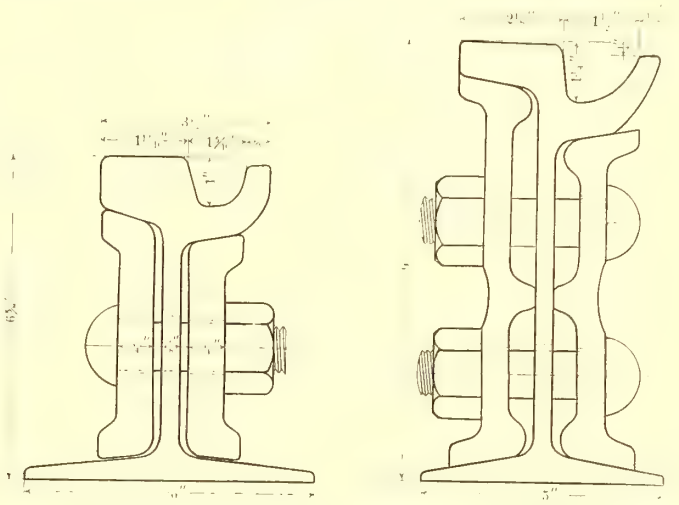


FIG. 2.—NEW ELECTRIC RAILWAY SECTIONS IN BUENOS AYRES

section of rails now being adopted of from 85 lbs. to 87 lbs, per yard run in weight. These rails are being laid in three ways. Fig. 3 shows them laid upon a concrete base extending the whole width of the track; Fig. 5 shows them laid on longitudinal concrete sleepers, one under each rail, and Fig. 4 shows the rail laid on cross ties of hard native wood called *quebracho*, the cross ties themselves being supported on a foundation of broken brick or stone. These three forms of road-bed are used respectively in different parts of the city according to the wheel traffic which predominates therein. The rails, supported on a complete concrete base, are used in the business center; those on the longitudinal concrete sleepers toward the outskirts, and those on cross ties in the suburbs, where the traffic is lightest. The space between the rails is paved with either wood, asphalt, stone sets, or macadam, as shown in the illustrations. Here, again, the wood paving and asphalt predominates in the center of the city, where the rails are laid on a complete concrete base, the stone setts, where the rails are laid on longitudinal concrete sleepers, and macadam, where the rails are laid on cross ties. The wagon traffic in Buenos Ayres, being, however, chiefly carried on by means of very heavy two-wheeled vehicles drawn by bullocks, there is a great tendency to wear down the macadam when used next to the rails, and it is the author's opinion that that form of paving will give place entirely to the use of stone setts, which form a more adequate protection to the track itself. It will be noticed from Fig. 2 that the modern section of rails used for the electrical reconstruction of these tramways has heretofore been of two types—one 9 ins. in depth, the other about 6⅝ ins. in depth. The 9-in. rail is

obviously too light structurally and has too narrow a base to give satisfactory results in maintenance, and so far as the electrical tramways of the Buenos Ayres & Belgrano Company are concerned, the 65-in. rail is now exclusively adopted. It will be noticed from Figs. 3, 4 and 5 that, owing to the small height of these rails, special attention has to be given to supporting the very deep stone setts, which are used in Buenos Ayres, and where the rails are mounted on a longitudinal concrete sleeper a mixture of cement and sand in equal parts is laid around the lower part of the rail to raise it up to the surface of the granite

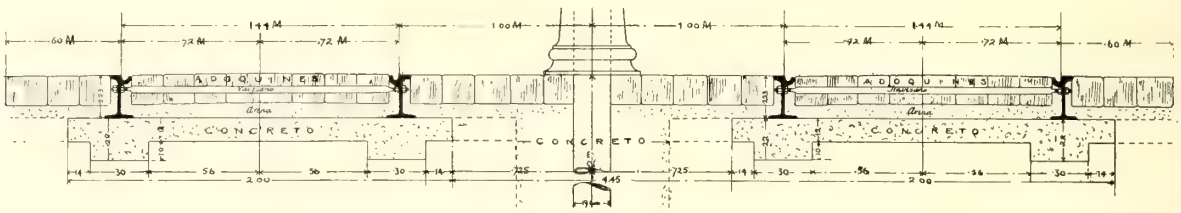


FIG. 3.—ROADBED CONSTRUCTION WITH CONCRETE BASE

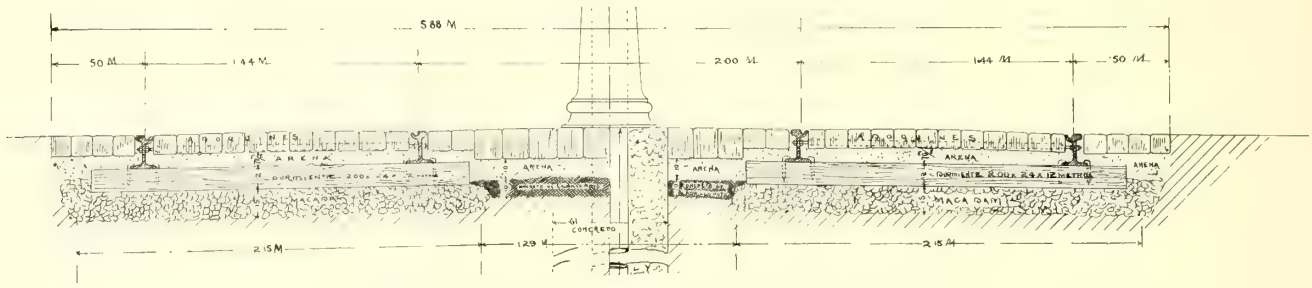


FIG. 4.—ROADBED CONSTRUCTION WITH WOOD TIES

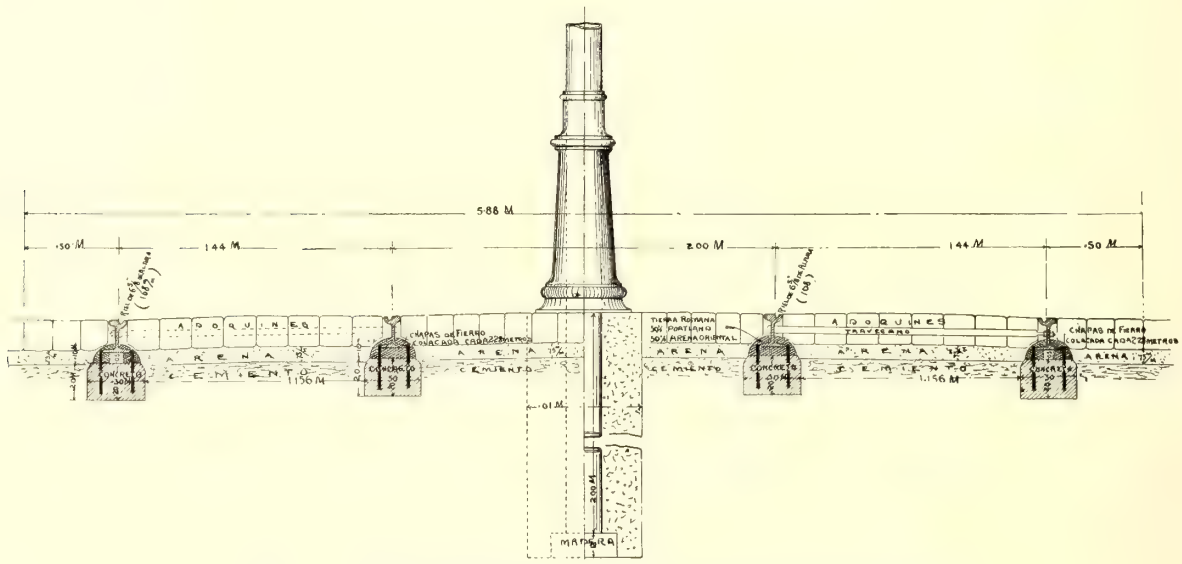


FIG. 5.—ROADBED CONSTRUCTION WITH CONCRETE STRINGERS

setts and to effectively support the latter, which are shaped to sit around the upper part of this concrete block.

Special attention has been given to the composition of the rails in order to insure their wearing quality under the onerous conditions existing with the use of electric motor cars. The rails are made of the best description of Bessemer steel, containing not less than 0.45 per cent of carbon. They are very cleanly and evenly rolled, each rail being made from a single ingot or part thereof, and free from all cracks, blisters, flaws or rough edges. They are seen to be perfectly straight when delivered, made to template throughout the entire length and straightened by pressure and not by hammering. These rails have been principally supplied by the Johnson Company, of Lorain, Ohio, and the Pennsylvania Steel Company.

These new types of rail, having an excellent external section, the joints between them are made by suitably designed fish-plates, and no trouble has been experienced yet in keeping the joints so made in perfectly good order. As, however, some of the companies reconstructing their roads for electric traction had recently laid rails of the two older sections shown in the figure, which were comparatively new, and therefore not to be discarded if possible, it has been arranged, in the case of the Buenos Ayres & Belgrano Company, that the joints of these rails should be cast welded on the "Falk" system, so as to render them suitable for mechanical traction, and this company has at present in use a complete "Falk" welding plant, including sand-blast and grinding outfit to insure the joints so made being perfect of their kind. It is obvious from an inspection of the section of these two types of rails that no satisfactory fish-joint could be made that would withstand the weight of the heavy motor cars constantly passing thereover.

The switches, mates and curved crossings have chiefly been made by the manufacturers of the rails, and are principally of cast steel. In the case of special crossings,

however, these have been built up locally of the standard section of rail, but in place of the joints being fished, they have been keyed together by iron being cast around them, suitable holes being formed through the web of the rails, through which the molten iron runs to key the whole mass together.

The municipality requires that the various sections of rails and the method of road construction be submitted to them for their approval before the work can be put in hand. The electrical bonding of the rails is, in the case of the Buenos Ayres & Belgrano Tramways Company, effected by the use of one Edison-Brown plastic bond and one 0000 Chicago bond to each rail length where the joints are fished, and one Chicago bond only where the rail joints are cast welded, the two lines and two tracks being suitably cross bonded. All of these bonds have, of course, been imported from the United States.

DISTRIBUTION SYSTEM

Of the electrical tramway systems actually at work at present, viz., those of the La Capital Company and the Buenos Ayres & Belgrano Tramways Company, two methods of distribution have been used. In the case of the La Capital Company the feeders are partly laid under ground in a wooden conduit and partly carried overhead on the standards supporting the trolley wire. On the Buenos Ayres & Belgrano system the feeders have been laid under ground entirely. The cables are divided into two groups, one being the "distributors," each running parallel to the tramways, and feeding at intervals into the trolley wires, and the other "feeders," which feed into the distributors at suitable points. Both types of cable are paper insulated and lead sheathed, without any further protection over the lead sheathing. These feeders and distributors are drawn into multi-way stoneware ducts laid beneath the foot-paths. The inside surfaces of these ducts, in contact with the lead-sheathed cables, are highly glazed, so that any further protection to the lead-covered cable would be useless, if not an actual disadvantage. The whole of the feeder system is laid out with a view to sustaining the least possible loss of electrical energy therein, having regard to the necessarily high price of electrical energy. Fig. 7 is a diagram showing the electrical energy to be conveyed to the various points on one of the Belgrano Company's two tramways and the maximum drop of electric motive force allowed at any point along the system. To obtain these results it will be observed that negative feeders are used, with negative boosters, and that the positive feeders to the extreme ends of the system have positive boosters working in connection therewith.

The lead sheathing of the cables is bonded at intervals to the rails to prevent any difference of potential between the rails and the cable sheathings, which would result in electrolytic damage to the lead sheathing of the cables. The municipality has not, so far, issued any regulations as to the conditions under which the distribution shall be effected, but in this particular case the principle has been adopted of working well within the Board of Trade rules governing in Great Britain.

The connections between the feeders and distributors, and between the distributors and the trolley wires, is effected through multi-way switches and fusible cut-outs arranged in section pillars placed on the footways, which are so commonly coming into use in Great Britain. The same section pillar contains a telephone enabling the guard, or any tramway official, to communicate with the central depot, and also contains suitable lightning arrester apparatus to guard the trolley wire and feeders. The tramway tracks are divided into sections a kilometer long, and at each section is placed one of these section pillars, the up-and-down trolley wires being provided at these points with section insulators, and the cross-over roads between the up and down tracks are also, for convenience sake, placed at these sectional points, a special switch being arranged in the section pillar to switch out the trolley wire over the cross-over when not in use. Fig. 8 is an illustration of one of these sectional switch pillars.

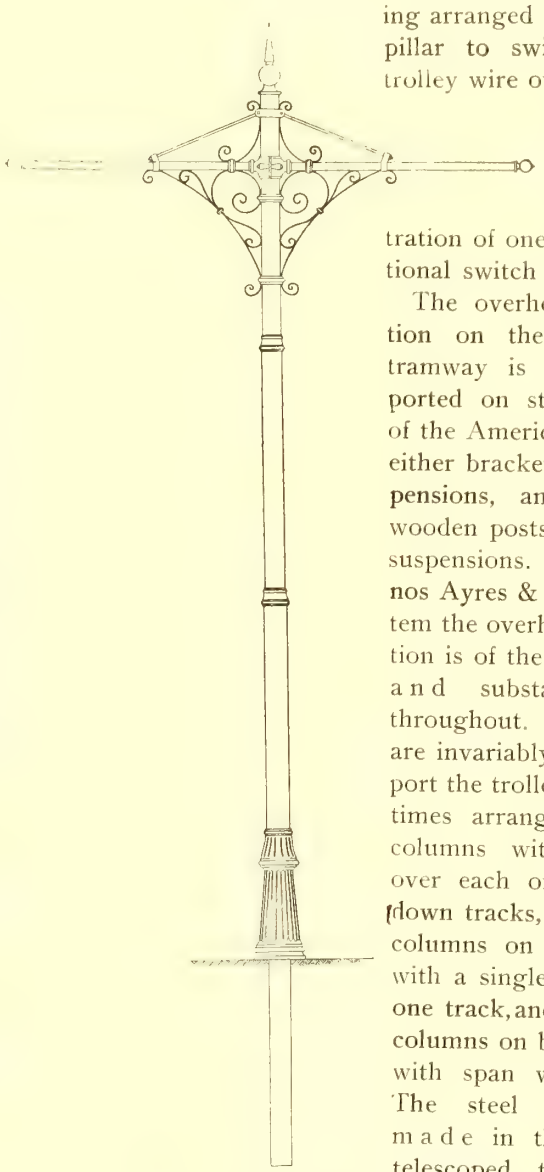


FIG. 6.—IRON POLE IN BUENOS AYRES

The overhead construction on the La Capital tramway is partly supported on steel standards of the American type, with either bracket or span suspensions, and partly on wooden posts with bracket suspensions. On the Buenos Ayres & Belgrano system the overhead construction is of the most modern and substantial type throughout. Steel columns are invariably used to support the trolley wire, sometimes arranged as center columns with a bracket over each of the up and down tracks, sometimes as columns on the sidewalk, with a single bracket over one track, and sometimes as columns on both footwalks with span wire supports. The steel columns are made in three sections, telescoped together, and for the main run of the tracks are of the following dimensions:

Top, 5 ins. diameter x .26 in. thick.
Middle, 6 ins. diameter x .30 in. thick.
Bottom, 7 ins. diameter x .40 in. thick.

While at each kilometer section columns of a larger size are used and of the following dimensions:

Top, 6 ins. diameter x .30 in. thick.
Middle, 7 ins. diameter x .40 in. thick.
Bottom, 8 ins. diameter x .60 in. thick.

And at those points where it is desirable to securely anchor the line, columns of the following dimensions are used:

Top, 7 ins. diameter x .40 in. thick.
Middle, 8 ins. diameter x .60 in. thick.
Bottom, 9 ins. diameter x .80 in. thick.

In addition, columns of the same dimensions as those above described for use at the sections are used along the length of the line at certain points where the municipality stipulates that arc lamps are to be erected, the columns in this case having to carry the connections from the underground feeders to the arc lamps.

The overhead fittings of the Belgrano road are all of the most modern and substantial type, the insulators being of the "West End" pattern, and, generally, no expense has been spared in making the overhead system neat in appearance and substantial in construction. The size of the trolley wire used is 00, and is of hard drawn copper.

getting onto and leaving the cars. The Buenos Ayres & Belgrano Company has therefore also provided a large number of single-deck combination cars, arranged to be opened in fine weather and closed in bad weather, and which, dispensing with the service of a second guard, seem, on the whole, to meet the conditions better than the double-deck cars. The municipality requires under its regulations that in the winter time the cars shall be closed and in the summer time opened. The double-deck car, which in itself is both partly open and partly closed, met this condition very well, since at all times of the year the passenger could choose the closed or open part of the car

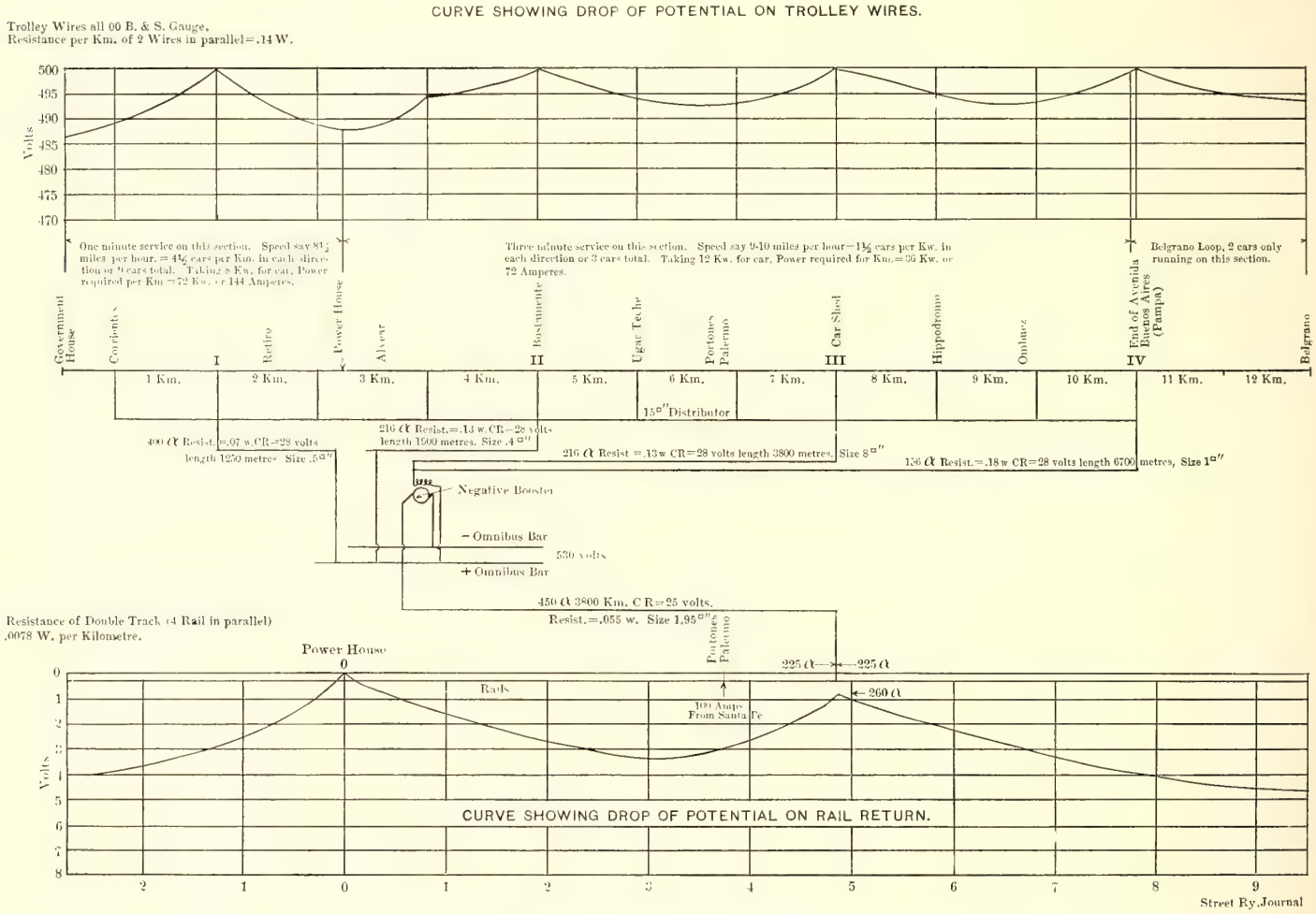


FIG. 7.—DIAGRAM OF DISTRIBUTION CIRCUITS, BUENOS AYRES AND BELGRANO TRAMWAYS

ROLLING STOCK EQUIPMENT

The rolling stock equipment on the two electric tramway systems at present running, viz.: the La Capital Company and the Buenos Ayres & Belgrano Company, embraces several types of cars. It was originally maintained that the country, with a Spanish population, would not use the upper deck of double-deck cars. La Capital Company, however, provided itself solely with an equipment of this description and met with complete success in the use of both decks, in all the better kind of weather the upper deck being extensively patronized; and the Buenos Ayres & Belgrano Company is now introducing on its system of cars of this description. These double-deck cars have an "imperial" over the upper deck so as to shield the passengers thereon from the rays of the sun and also to carry the trolley arm. In the practical use of these cars, however, difficulties have been experienced, owing to the large number of passengers crowding on to a single car, in collecting fares and in the speedy disposal of the passengers as desired. The combination car, however, meets this regulation even better than the double-deck car, as it is completely converted into either an open or a closed car as the season of the year may require. Until lately combination cars with removable panels of the type made by the Barney & Smith and Jackson & Sharp companies have been used, but they have the disadvantage of requiring some little time to be spent in the conversion of the car from open to closed or vice versa, and the Buenos Ayres & Belgrano Company is now introducing on its system some of the new type of Brill cars, in which both the panels and windows slide up into the roof, enabling the change from open to closed, or vice versa, to be effected in a few minutes. It is believed that this type of car will prove eminently satisfactory in meeting the conditions.

The cars are mounted on both Peckham and Brill extra long trucks, where the length of the car over the platform does not exceed 28 ft., and on Peckham and Brill double trucks, where the length of the car exceeds that dimension.

The tramway tracks, being as a rule very straight and the curves where necessary being of comparatively large radius, wheel-bases of from 7 ft. to 7 ft. 6 ins. are in use with the single trucks. All the trucks at present in use have been imported from the United States from the makers mentioned, and none have so far been made locally. In Fig. 9 is shown a removable panel, combination Barney & Smith car used on the Belgrano system, and in Fig. 10, a double-deck car, with an imperial, while in Fig. 11 is shown the Brill convertible car.

The rolling stock on both the La Capital and the Belgrano systems are equipped with motors of the General Electric Company's make. Those of the La Capital Company are of the G. E.-800 size, and are not fitted with electro-magnetic brake attachments. The cars in use on this system are smaller, on the whole, than those used on the Belgrano system, and this size of motor equipment is ample for the requirements of the line. On the Belgrano system the G. E.-1000 motor equipment is being invariably used, and the General Electric Company's electro-magnetic brake attachment is also provided. Having regard to the fact that in some parts of the city the cars have to slow up at the end of each block of 120 meters, the electro-magnetic brake has proved particularly useful, enabling a high average speed to be maintained, notwithstanding the constant slowing. Controllers used on both systems are of the General Electric Company's make, those on the Buenos Ayres & Belgrano Tramways having the requisite extra number of brake contacts, and these controllers have all been imported from the United States. The trolleys employed are on the most modern United States system, and are also imported.

The municipality regulates the number of passengers that may be carried on the cars, and these are restricted to the proper number accommodated by the seats in the cars, except that three passengers are allowed to stand on each platform. This limit to the number of passengers has been fixed by the municipality, not so much with regard to the comfort of the passengers themselves as to the number of passengers on a single car that the horses ordinarily in use on the horse tramways are judged capable of hauling, and now that electric traction is being introduced on some of the tramways, it is likely that the restriction as to the number of passengers on the platforms may be removed. The platforms on most of the cars are 4 ft. long, and therefore would accommodate a considerable number of passengers. There have been so far no restrictions made as to the speed at which the cars shall travel, this being limited only by the exigencies of the other traffic over the tramway lines. Thus, at the outskirts of the city the cars travel at as high a speed as from 12 to 16 miles an hour, while in the business center a greater running speed than 8 miles an hour is not practicable. So far, great difficulty has been experienced in obtaining drivers sufficiently careful in the running of the cars to prevent accidents to persons crossing the tracks, and in the case of the two companies at present running electrically, quite a considerable number of fatal accidents have occurred. All the cars, however, are now being equipped with the "Providence" fender, and it is believed that the use of this will materially diminish the number of accidents of this kind.

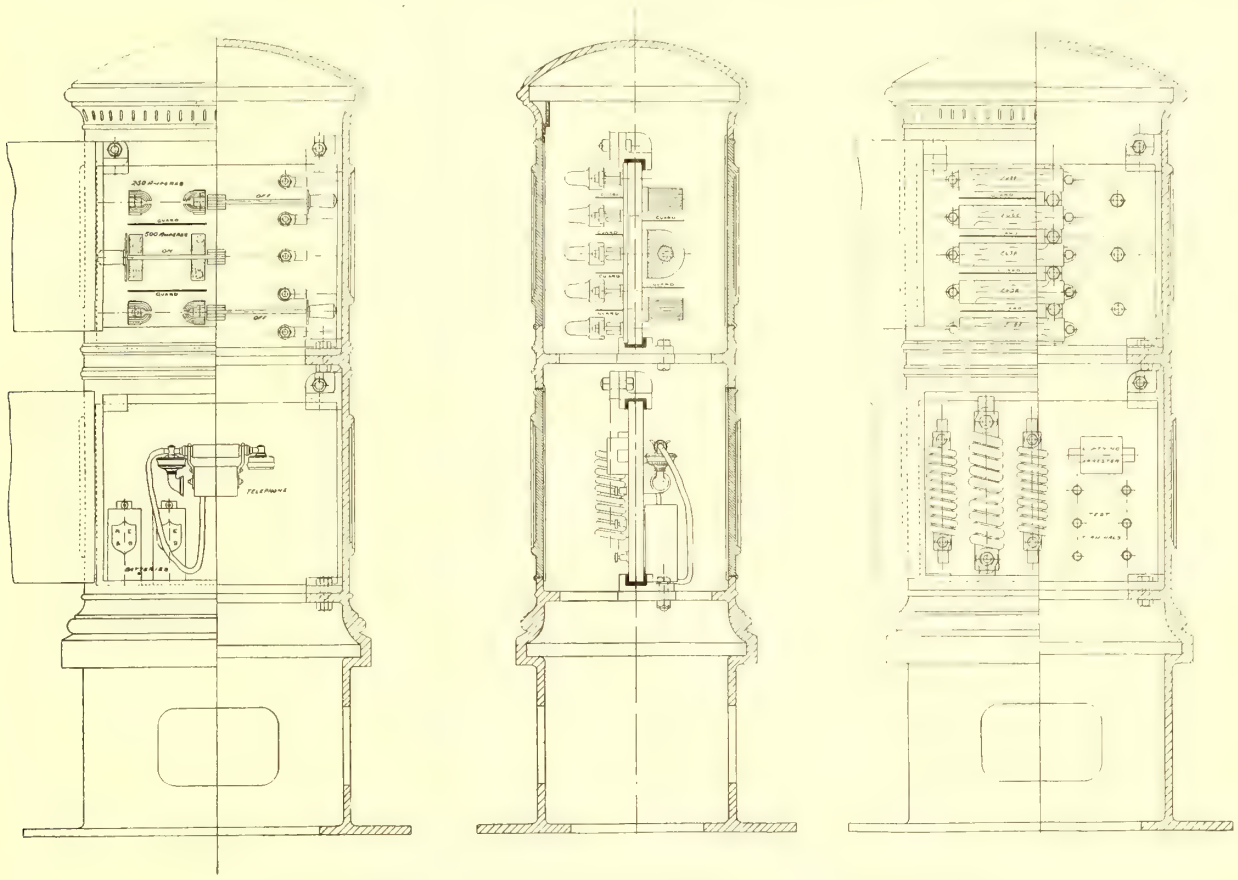


FIG. 8.—FEEDER AND SECTION SWITCH PILLAR, BUENOS AYRES

POWER STATIONS

Of the two tramway companies at present using electricity for their tramways, the La Capital Company has a power station of its own, while the Belgrano Company has made arrangements with one of the four electric lighting companies in Buenos Ayres to supply it with current.

There, therefore, cannot be said to be any general plan on which the tramway power stations of Argentine are built. La Capital Company is using Stirling boilers with Green's economizer, direct-coupled Ball & Wood engines and Walker generators. The boilers and engines are placed at right angles to each other, probably on account



FIG. 9.—COMBINATION CAR, BUENOS AYRES AND BELGRANO TRAMWAYS CO.

of the exigencies of the site, and a single range of steam piping is used. The plant installed by the lighting company, from whom the Belgrano Company purchases its current, consists of 500-kw. engines and generator, made respectively by the McIntosh-Seymour Company and the General Electric Company. This company has, in addition to the special plant installed for the current directly supplied to the Belgrano Tramway Company, a considerable plant for the production of electrical energy for lighting purposes, consisting of direct-coupled, compound "Allis" engines and monocyclic alternators of the General Electric Company's make. No special spare steam plant has been provided by the lighting company for the supply of current to the Belgrano Company, and for this purpose motor generators receiving their energy primarily from the monocyclic alternators have been installed. A 1000-kw. direct-current plant has been, up to the present time, provided for the supply of energy to this tramway company, together with one 500-kw. motor generator as a spare. The boilers used by the lighting company are of the Belleville type, and the steam range is arranged on the ring system. In all there are installed in this lighting station about 3000 kw. of generating plant. The same company will probably supply electrical energy for the running of a part of the Anglo-Argentine Company's system when this is electrically equipped, and the Anglo-Argentine Company will probably have, in addition, a multiphase generating station of its own to enable it to economically distribute current through static and rotary converters to the remaining portions of its very extensive system.

Automatic stokers are not usually employed on the boilers in the Buenos Ayres generating stations, owing to the fact that Welsh steam coal is almost invariably used, and this coal is not of a description that can be best dealt with by automatic stokers.

The fact that the supply of current to the Belgrano system is obtained from one of the lighting companies has prevented the most suitable position for the power house being selected, and as a matter of fact it is situated very near one end of the line, necessitating the use of both positive and negative boosters, which would probably not have been required had the generating station been situated somewhere near the center of the system. The first illustration gives a very good idea of the arrangement of the tramways and overhead construction along the Passeo de Julio, one of the important boulevards along which the Buenos Ayres & Belgrano system extends, and shows clearly how little obstructive, from an æsthetic point of view, is the arrangement of the overhead construction. In this boulevard the system adopted almost exactly resembles that employed at Hamburg, Germany, where a somewhat similar arrangement of boulevards with grass plots and trees exists.



FIG. 11.—IN THE SUBURBS OF BUENOS AYRES

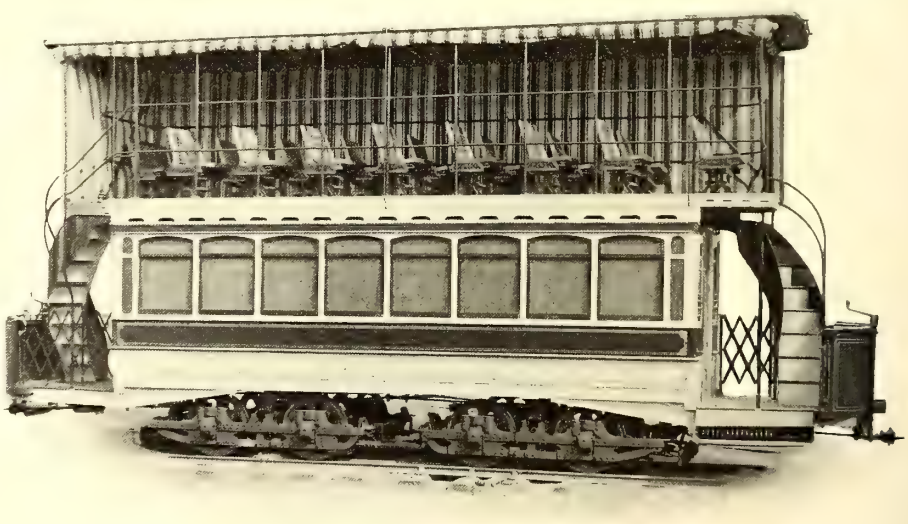


FIG. 10.—BUENOS AYRES CAR WITH TOP SEATS AND IMPERIAL

THE SERVICE PERFORMANCE OF RAILWAY MOTORS

BY W. B. POTTER

The conditions imposed in railway service are so intermittent and varied that it is not possible to establish a standard factory test that will meet all the requirements of actual practice. The General Electric Company has therefore adopted, as representing extreme conditions, an arbitrary standard, based on temperature rise of the motor of 75 degs. C. in one hour, the temperature of the surrounding air being assumed at 25 degs. C. The horse power rating obtained on this basis represents only one hour's continuous run and the temperature of the motor will rise to an injurious point if it is operated for an extended time at the rated output.

While a railway motor cannot be operated continuously at the rated horse power without injurious heating, this output can be exceeded for short periods of time, as in rapidly accelerating a car or climbing short heavy grades, but for ordinary service the average horse power required of a motor throughout the day should not be greater than 30 per cent of its horse power, rated on the hourly basis, which will give a temperature rise of about 60 degs. C.

These figures are based on a line potential of 500 volts, and the average rating of the motor may be increased approximately as the voltage is increased. For example, if a motor wound for 500 volts be operated on a potential of 550 volts, the average output may be increased about 10 per cent.

When electric brakes are proposed, a motor of greater capacity must be used, since the heating of the motor is increased from 20 per cent to 25 per cent by the use of electric brakes, this extra heating depending on different conditions of service. The minimum increase of 20 per cent represents a service containing few grades and stops, and the maximum of 25 per cent should be allowed on hilly roads with frequent stops, where the electric brake will be in use a large part of the time.

HORSE POWER OF MOTORS

The total horse power (rated on the hour basis) of an equipment for ordinary city and interurban service may be determined approximately by the following general formulæ. The ton in all cases is taken as 2000 lbs.

$$\text{Horse power} = \frac{(\text{Total wt. in tons}) \times (\text{Maximum speed in m.p.h. on level})}{5}$$

If electric brakes are to be used the formula should be as follows:

$$\text{Horse power} = \frac{(\text{Total wt. in tons}) \times (\text{Maximum speed in m.p.h. on level})}{4}$$

If the maximum speed is not known it can be taken as being twice the schedule speed, since this ratio is usually found in practice.

As an example, assume a 20-ton car with a maximum speed of 50 miles per hour, the line potential being 500 volts, then

$$\frac{20 \times 50}{5} = 200 \text{ h.p., or four 50-h.p. motors.}$$

If the line potential be increased to 600 volts, electric brakes could be used with these same motors, the gear ratio being changed to give the same speed as before.

As another example, consider an ordinary street car weighing, equipped and loaded, 11 tons, the maximum speed being about 25 miles, then

$$\frac{11 \times 25}{5} = 55 \text{ h.p., or two 30-h.p. motors.}$$

If electric brakes were to be used, then

$$\frac{11 \times 25}{4} = 69 \text{ h.p., or two 35-h.p. motors.}$$

The motor capacity required for any given service is so largely affected by the condition of track, grades, etc., that these rules should be cautiously applied, as they are simply a guide to the selection of a motor equipment and indicate the *minimum capacity* under ordinary conditions.

The schedule speed, or speed of the entire run, including stops, is ordinarily about one-half of the maximum speed on a level track, but where stops are frequent this ratio becomes less. In suburban service this figure may be exceeded since the relation between the two speeds is governed by the number of stops per mile the cars are required to make, and the fewer the number the more nearly the schedule speed will approach the maximum speed. For example, if a certain equipment can make a maximum speed on a level of about 25 miles per hour, then the limit of the schedule speed with seven stops per mile will be about 10 miles to 12 miles per hour, while the same equipment, with but two stops per mile, could make a schedule speed of between 15 miles and 18 miles per hour. High schedule speeds with frequent stops require equipments with large motor capacity and problems of this kind should always be treated as special.

TRACTIVE EFFORT

The tractive effort required to move a car or train is dependent on the rate of acceleration, grade and car friction, air resistance being included in the latter. In railway practice acceleration is conveniently expressed in miles an hour per second, that is, an accelerating rate of 1 mile an hour per second means that the rate of speed is increasing 1 mile each second and that in twenty seconds, for example, at this rate, the speed will be 20 miles an hour. One mile per hour per second is equivalent to 1.466 ft. per second.

Excluding car friction, a tractive effort of 92 1-3 lbs. per ton (2000 lbs.) will produce an acceleration of 1 mile an hour per second on a level track, and the rate of acceleration will vary in direct proportion to the amount of tractive effort used. On the ordinary street car the tractive effort during acceleration often rises to between 200 lbs. and 300 lbs. per ton. In elevated or suburban train service the maximum tractive effort is generally from 100 lbs. to 150 lbs. per ton, while for heavy freight work where slow speeds are used, it may not exceed 30 lbs. or 40 lbs.

Grades are commonly expressed in percentage of feet rise in a length of 100 ft. and the tractive effort required

for a grade is the same percentage of the weight as the rise in feet is to a length of 100 ft. For instance, a 3 per cent grade will require a tractive effort equal to 3 per cent of one ton, or 60 lbs. per ton. To this figure must be added the tractive effort necessary to overcome the car friction, if the total tractive effort is required.

The car friction necessary to overcome the rolling friction of the rail and air resistance has been compiled from a number of tests and the approximate amounts are given in the following table:

Fifteen-ton car, up to 25 miles per hour, tractive effort equals 25 lbs. per ton.

Fifteen-ton car, up to 50 miles per hour, tractive effort equals 50 lbs. per ton.

Twenty-five-ton car, up to 25 miles per hour, tractive effort equals 20 lbs. per ton.

Twenty-five-ton car, up to 50 miles per hour, tractive effort equals 25 lbs. per ton.

One hundred-ton train, up to 25 miles per hour, tractive effort equals 15 lbs. per ton.

Heavy freight train, up to 25 miles per hour, tractive effort equals 6 lbs. to 10 lbs. per ton.

The above figures would be considerably increased by presence of snow or dirt on the track.

TRACTIVE COEFFICIENT

This coefficient is usually expressed as the ratio between the weight on the driving wheels and the total tractive effort and is dependent upon the adhesion between wheels and rail. It has a variable value for the same equipment, being largely affected by the condition of the rails, whether wet, dry or sanded.

In train work, it may be stated as a general rule, that the weight on the driving wheels should be at least six times the tractive effort required. For example, the weight of a locomotive necessary to haul a 100-ton train up a 2 per cent grade would be found as follows:

100 × 15 lbs. friction = 1500 lbs. for friction of train,
100 × 40 lbs. for grade = 4000 lbs. for grade,
Total tractive effort required, 5500 lbs. for train only.
Assuming a 20-ton locomotive, we have:
20 × 15 lbs. for friction, = 300 lbs.
20 × 40 lbs. for grade, = 800 lbs.
Total tractive effort for locomotive only, 1100 lbs.
Total tractive effort for train, 5500 lbs.
Total, 6600 lbs.

This is 16.5 per cent of 20 tons, the weight of the locomotive, it being assumed that all axles on the locomotive are equipped with motors and the entire weight is, therefore, available for traction.

Starting this train on the 2 per cent grade, assuming the slow accelerating rate of one-third of a mile an hour per second, would require an additional tractive effort of $\frac{92.3}{3}$ = 30.8 lbs. per ton, a total of 11,543 lbs. This would necessitate using a 35-ton locomotive and the total tractive effort in this case is 16.8 per cent of the weight of the locomotive, or 35 tons.

The following table is based on the results of a series of tests and shows, in a general way, the variation in the tractive coefficient under different conditions:

TRACTIVE COEFFICIENT

	Per cent	Sanded, Per cent
Dry rail	28	28
Thoroughly wet rail	20	25
Greasy moist rail	15	25

With ice or snow on the rails the coefficient may be even lower, while the rolling friction at the same time may be largely increased on account of the snow. With this fact in mind the value of four-motor equipments, even for single cars, is evident, especially on suburban service where the cars run through an open country exposed to snow and ice.

AVERAGE ENERGY

To approximate the capacity of the power station for any given service the average energy required may be assumed as 100 watt hours per ton mile of schedule speed. As an example, assume a schedule speed of 12 miles per hour and a car weighing 15 tons. The average kilowatt rate of energy consumption per car would be
100 watt hrs. × 15 tons × 12 m.p.h. = 18,000 watts = 18 kw.

The figure of 100 watt hours per ton mile of schedule speed is generally correct for the ordinary conditions of city and suburban service. If the stops are a mile or more apart, the energy consumption may be as low as 60 watt hours or 70 watt hours, while frequent stops and very high schedule speeds may increase this figure to 120 watt hours or even more.

The Westinghouse Electro-Pneumatic System for Controlling Railway and Other Motors

It is a well known fact that under certain conditions in electric train operation, important advantages arise in the ability to simultaneously control, from either end of a train, all the motors of the several cars of a train. This problem has been undertaken by Geo. Westinghouse, who has invented and personally developed, at the works of the Westinghouse Air Brake Company, at Wilmerding, near Pittsburgh, Pa., an electro-pneumatic system of motor control. This system is covered by United States and foreign patents, which have been granted to Mr. Westinghouse, and involves the use of compressed air for moving the controlling apparatus, the admission of the air to the several parts being effected electrically by means of magnets attached to the air valves. The reliability of pneumatically operated apparatus has been demonstrated by years of service in railway work. In fact, the air-transmitting and applying apparatus, and the electro-magnetic devices employed in this system of control are standard parts manufactured respectively by the Westinghouse Air Brake Company and the Union Switch & Signal Company. In this respect the Westinghouse method will possess in advance the confidence of railway managers who have had experience with the use of these appliances.

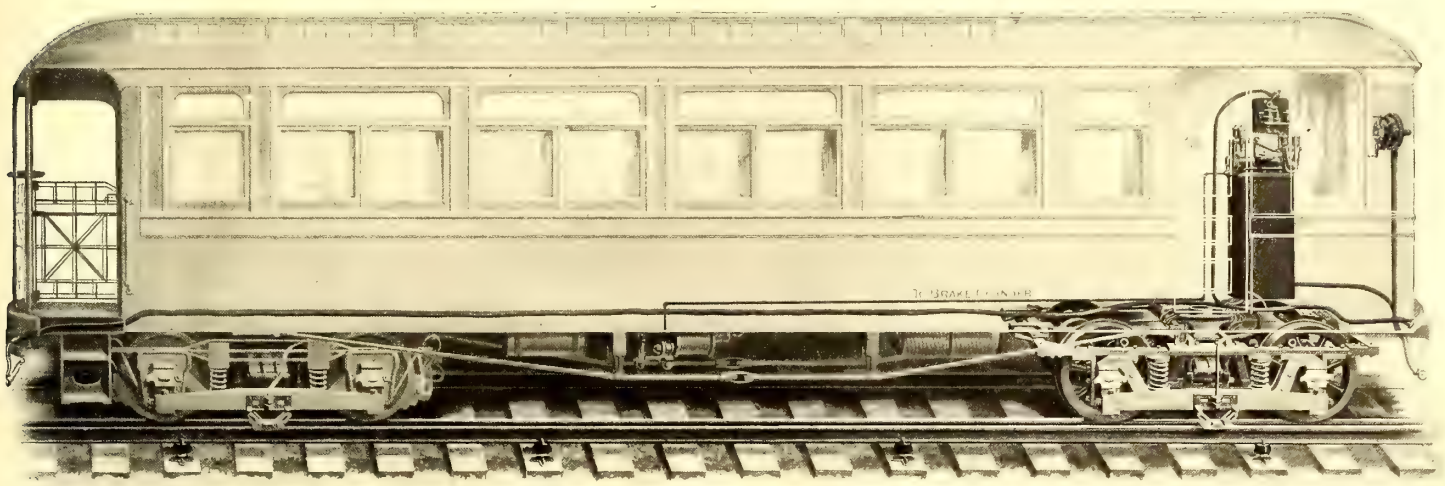


FIG. 1.—CAR EQUIPPED WITH ELECTRO-PNEUMATIC SYSTEM OF CONTROL



FIG. 2.—TRAIN OF CARS AT PITTSBURGH, FITTED WITH ELECTRO-PNEUMATIC SYSTEM OF CONTROL

This system is adapted for use on any number of motor cars per train. Each motor car requires the usual current collecting and controlling devices. A full complement of air compressing and

storage apparatus is employed on at least one car, and auxiliary storage apparatus on each motor car.

The controller proper may be of any standard type designed for railroad work. Instead of the usual hand lever, however, a pneumatic operating mechanism is used, which may be adapted to any form or design of controller. The automatic circuit breaker in connection with each controller may also be of a standard type, and is provided with an operating device similar to that for the controller.

The air is taken from the reservoir which supplies the brakes, and the electric current for operating the magnets is obtained from a small primary or secondary battery. The operation of the controlling apparatus is therefore independent of the power circuit, except in so far as the reservoir is periodically charged by the motor-driven pump, receiving current from the power circuit.

The devices for operating the controller and circuit breaker do the work which normally devolves upon the motorman with the ordinary system of hand control and in precisely the same way, i. e., the controller is moved from notch to notch at the will of the operator. The controller, therefore, may be placed upon any notch and kept there as long as desired, and the movement over a complete cycle may be made either slowly or quickly, as the condition of the rails, load, grades, etc., may require.

A general idea of the construction of the apparatus used can be secured from the accompanying engravings.

Upon the extended end of the shaft of the main operating drum of the controller, in place of the handle, are mounted two ratchet wheels and a pinion, as shown in Figs. 3 and 4. Upon the top of the controller frame are mounted two air cylinders. The shorter of these two cylinders contains the piston for operating the pawls, which engage in ratchet wheels. The piston rod of the longer cylinder is provided with a rack which meshes with the pinion. Both of these cylinders are single acting, and are so mounted as to produce opposite direction of rotation of the controlling drum. To the upper part of the cylinders are attached the iron-clad magnets for operating the air valves.

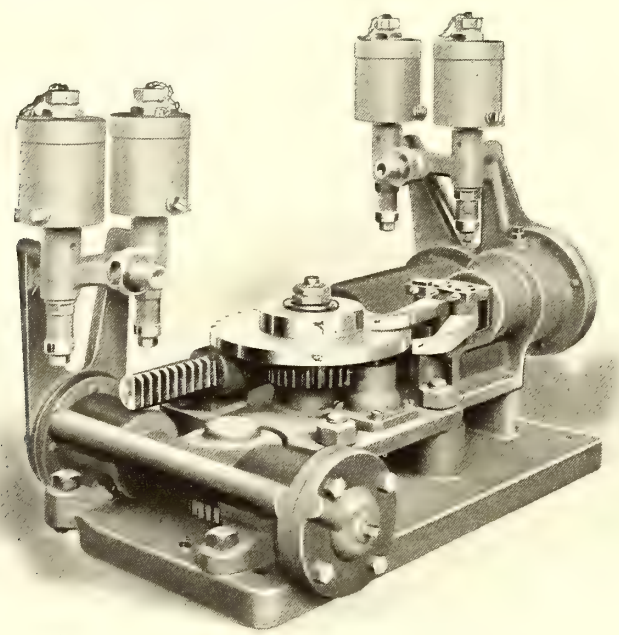


FIG. 3.—PNEUMATIC MECHANISM ON TOP OF CONTROLLER

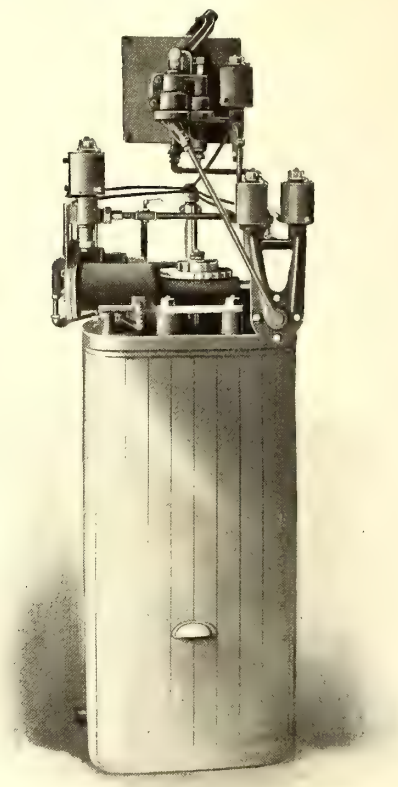


FIG. 4.—COMPLETE CONTROLLER

A single stroke of the ratchet piston turns the controller "on" one point, hence this piston must make as many strokes in turning the controller "full on," as there are operating points or notches. Two pawls and ratchet wheels are employed only in cases where movement steps of different lengths are desired. In such cases simplicity and certainty of operation are insured by employing ratchet wheels of different diameters and actuating them by pawls having an invariable stroke.

To prevent the inertia of the controller drum from carrying it further than is intended with any given impulse, the ratchet wheel is provided on the under side with a series of projections. A stop attached to the frame is made to successively engage the several projections by the air pressure in the cylinder which operates the pawls. Hence, whenever air is admitted to the operating cylinder, the stop is brought into position by the time the pawls have completed their stroke and the controller drum is thus prevented from turning too far.

When air is admitted to the long cylinder, the piston is forced to the end of its stroke, which throws the controller to "off" position. The action of this cylinder is independent of the position of the controller at the time the air is admitted, the piston making either a full stroke, or a part of a stroke, depending upon the position of the controller.

The shaft of the reverse switch is also extended above the controller top and carries a pinion. The rack which engages the pinion is formed on a piston rod having at each end a small piston, which works in a corresponding cylinder. Upon one of these cylinders are mounted two magnets and the necessary valves for controlling the admission of air through suitable ports to either of the two cylinders. Air admitted into one cylinder will set the reverse switch in the position for giving a forward movement to the car, and when admitted into the other cylinder will set the reverse switch for a backward movement of the car.

The mechanical interlocking device of the standard controller serves to prevent the motorman from reversing the controller with the current on.

The circuit breaker is of the usual canopy type, for opening the circuit either automatically through the action of an excess of current or by hand. This circuit breaker is provided with two cylinders having pistons and rods arranged to act upon a lever for closing and opening the circuit breaker. The larger of the two cylinders is for closing the circuit breaker and receives air from the reversing switch cylinders on the controller. When the air is admitted to either of the reversing switch cylinders, air is also supplied to the closing cylinder of the circuit breaker. The smaller cylinder on the circuit breaker is for opening the circuit, the air being suplied to this cylinder by means of a magnet and valve similar to those used on the controller.

The details of the electro-magnets for operating air valves are carefully worked out. The coil is imbedded between an iron core and an iron shell, and the armature, which consists of a circular iron disc, partially completes the magnetic circuit between the upper ends of the core and shell. A suitable air gap is maintained by means of a spring washer bearing against the armature. When the circuit is closed, the armature is attracted, compressing the

spring washer and opening the air valve below the magnet by means of a brass rod attached to the armature. The valve is provided with a spring for keeping it normally in the closed position.

These magnets require but one-twentieth of an ampere at 6 to 8 volts. A battery of ten or twelve cells is sufficient for a train of five cars and will last a long time. Each motor car is provided with one of these batteries.

The controller and circuit breaker may be mounted anywhere on the motor car, but should be placed in an accessible place on account of inspection and repairs. For this reason it is always preferable to place the controller in the motorman's compartment or in a special compartment provided for the purpose.

To operate the controlling apparatus of each motor car of a train, from any specified place on the train (say either end of any motor car), a multiple control switch is required. With this switch the motorman makes or breaks the electric circuit from the battery through the several air valve magnets on all the cars of the train.

The multiple control switch, Fig. 5, consists of a cylindrical metal box provided with three handles and contains the several switches in circuit with the controlling magnets. The lower handle, shown in the illustration, controls the circuits to the magnets supplying air to the main operating and release cylinders on the controller. This handle is removable and designed to close the main battery circuit leading to all the switches contained in the box, when the handle is in place, and to open this circuit when the handle is removed; hence it is impossible to operate any part of the controller when this handle is removed from the box.

A single movement of this handle to the right closes the circuit to the magnet of the operating cylinder, which admits air and turns the controller "on" one notch. The position of the controller is indicated by the position of the index on the face of the box. It is, therefore, necessary to move this handle to the right and back to the middle position as many times as there are notches of operating points on the controller in order to move the controller to the full speed running position. To release the controller, this handle must be turned to the left, thereby closing the circuit to the magnet of the release cylinder. The magnet circuit is not opened by bringing the handle back to the middle position, but when the controller is fully released, air from the release cylinder is delivered through a suitable pipe to a small cylinder and piston in the multiple control switch, whereby the magnet circuit is opened, and the index on the face of the box turned to the "off" position. The air is not admitted to this cylinder until the release cylinder on the controller has completed its stroke, i. e., until the controller has entirely shut off the power from the motors.

The upper handle, shown in the cut, is for operating the reverse switch of the controller. To give a forward movement to the car, this handle is turned to the right slightly beyond the position shown. This closes the battery circuit through the magnet, which operates the valve supplying air to one of the reversing cylinders on the controller. To give a backward movement to the car, the handle is turned to the left. This similarly admits air to the other reversing cylinder on the controller. The handle will remain in either position, thereby indicating the direction in which the car will move.

The small handle at the right side of the box is attached to a cut-out switch, whereby a part of the controllers on the train may be cut out of service. When the handle is thrown upward to its extreme position, the motor car upon which the box is mounted is in service, the other motor cars being out of service; when the handle is thrown downward to the extreme position the motor car upon which the box is mounted is out of service, and the other motor cars are doing the work; and when the handle is placed in the middle position, all the motor cars of the train are in service.

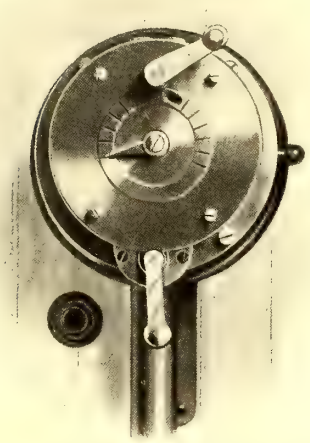


FIG. 5.—MULTIPLE CONTROL SWITCH

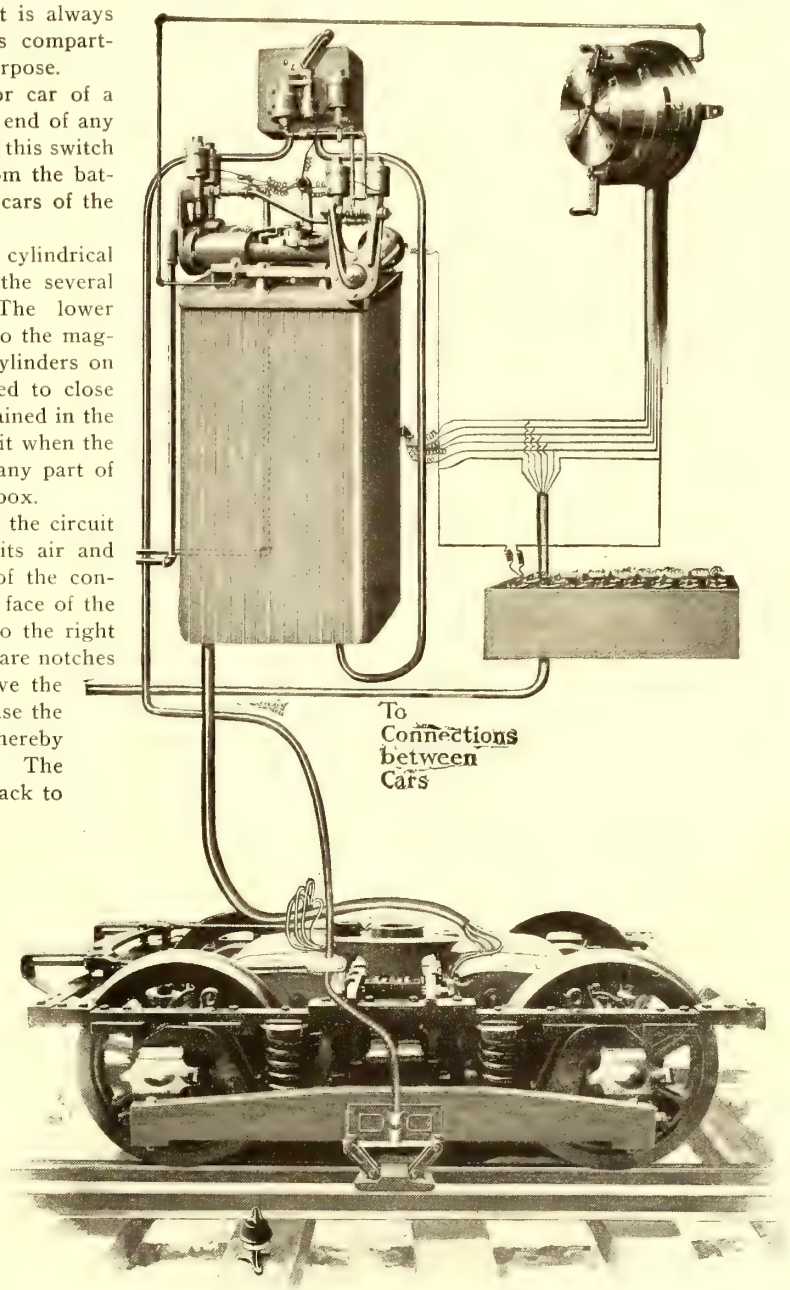


FIG. 6.—ARRANGEMENT OF CAB CONNECTIONS

The multiple control switch is mounted on a wooden base provided with sockets, in which plugs on the back of the switch engage. All parts are made interchangeable, so that any switch can be mounted on any back, the electric and air connections being permanently made to the base, and the connections with the switch made through the plugs and sockets. In this way a switch can be dismounted by simply removing four screws without disturbing the permanent wire or pipe connections.

A simple push button is mounted near the multiple control switch for opening the circuit breaker when desired. This simply closes the battery circuit through the tripping magnet on the circuit breaker.

An ingenious emergency device is also provided in connection

with this system. This consists of an air connection between the automatic air brake cylinder and the release cylinder on the controller. This is so arranged that whenever the air brake is applied the controller will be released by the air pressure from the brake cylinder, if this has not already been done by the operator. Such a device is of great value in case of accident or other contingency requiring emergency application of the air brakes, since it is not necessary to first release the controller before applying the brakes, but a single movement of the brake valve serves to open the motor circuit by effecting the return of the controller drum to the "off" position, and at the same time to apply the brakes.

It is also readily seen that this system of electro-pneumatic control may easily be adapted to other features of train operation, such as opening and closing ventilators, operating whistles and bells as signals or sanding track rails for traction. With motors on several cars of a train there is a special demand for such a means of sanding the track rails. This feature, as already developed in the cars now in operation at Pittsburgh, involves the use of a pneumatic sanding device, whereby an air jet is used for delivering the sand upon the track in front of the wheels, the supply of air being controlled by means of magnets similar to those used on the motor controlling apparatus, and an additional circuit passing through the train.

As an additional safety precaution, a device may be attached to the operating handle of the multiple control switch which will throw this handle to the release position and shut off the power from the train when the motorman removes his hand from the handle. A similar device may be attached to the handle of the brake valve, whereby the brakes will be applied and the power also shut off at the controller when the motorman removes his hand from the handle of the brake valve.

A diagram of the complete system for two cars with all connections is given in Fig. 7. In this, 1 is the controller; 2, the operating air cylinder for turning the controller in a forward direction; 3, the cylinder for turning it in a reverse direction; 4, the reservoir; 5, multiple controlling switch; 6, the rotary compressor; 7, the motor for operating the compressor; 8, the engineer's brake valve; 9, the main circuit breaker; 10, the air brake cylinder; 11, the circuit breaker for the compressor motor circuit.

When this system of control is applied to elevated railways the best results may often be obtained by equipping only the front and rear cars of each train. The number of motor cars required to operate a given road may be thus kept at a reasonable minimum and a considerable amount of time and cost of operation saved by thus abolishing the necessity of shunting and relaying motor cars at terminal stations. The number of cars per train may be varied by changing the number of ordinary cars between the two motor cars, this being accomplished with but slightly more effort than that involved in adding trailers to the end of a train.

Where this method of operating trains is adopted, it is necessary to provide the controlling apparatus for motors and air brakes at one end of each motor car only, that end being always either the leading or trailing end of the train. In this way a larger compartment can generally be provided for the motorman, in which may be installed, not only the operating apparatus, but also the controller proper, the circuit breaker and the air compressor, with necessary reservoir and accessory apparatus.

The advantages of the quick acting automatic air brake, manufactured by the Westinghouse Air Brake Company, are so well known to railway men as to scarcely need mention here. As an emergency brake in case of accident, it is especially valuable on account of its quick operation. There is also a great saving in the time required in making ordinary service stops, particularly in cases where it is necessary to bring the train to a stop with accuracy at a certain point of the station platform. Under such conditions trains in daily service, equipped with the automatic air brake, are being stopped from a speed of 30 miles per hour, in a distance of 400 ft. to 500 ft.; and from 20 miles an hour, in 275 ft. to 300 ft. With the Westinghouse air brake and the Westinghouse electro-pneumatic system of control, dangerous results from a train "breaking in two" are also entirely eliminated. When the cars part the air connection is broken, causing an emergency application of the brakes on both sections of the train. This in turn shuts off the power by means of the pneumatic connection between brake cylinders and controller, releasing the cylinders described above.

Another interesting and novel feature of the Westinghouse electro-pneumatic system of control is the compressor used. As is well known, all motor-driven air pumps, heretofore, have been of the reciprocating type, involving the use of gears. The Westinghouse pump, used with the equipment mentioned above, is of the compound rotary type, and consists essentially of a drum mounted eccentrically in a cylinder, and provided with radically moving pistons or piston slides, according to the usual rotary

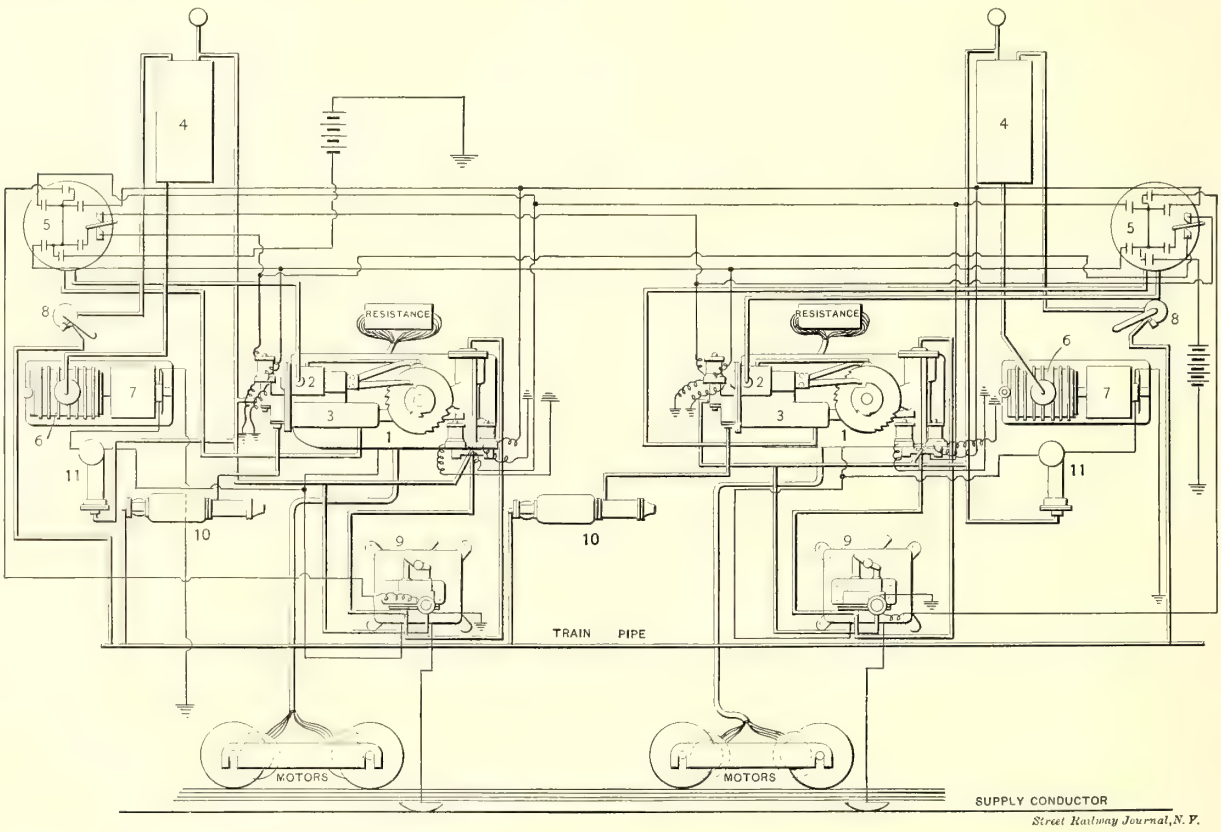


FIG. 7.—DIAGRAMMATIC VIEW OF ALL ELECTRIC AND PNEUMATIC CONNECTIONS ON TWO-MOTOR CARS

pump and engine practice. Mr. Westinghouse, however, has also introduced what is termed a balancing ring, for reducing the friction between the moving piston slides and the inner surface of the cylinder, as well as means for injecting oil at different points and pressures for lubricating and packing purposes. The armature of the driving motor is mounted directly on the pump shaft, and the whole outfit is compact and substantial in construction. These pumps, which are illustrated in this connection, are giving marked satisfaction in all places where they have been installed.

A fully equipped elevated railway train, designed as a model for

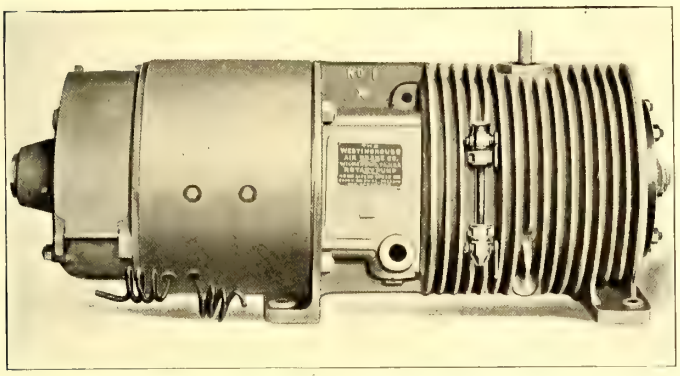


FIG. 8.—MOTOR AND ROTARY AIR COMPRESSOR

such service, is also in operation upon the experimental tracks between the factories of the Westinghouse Electric & Manufacturing Company, at East Pittsburgh, and the Westinghouse Air Brake Company, at Wilmerding, Pa.

This train is operated by two motor cars designed with special reference to the requirements of electric traction on elevated structures. Each motor car is equipped with two 150-h.p. Westinghouse motors, mounted on the same truck, which is placed under the front end of the motor car.

The trucks, which are illustrated in Figs. 9 and 10, have been specially designed for heavy electric railway service of this kind by the Baldwin Locomotive Works, and have a number of special features. As will be seen, they are very similar in general features to the standard M. C. B. truck, but vary somewhat to fit them for electric railway service. The main points considered in their design were simplicity of arrangement and facility of inspecting and removing the motors. By removing four thimble bolts under the pedestal and by disconnecting the motor cables the entire upper half of the truck can be removed from the lower part, as shown in Fig. 10. This leaves the axle, motors and side suspension bars entirely exposed, so that they can be easily inspected.

It will also be noticed that the motor spring suspension is entirely separate from the car spring system, the motor being supported on separate side bars, as shown in Fig. 10. This enables the traffic manager to graduate the system of springs supporting the car body to any extent desired, making a very easy riding car. The dimensions of the truck illustrated are as follows:

Wheel base, 6 ft.
Diameter of wheels, 36 ins.
Kind of wheel, steel tired with wrought iron spoke centers.
Axles, best hammered iron.
Diameter of axle center, 6½ ins.
Diameter of axle gear seat, 7½ ins.
Diameter of axle wheel seat, 7½ ins.
Journals, 4¼ ins. x 8 ins.

Another novel feature of the truck is that the gears are pressed on to the axles and keyed. This practice of pressing the gears on the axles was followed to avoid any possible weakness in split gears which might develop in transmission of the large amount of power required in equipments of this kind. In fact, it is claimed that it is practically impossible to make a split gear of sufficient size to accommodate the proper number of bolts to hold the two halves together. To press the gear off it is, of course, necessary to first remove the wheel and afterward press it on again. This can be done, however, several times without destroying the fit. As two gears will probably outwear one axle, this operation, however, will occur only once in the life of an axle. The weight of the motor truck, complete with special suspensions described, but without motors, is 10,000 lbs.

Mention should also be made of the construction of the motor end of the cars, which is of special type, to secure plenty of room above the motors without elevating the car floor more than was absolutely necessary. The floor framing at the end over the truck carrying the motors is covered with ½-in. steel plate, extending from the end sill to the inner end of the truck. The center sills of the car are two 4-in. I beams extending the entire length of the car, and the side sills are 3½-in. x 8-in. wood, reinforced on the inside by 6-in. channels. This method of construction makes an exceedingly strong car end and provides the maximum amount of room underneath the floor of the motors and trucks with any given height of car platform. The standard height of an elevated car platform is 42 ins. above the rail, and with this construction of car this height can be maintained, when using the largest size of motor which can be designed for a standard gage track. These cars were built by theWason Manufacturing Company, of Springfield.

The weight of the motor car, as equipped at East Pittsburgh, having two 150-h.p. motors on one truck and a trail truck at the other end of car, is:

	Motor Truck End	Trail Truck End
Light weight	41,000 lbs.	19,500 lbs.
Loaded weight (90 passengers at 140 lbs.)	47,000 lbs.	26,500 lbs.
Total weight loaded car	73,500 lbs.	

The motors are designed especially for elevated and suburban railway service. A new type of suspension is used whereby the motors are supported through suitable springs from the axles of the truck, and not from the frame of the truck. With this arrangement the truck springs are designed to carry the car body only, thereby obtaining as good riding conditions as can be secured on any ordinary passenger car.

In the front end sill of each motor car is inserted a Westinghouse friction buffer, securely anchored to the steel framing. This buffer comes into use in times of collision only, and is completely compressed with only 100 tons pressure, and has a travel of 2¼ ins.

The motorman's compartment occupies the entire end of the

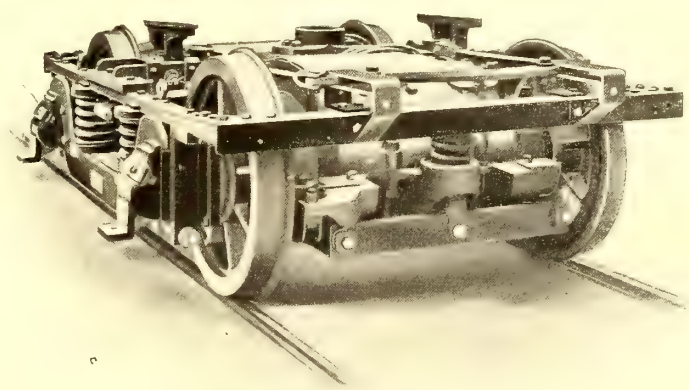


FIG. 9.—END VIEW OF TRUCK

motor car, and is separated from the passenger section of the motor car by a heavy partition, placed just in front of the center line of truck. A door is provided on each side of the passenger section, next to this partition, for the ingress and egress of passengers. The compartment contains the controller, circuit breaker and multiple control switch; also the rotary air compressor, with direct connected motor and main reservoir, and the motorman's valve for controlling the automatic air brakes. This arrangement brings all the accessory parts of the apparatus together in a place where the motorman can easily inspect them, and where the parts can readily be cleaned and repaired.

The resistance used in connection with the standard controller is mounted underneath the car body, and all the wiring is enclosed in iron armored conduits. Sand boxes are placed under the seats of the car, and the electro-pneumatic system of applying the sand to the rails is used. The cars are also equipped with electric heaters placed under the car seats, and with electric lights distributed above the windows along both sides of the car.

Suitable contact shoes are provided for collecting the current from a third rail. The shoes are mounted on the motor cars only, and the heaters and lights on the trailers are supplied through suitable flexible connectors between the cars. One of these motor cars is used at each end of the train, the compartment end of the motor car being always either the leading or trailing end of train. Wires and connectors, already described, for simultaneously operating the controllers, circuit breakers and sanding devices on both motor cars from the compartment of either motor car, are also provided on all cars. Each of these motor cars, without passenger load, weighs about 60,000 lbs., the weight of the motor end being 41,000 lbs., and the other end 19,000 lbs.

Upon the same experimental road, between East Pittsburgh and Wilmerding, are also operated two very heavy motor cars, each equipped with four 150-h.p. motors, and two controllers operated by means of the Westinghouse electro-pneumatic system of control. These cars are also equipped with air pumps and quick action air brakes, and are constructed for operating heavy suburban trains, running at high speed and making frequent stops.

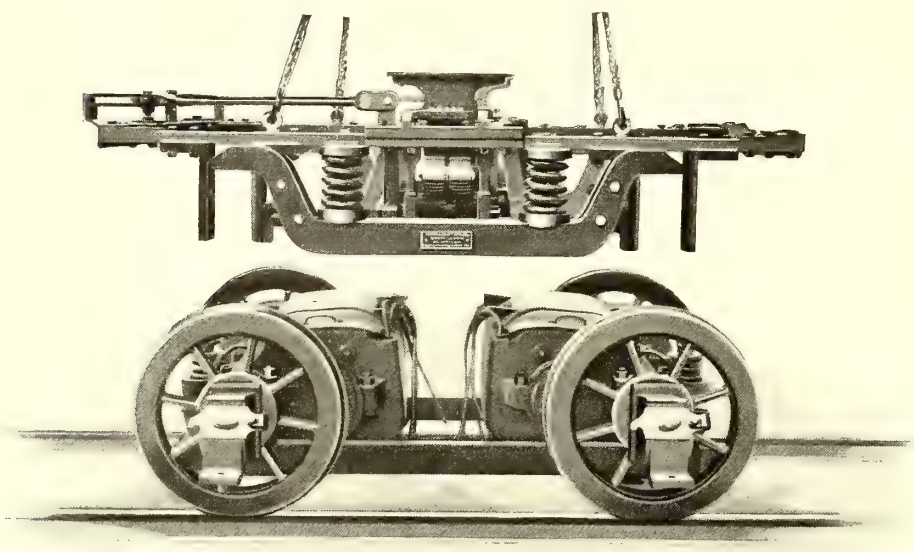


FIG. 10.—VIEW OF TRUCK WITH UPPER PART REMOVED, EXPOSING THE MOTORS FOR INSPECTION

By reason of the close business relations which obtain among the Westinghouse Companies and an existing working agreement with the Baldwin Locomotive Works, substantially all the parts of a complete equipment, except the car body, are manufactured by associated interests. It is, therefore, possible to provide a complete equipment, all the elements of which are designed to harmonize and properly co-operate with each other.

Telephones for Electric Traction Systems

The General Electric Company, Limited, of 39 Victoria Street, London, is making a large number of telephones for electric traction systems, and for this purpose has designed an instrument of an efficient type and yet one which occupies a minimum space, the latter being a most important requirement. In order to obtain this end, the instruments, while of the usual character, including microphone, receiver and induction coil, are so connected that in the boxes on the line poles no batteries are required. thus, at the outset, effecting not only a considerable saving of expense, but also a most important economy of space. All instruments to be installed in such places are thoroughly protected against any possible injury from the weather or damp. The internal connections having been made, the containing case is filled in solid with pitch, making a permanent and substantial job; the flexible cord between the telephone and containing case is well waxed, and then drawn through a thick rubber tubing. The microphone is absolutely watertight and could be submerged in water for many hours without injury, and the receiver has its coils surrounded by paraffine wax poured in in a molten condition.

A Large Manufacturer of Electrical Goods

The American Steel & Wire Company, contrary to the impression which might be created by its name, is by no means confined to the production of iron and steel wires or their products. By the absorption of the Washburn-Moen Manufacturing Company the larger organization inherited one of the world's most important manufactories of bare and insulated copper wires in various forms and for all electrical purposes.

With the immense plant at Waukegan, Ill., only 35 miles north of Chicago, at which much of the copper wire is produced, the American Company enjoys exceptional facilities for catering to the wants of the trade in the West, giving, as it does, to this organization the same prestige in occupying the Western field that is enjoyed by the Washburn-Moen department at Worcester, Mass., in Eastern territory. These statements are made on the assumption that they will be news in the commercial and manufacturing world having been so numerous to many readers, the recent changes and kaleidscopic that many, even among the large users of their products, have not become familiar with the new scope of their operations.

In every line of production certain names come to stand out in bold relief as synonyms for some characteristics of excellence. In the production of electrical wire, bare and insulated, the introduction of improvements calculated to secure best results and in uniformity of excellence, no name has ever stood higher than that of Washburn-Moen. The merging of this company into the American Steel & Wire Company means simply that, with unlimited resources, continued investigation and improvements are assured in the production of all forms of electrical wires, rail bonds, etc.

At the Waukegan plant special attention is given to the manufacture of the well-known "extra BB," "BB" and "steel" telephone and telegraph wires and copper wires for electric lighting and street railway plants in all their various forms, and the system of tests at every stage of the manufacture of these goods is at once so unique and rigid that the high standard set for all the products of this company is always maintained. Purity, conductivity, tensile strength, finish and uniformity to gage, are all given due attention, resulting in the output of millions of pounds, distributed among all the nations of the earth in the operation of the great telephone, telegraph and electrical traction systems.

In the production of copper rail bonds, either solid or flexible, the prestige of the Washburn-Moen name has been added to, since the formation of the American Steel & Wire Company, and the output of solid and flexible "crown" bonds in a variety of patterns and for adjustment to the rails in various positions has been marvelous. This is equally true of the manufacture and sale of copper trolley wire, in which this company has earned a commanding position.

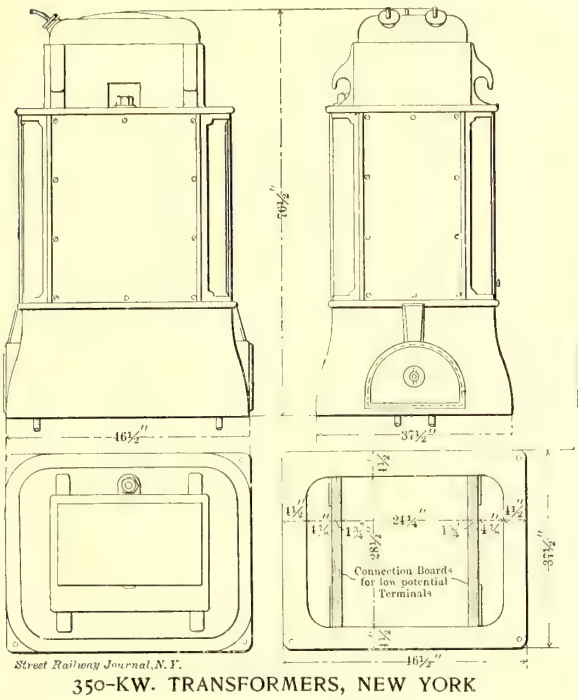
In the department of insulated wires, the entire line, including every form of magnet wire, office and annunciator wire, weatherproof wire, feeder wires, lead incased wires and cables, and submarine cables, is thoroughly covered, the rubber insulating, taping, braiding, lead incasing, armoring and weather-proofiing being carried on under the supervision of the most expert scientific skill and experience that can be secured.

The general offices of the company are located in "The Rookery," Chicago, with branch offices in New York, Worcester, St. Paul, St. Louis, Cleveland, Denver, San Francisco and other cities.

It is stated that the New London Street Railway Company contemplates extending its lines to Niantic.

Apparatus for Power Transmission in New York

Long distance power transmission systems for railway work, as a rule, involve the use of three distinct types of apparatus, i.e., an alternating current generator, preferably of the three-phase type, by which mechanical energy is converted into electrical energy of the desired potential and frequency; step-up transformers to raise the potential of the generated current to that most effective for transmission over the line, with similar step-down transformers at the sub-station for reducing the line potential; and rotary converters for transforming the multiphase alternating current into



350-KW. TRANSFORMERS, NEW YORK

direct current of suitable voltage. In large systems where the distances are not so great as to demand an excessively high voltage, it is frequently found desirable to generate the current at the potential of the high tension transmission line, thus dispensing with step-up transformers and resulting in a simplification of the switchboard and wiring in addition to a considerable decrease in the initial cost of the plant.

A typical system of this character equipped with modern apparatus is that of the Metropolitan Street Railway Company, of New York City, now being installed by the General Electric Company. Some particulars of this station were published last month, and a map showing the location of the sub-stations was given.

The alternating current generators in this power station are of the revolving field type with external stationary armature, and are direct connected to Allis vertical compound engines. They have a normal capacity of 3500 kw., and generate three-phase current of 6600 volts at a frequency of 25 cycles and operate at a speed of 75 r.p.m. The internal revolving field ring carries forty poles, and is mounted directly on the engine shaft. The armature core is built up of soft sheet iron punchings, thoroughly japanned before assembling to prevent eddy current losses, and further insulated by sheets of paper inserted at suitable intervals.

The winding is placed in slots punched in the inner circumference, which are recessed for the insertion of wooden wedges to hold the winding firmly in place. The discs are firmly secured to the frame by dove-tailed projections fitted into corresponding recesses. Ventilating spaces properly placed allow a free circulation of air through the core in direct contact with the core and coils. The armature winding consists of separate coils accurately formed, and the construction is such as to allow any defective or burned out coil to be readily removed and replaced without disturbing more than a few adjacent coils. The coils are connected to the terminals by insulated conductors passing through holes in the projecting shields. After assembling, a high potential alternating current of 25,000 volts is applied to the winding for one minute.

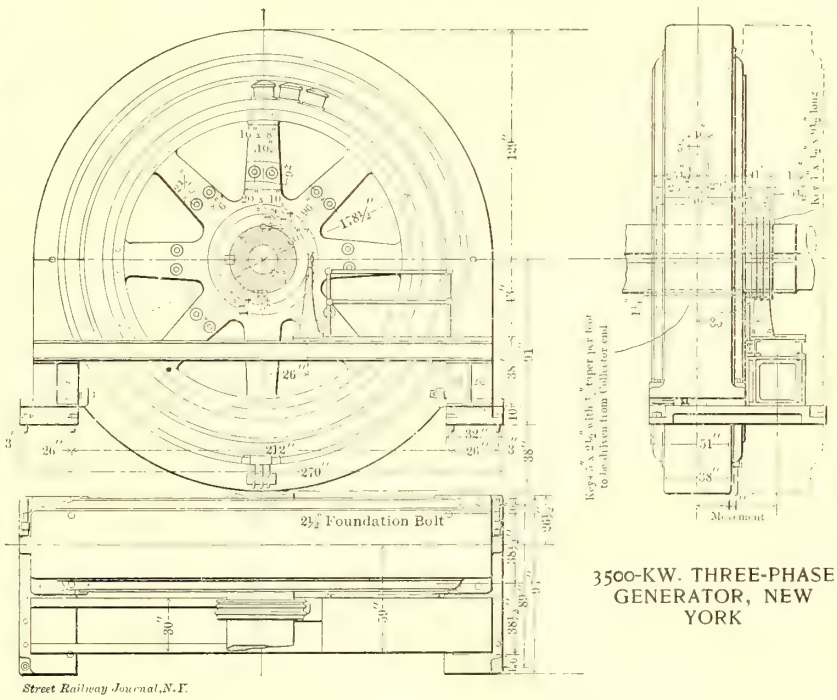
The cast iron armature frame is arranged with sliding foundation plates, so that it may be moved to one side until clear of the revolving field, thus permitting access for inspection and repairs to both armature and field. The frame is made in sections, which are securely joined together by double-headed keys.

The revolving field is composed of a steel ring divided in the middle, the two parts being fastened together by double-headed keys. This ring carries the magnet poles and coils, which are securely bolted thereto, and is firmly bolted to the cast iron spider, which in turn is securely keyed to the engine shaft.

The field poles are built up of soft sheet iron punchings bolted together. The coils are wound of soft copper strips on edge, so that one side of the copper is exposed directly to the air. Each coil is thoroughly protected by insulating collars, and is held firmly in place by the projecting horns of the pole pieces. The e.m.f. required for exciting the field circuit is normally 125 volts.

The exciting collectors consist of two insulated iron rings, well insulated. These rings, as well as the supporting shield, are made in halves, so that they may be replaced in case of accident. Carbon brushes are used to carry the current.

The step-down transformers at the rotary converter sub-stations are rated at 350 kw., and are connected delta, each bank of three transformers being used to operate one rotary converter. By this method of connection one transformer may be cut out in case of accident, and the rotary converter operated at reduced output from the other two.



3500-KW. THREE-PHASE GENERATOR, NEW YORK

The primary winding of the transformer is designed for a potential of 6000 volts, and the secondary for 350 volts, the ratio of transformation being 17.15.

The transformers are of the air cooled type, and consist of flat primary and secondary coils placed vertically and surrounded by a built up iron core. The core of the transformer is bolted to a substantial cast iron base, and a cast iron cap or cover, and is enclosed in a sheet iron casing; one side of the casing forms an air chamber for the supply of air to the transformers, and the other side is perforated to allow the escape of the heated air. The low potential terminals are located in the base and the high potential in the cap. Register gates at the top and on one side of the transformer provide for the control of the air supply.

The core is built up of laminated iron sheets carefully annealed and insulated from each other in order to reduce eddy current

losses. The primary and secondary windings are subdivided into several coils, each built up of flat conductors wound with but one turn per layer, so as to form a thin and high coil. Each coil is thoroughly insulated with a continuous wrapping separately treated with a special insulating compound, so as to form together a very durable and moisture-proof insulation capable of resisting a potential stress much greater than that for which the transformer is wound.

The conductor consists of a sufficient number of strands in both primary and secondary to effectually prevent any eddy current losses in the winding. A solid insulating diaphragm is rigidly held between the adjacent sections of the primary and secondary winding, so as to provide an air duct of equal width on each side. Frequent open spaces or ducts are also provided in the laminations so that air can be forced through the entire structure to maintain the low temperature necessary to avoid deterioration. The secondary terminals consist of substantial castings, into which the cables coming from the coils are sweated, and are provided with tapered holes suitably drilled for receiving the out-going cables. The primary terminals consist simply of cables with an approved form of union coupling for joining to the station wiring. This coupling is provided with a hard rubber insulating sleeve.

Before leaving the factory the insulation of each transformer is tested with an alternating e.m.f. of 12,000 volts between the primary winding and the core or case, and with volts between the secondary winding and other metallic parts of the transformer. The transformer has an efficiency at full load of 98.22 per cent.

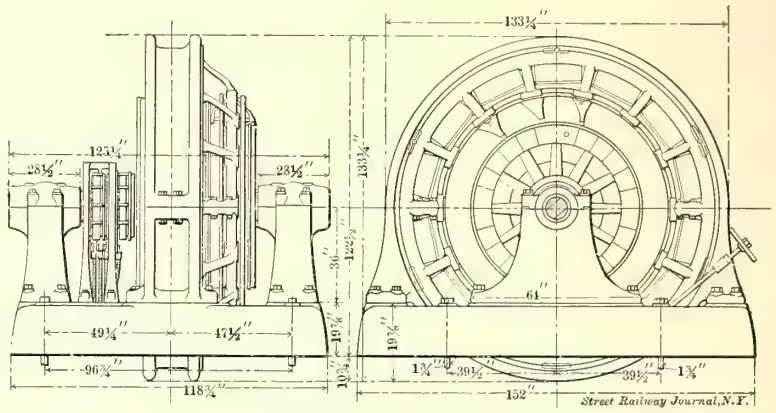
The regulation at full non-inductive load is .97 per cent, and the core loss 3970 watts. Each transformer requires approximately 1150 cu. ft. of air per minute at a pressure of ⅝ oz. for purposes of cooling.

The rotary converters in the sub-station are of the revolving armature type provided with six collector rings at one end, and a direct current commutator at the other end. The machines are rated at 990 kw. at 550 volts. When supplied with the necessary six-phase alternating current at 25 cycles per second the speed of the rotary converter is 214 r.p.m.

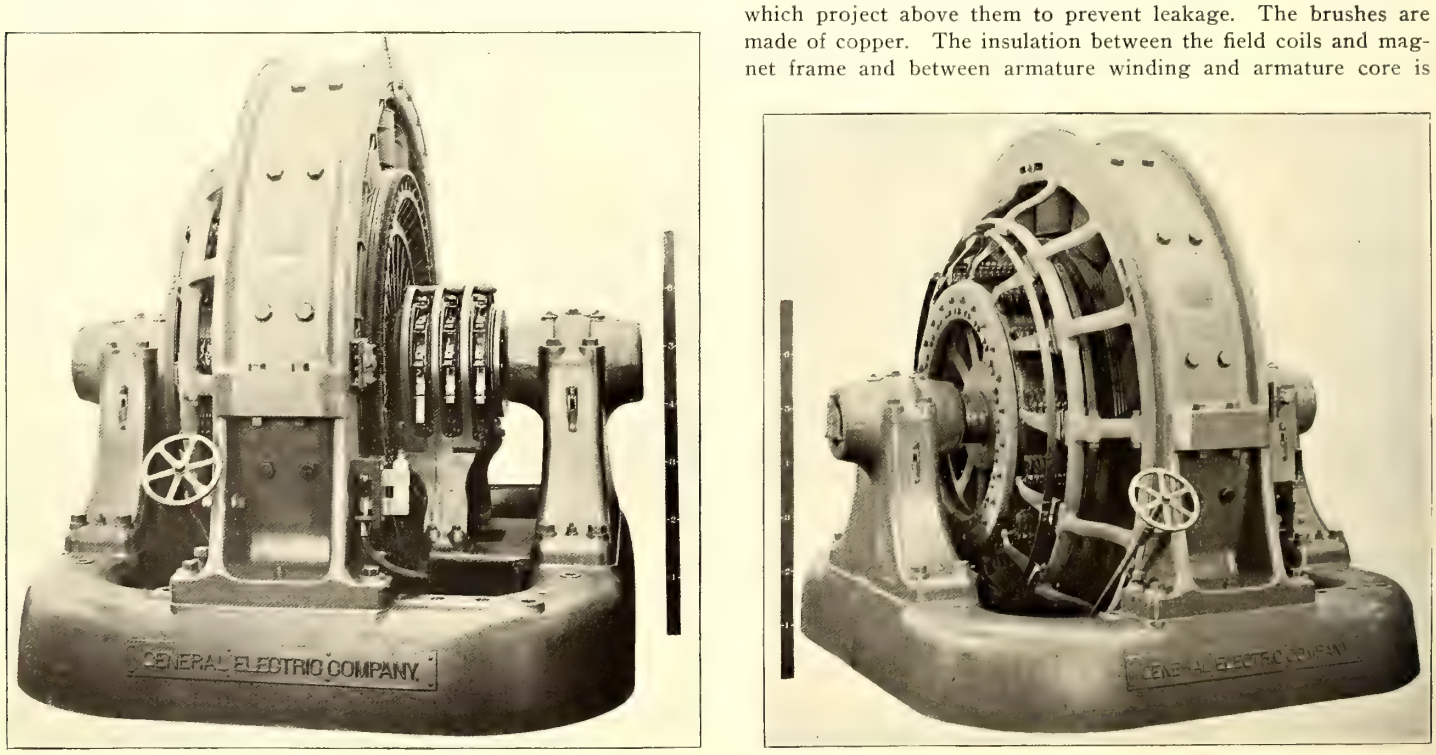
The magnetic circuit consists of a circular cast iron yoke with eighteen inwardly projecting poles made of cast steel. The poles and field coils are made removable without disturbing either the armature or the magnetic yoke. The field coils are wound on malleable iron spools, and are insulated with veneer board and oiled cotton.

The armature is of the iron-clad or slotted core type, and is thoroughly ventilated by means of air ducts suitably spaced. The spider is of cast iron, and the laminations or punchings are keyed thereto in such a way that no bolts pass through the core. In order to prevent eddy currents in the core the laminations are thoroughly insulated by a coating of japan on each sheet.

The armature winding consists of copper bars laid in slots, and insulated from the armature core by means of alternate layers of oiled linen and paper. The commutator is supported on the extension of the armature spider in such a way as to entirely avoid any relative movement of armature winding and commutator segments. Commutator segments are made of hard-drawn copper, insulated by sheet mica. Collector rings of cast copper, supported by a cast iron shell, and insulated therefrom by mica rings, are provided to carry the three-phase alternating current from the low potential side of the transformer to the armature winding of the rotary converter. These rings are further insulated from each other by wooden rings, which project above them to prevent leakage. The brushes are made of copper. The insulation between the field coils and magnet frame and between armature winding and armature core is designed to stand an insulation test of 5000 volts alternating current.



990-KW. ROTARY CONVERTER



SIDE AND END VIEWS OF ROTARY CONVERTERS

The rotary converter was found in test to give the following efficiencies, including losses in commutator, brushes, bearings, core and winding as six-phase machines:

Double load	96.8 per cent
Full load	96.0 per cent
One-half load	93.6 per cent

The regulation in potential at the direct current end of the rotary converter is obtained by means of reactances having a volt-

ampere capacity of 5 per cent of the capacity of the converter. These reactances are connected partly in the low potential side of the static transformers at the sub-station and partly in the high potential circuit at the generating station, these latter reactances or choking coils being designed to reduce the current taken by the generators in case of a short circuit on the line. A series winding is provided to automatically vary the field charge so as to obtain the desired adjustment of potential at the direct current end.

As a precaution against excessive speed of the rotary converter, due to the direct current and a weakened field, a centrifugal switch is mounted on the rotary converter shaft, which will open the switch in a circuit normally energized, and trip the automatic circuit breaker through which the direct current must pass in the event of the speed exceeding 20 per cent above normal.

The rotary converters are started from the direct current end by means of current furnished by storage batteries. This method insures starting the rotary with the right polarity, thus avoiding possible delay, and enabling the machine to be more readily synchronized.

New Type of Compound Engine

The accompanying engravings show a new type of compound engine, manufactured by the Chandler & Taylor Company, of Indianapolis. The principles upon which this engine is based are novel and are intended to secure a high rate of engine economy on widely varying loads, a condition of the greatest importance in electric railway service where the load is constantly fluctuating. The system adopted to accomplish this result has been carefully worked out by Mr. Rites, the well-known inventor of the inertia governor, which has been widely adopted in steam engine construction.

The generally adopted methods of compounding the cylinders of small and medium-sized steam engines may be divided into two classes. The first method is to connect both the high-pressure valve and the low-pressure valve to one eccentric under the control of the shaft governor. The other is to control with the governor the valves of the high-pressure cylinder only, and connect the low-pressure valve to an eccentric fixed on the shaft. In the first method both valves have the same relative stroke or travel, and this travel varies with the load on the engine. The effect of this arrangement is to vary the steam pressure in the receiver between the high and low-pressure cylinders, causing a high receiver pressure on light loads and a low receiver pressure on heavy loads. The use of the second method has a precisely opposite effect, that is, while the receiver pressure varies with different loads the pressure is low with light loads and high with heavy loads. It will be seen that in either case a variation of load produces a variation in the pressure of the receiver, and the effect of this is inimical to the efficiency of the engine, first, because it varies the distribution of the load between the cylinders, and, second, because it produces a great variation in the temperatures of the steam in the low-pressure cylinder, thus wiping out the advantages gained in compounding. The device employed on the Chandler & Taylor compound engine is intended to avoid this trouble by equally dividing the work between the two cylinders whether the engine is heavily or lightly loaded, and to do this by operating the low pressure valves by a compromise method between the two already described, that is, the low-pressure valve is partly under the control of a fixed eccentric and partly under the governor, and just enough under the control of each to vary the cut-off of this valve for different loads in such a manner as to maintain the pressure in the receiver constant under all loads within the capacity of the engine.

The arrangement adopted is illustrated in Fig. 2. The rocker arm is shown at *A*, and is attached to the high-pressure eccentric rod *B*, which is under the control of the governor. The rocker arm carries a link *F*, the upper end of which is connected to the low-pressure rod *C*, which is attached to an eccentric fixed on the shaft. The high-pressure valve rod *D* is driven directly by the eccentric rod *B*, but the low-pressure valve rod *E* is connected to the middle of the link *F*. In this way it partakes of a motion intermediate to that which would be given by either *B* or *C*, and thus imparts to the low-pressure valve the required amount of travel to keep the pressure in the receiver at a constant in its relation to the initial pressure in the high-pressure cylinder.

While the system of steam distribution in this engine is a very important one, and has been given prominence on account of its new features, there are other points in addition to the method of

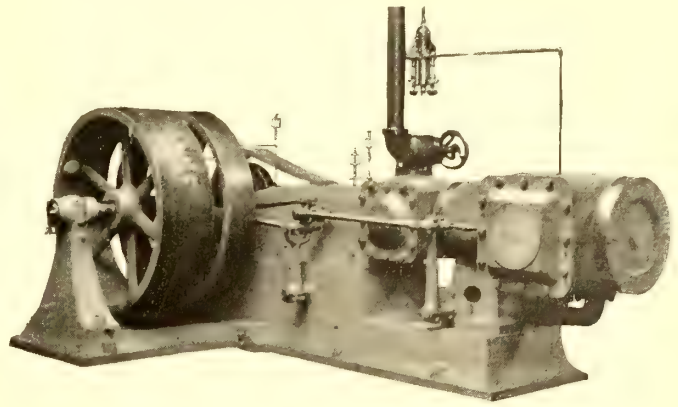


FIG. 1.—PERSPECTIVE VIEW OF ENGINE

compounding which merit attention. It is of a self-contained side crank type, mounted on a heavy sub-base which extends back into the distance piece to support the very heavy and substantial stand on which the distance piece is mounted. The arrangement of the cylinders is such that the pistons and rods can easily be withdrawn through the low-pressure cylinder without dismounting any part of the machine except the cylinder head. The pistons are threaded and the piston rods screwed into them, the piston rod being continuous from cross-head to the low-pressure

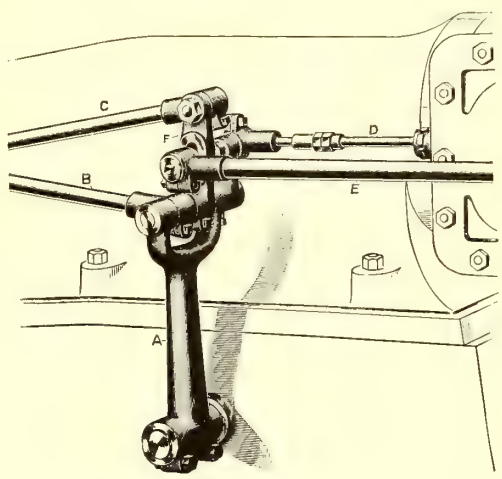


FIG. 2.—VALVE GEAR

cylinder. The piston rod is held securely in the piston by lock nuts and set screws. The cross-head is screwed on the rod and held secure by a clamp nut. The connecting rod is a steel forging, mortised to receive the brass babbitt lined boxes. The governor is of the Rites type. All engines are thoroughly tested before shipment.

An Automobile Publication

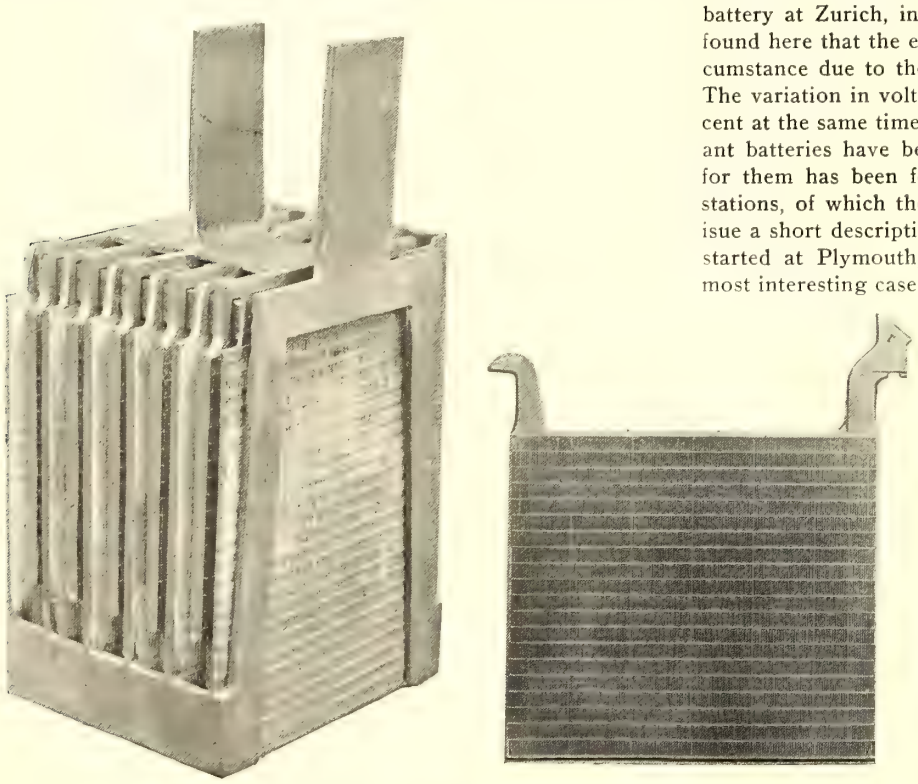
The E. L. Powers Company, of New York city, has issued No 1 of vol. 1 of a monthly periodical known as "The Automobile," and which will be devoted exclusively to the presentation in short concise articles of the latest information obtainable respecting the various uses of horseless carriages. Valuable points on the construction, operation and maintenance of these vehicles will be contained in each number.

Tudor Accumulators for Traction

The use of accumulators for electric traction may be divided under two headings: (1) stationary batteries at the generating or sub-stations, and (2) portable batteries on the cars or locomotives. It is very probable that in the future the use of accumulators in the first way will have a much wider application than the second, as though portable batteries have been very successfuly employed where trolley lines are not allowed or the traffic is insufficient for the capital outlay on the line, yet they can scarcely compete with the trolley in other cases.

The object of a stationary battery at the generating station is two-fold, it steadies the load on the engine under the varying outputs required on the line, and it helps over periods of heavy load, such as increased traffic, or in combined lighting and traction stations during lighting hours. Sub-station batteries, in addition, help to keep the voltage on the line steady at points distant from the generating station, in spite of the varying drop in volts. For all these purposes it is important to have a cell capable of withstanding high rates of charge and discharge, and of such cells it is an essential condition that they should be mechanically strong, and have Planté formed positive plates with large surface, so as to keep the current density per square inch as low as possible.

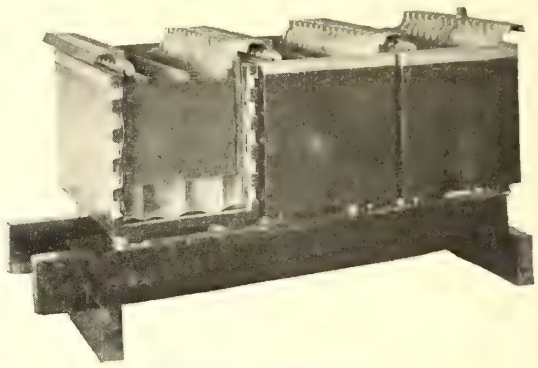
In the Tudor cells, which are now so largely used in traction stations in all countries, these points have been made a special feature; the positive plates are ½ in. thick, and are cast in one piece in a special mould, with fine vertical ribs to give a large surface, and stouter horizontal ribs at intervals to give the plate ample rigidity, as can be seen in the illustration. The surface is formed



TUDOR CELL AND SINGLE PLATE

by the original Planté process, i. e., with sulphuric acid only; the process is a slow one, taking about six weeks, but the coating of peroxide of lead that is produced in this way is even, homogeneous and thoroughly adherent, which is often not the case when the process is hastened. Further, every detail of the Tudor cell has been carefully studied with a view to giving it the greatest possible mechanical strength; thus the plates are suspended from above so as to be always in tension, and they are burnt singly to a common connecting bar after erection, no screws whatever being used in any part of the batteries. All suspending sheets, separators, etc., are of glass, and no materials other than glass and lead are used inside the cells; a space equal to one-third of the depth of the plates is left for the accumulation of peroxide, and the cells require cleaning only at very rare intervals. The method of mounting is shown herewith. From these few details it will be seen that the Tudor cells combine both durability and solidity, and that the cost of their maintenance should be very low; that this is the case can be judged from the fact that they are maintained in good condition, and their full output guaranteed under contract at rates varying from 3 to 6 per cent of their cost.

A small point to which attention may be drawn is the usual way of mounting Tudor cells on stands that are insulated from the earth by porcelain oil insulators; these are in addition to the oil insulators under each cell, and when it is remembered that one



BATTERY OF THREE CELLS

pole of the battery is directly connected to the earth, and that comparatively high voltages are used, it will be seen that this detail has its importance.

Tudor batteries were first used for traction stations in 1892, a battery at Zurich, in Switzerland, being one of the first. It was found here that the effect on the coal bill was most marked, a circumstance due to the steadying effect on the load of the engine. The variation in voltage on the line was reduced from 12 to 4 per cent at the same time. Since then similar and much more important batteries have been put down everywhere, and a further use for them has been found in the combined lighting and traction stations, of which they are an important part. Elsewhere in this isue a short description is published of one of these stations lately started at Plymouth, where Tudor batteries are used. Another most interesting case may be found at Rome, where the generating plant is water power, and the tram cars are entirely driven by the batteries during lighting hours; the batteries here have a capacity of 3500 kw. hours, and are charged by rotaries from the alternating current lighting plant. Among other batteries of the same system for traction in the United Kingdom may be mentioned Southampton Corporation and Middlesborough Tramways, Brighton Seashore Lines and the City & South London and Hill of Howth (Ireland) electric railways; in the two last cases the batteries are placed in sub-stations to keep up the volts on the line.

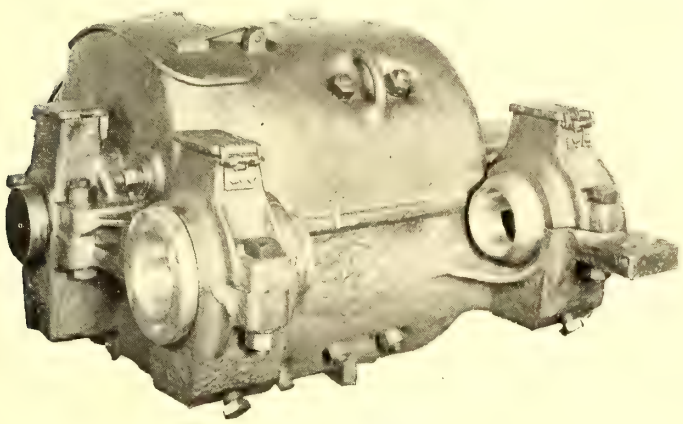
The second heading mentioned at the beginning of this article is too wide a subject to be discussed here at any length, but attention must be drawn to the novel way in which this problem has been attacked by the Tudor firms. Hitherto the two great obstacles to traction by portable cells on the cars have been weight and cost of maintenance. These two difficulties are closely linked together, as if the weight is reduced, the cell is less solid in construction, and, on the contrary, the most durable cells are the heaviest. The Tudor companies have availed themselves of the special capability of their cells to withstand high rates of discharge; they have kept their ordinary type of plate, of which the weight has been reduced as far as possible, but not so much as to compromise its durability. To reduce the weight of the battery, they only give it sufficient capacity for one trip, on the completion of which they charge it up without removing it from the car, in less than a quarter of an hour. A further development of this system is the combined battery and trolley line, where the battery runs the car in the center of a town, and is recharged at constant

potential from the trolley line when the car gets outside. Portable Tudor cells have now been in use in this way for over four years, and the results, both in working and costs, have everywhere been satisfactory. The main office of the Tudor Accumulator Company is at 16 Victoria Street, London.

New Types of Street Railway Motors

The Westinghouse Electric & Manufacturing Company has recently designed and will soon place upon the market five new types of electric railway motors ranging in size from 20 h.p. to 150 h.p. These, with the existing standard motors, supply a complete set of motors, from 20 h.p. to 150 h.p., designed for all conditions of railway service.

The new motors, which are graded according to capacity, are entitled No. 69, No. 68, No. 56, No. 70 and No. 50-C, are, in general, characterized by increased carrying capacity of the field winding, so that the temperature rise, resulting from continuous operation, will be the same in the field as in the armature. The use of laminated poles has been continued, but the poles are bolted to the yoke, rather than cast in, as has been heretofore the practice. The armature construction has also been modified somewhat, but particularly in the direction of securing the greatest possible ventilation, and, as will be described later, the core is



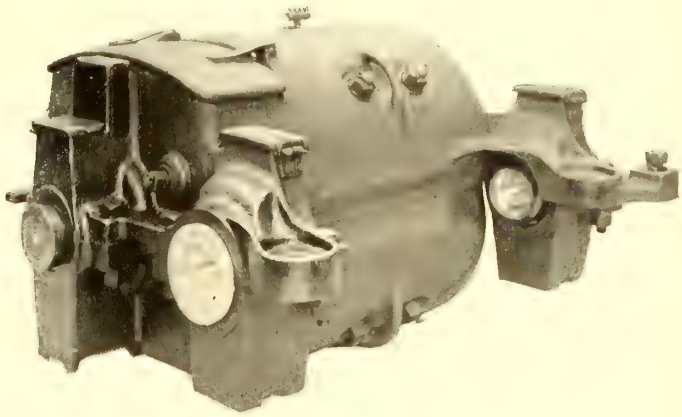
NO. 69 MOTOR

provided with air passages, and the coils are placed in the slots in such a manner that air spaces between them at their ends are secured. The following table gives the weights and gear ratios of these machines:

Name of Motor	No. 69	No. 68	No. 56	No. 70	No. 50-C
Total weight, lbs.....	1,951	2,261	2,968	4,792	5,200
Weight armature, lbs..	385	505	720	1,421	1,475
Gear ratio	64:18	64:18	64:18	70:18	52:19
	68:14	68:14	68:14	62:26	....
	....	....	58:24	52:36	....

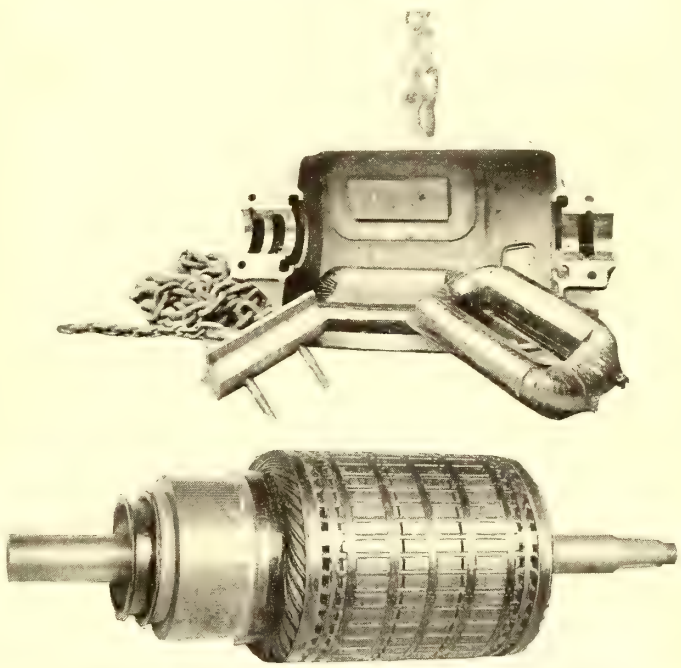
The No. 69 and No. 68 motors, which will be first discussed, are similar in general construction, but vary somewhat in capacity, the No. 69 motor being rated at 30 h.p. and the No. 68 motor at 40 h.p. They are fitted with removable laminated pole pieces bolted to the yoke, the coils being held in place by pole tips. The bolts which retain the poles do not pass through them, but terminate in a long nut inside the pole piece. The pole face, therefore, presents a smooth, unbroken surface, and the pole is perfectly rigid. The bearings are extra long and designed for either grease lubrication from above or oil lubrication from an oil wick at the side. In this position the oil can be inserted more easily than with a center wick, and the feed being between the gears, the pressure is the least at this point between the shaft and the bearing.

The motors are so designed that by removing the axle caps and the pin from the suspension link the motor can be lowered into a pit. Where this design of motor is used provision is made in the car barn or shop for a ram, or pit jack, in the pit, which lifts the motor into place on the car, or lowers the motor into the pit. With this equipment it is the practice to substitute one motor for another under the car, the new motor having been previously inspected and the old motor being laid aside for inspection the next day. Provision is made for hinging the upper field, so that it can be raised and inspection made while the motor is lying on the floor. In this manner a thorough inspection of all parts of the motor can be made with the greatest convenience, and the inspection does not have to be made at night or in a hurry, due to



NO. 56 MOTOR

the fact that the car must be in service again in the shortest possible time. It has also been demonstrated that the time for changing motors in this system is very much less than the time necessary for inspection of the motors underneath the car. Special provision is made for centering the motor on the head of the ram or jack referred to above. With a motor properly centered in this manner it can be raised to its exact position under the car, and no time is necessary for adjustment. The brush holders have adjustable coil springs, and the armatures have sunken bands and short-necked commutators. Three formed coils are placed in each slot. The motor is arranged for either cradle or nose suspension. While the method of dismounting and inspecting the interior is the quickest possible, it requires, as stated, the use of

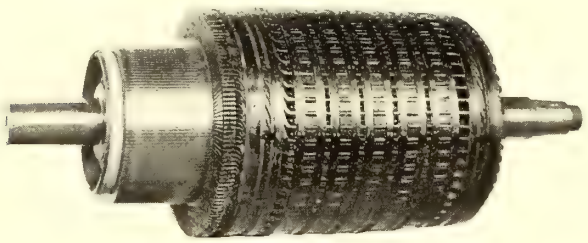


UPPER CASING AND ARMATURE OF NO. 56 MOTOR

a pit-jack, so that this motor will probably be most popular on those roads where the car house and repair shop facilities are quite complete. In other words, this motor is particularly for large roads, and is the one adopted by the Third Avenue Railroad Company, of New York, the North Jersey Traction Company and other large corporations.

These motors may also be furnished with the same style field as No. 56. The No. 56 motor is similar to the Westinghouse No. 68 motor, but 20 per cent to 25 per cent more powerful than the 38-B, and is intended for the heaviest city, suburban and interurban work. The pole pieces are removable, like those of the

No. 68 and No. 69. The bearings are long and the lubrication is identical with that previously described. The commutator is built up of drawn copper segments, and is very deep, allowing for a great amount of wear. Bond wires retain the armature coils, and are sunk in the periphery of the core, thus obviating any danger of cutting them should the bearings be allowed to wear until the armature strikes the pole pieces. The amount of copper in the field winding is very large, and the motor is de-

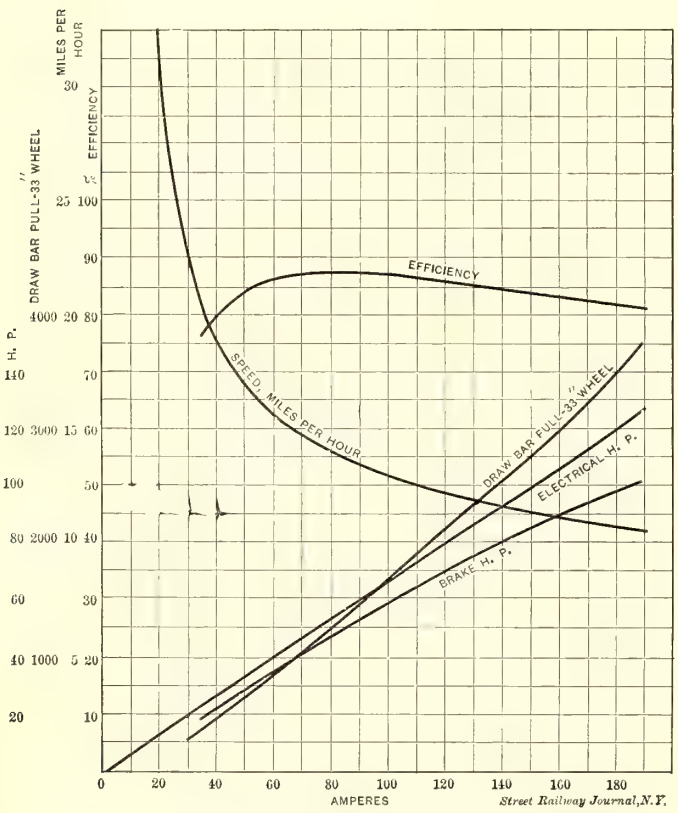


ARMATURE OF NO. 50 C MOTOR

signed throughout with a wide margin for heavy overloads. The performance curve of the No. 56 motor is shown herewith.

The interior of the motor and armature can be inspected without dismounting the frame from the car axle. The method is to first run the motor over the pit, then unscrew the bottom half, which, with the gear casing, is hinged at the middle. The lower field can then be swung down, the armature being retained in either the upper or lower half at pleasure. As will be seen, the motor can be put in condition for inspection in this way without touching the suspensions, and in this particular is similar to the No. 49 or the No. 38-B.

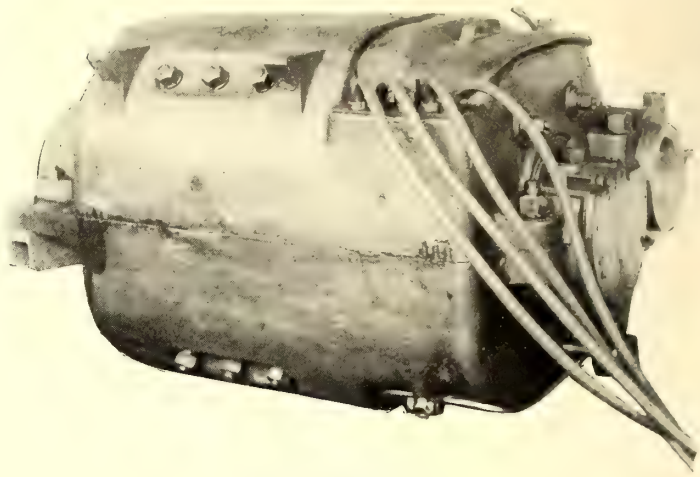
The No. 70 motor is of still larger capacity, and was designed



CURVES OF NO. 56 MOTOR

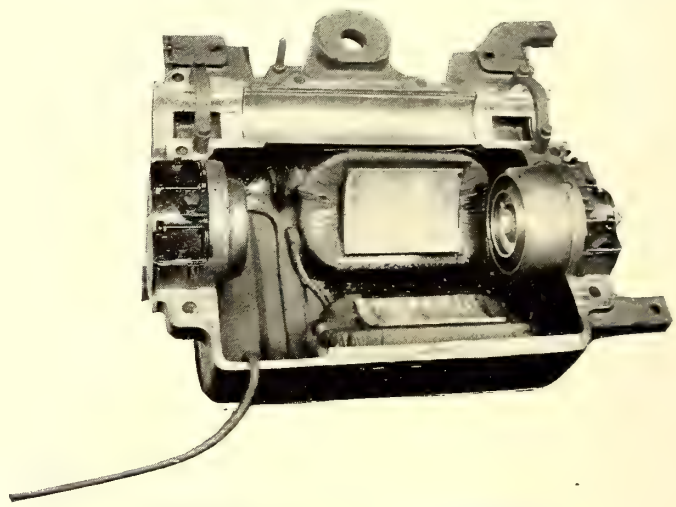
for heavy, slow-speed interurban and elevated work over long lines. It will operate at 750 volts, which is an important point where the line drop is large. The motor is rated 110 h.p. to 115 h.p. at 500 volts and 150 h.p. at 750 volts. The poles are removable; the field winding is heavy; the armature is bar wound, absolutely oil proof and exceptionally well ventilated. The bearings are extra long and are carried in separate boxes and lubricated on both sides of their entire length.

The No. 50-C motor, which, rated at 150 h.p., is the largest of the company's standard types, and is designed for the heaviest railway work. In mechanical design it is similar to the No. 70. There is no provision for getting at the inside of the motor when on the car, as the motor is designed for use on trucks which can be run out from below the car when inspection is desired. When thus exposed, the bolts which hold the top field half to the lower half are unscrewed. As the lower half is supported on the truck,



NO. 50 C MOTOR

the upper half, with the upper half of the gear casing, can then be raised by a tackle. The armature can be retained in the upper half or left in the lower half, exposing all parts of the motor. The motor is lubricated in its armature and axle bearings by oil only. The armature bearing is a solid housing, provided with top and bottom bearing bushings. The object of this is to prevent the escape of oil. This bushing can be slipped off from the armature shaft on the commutator end, but to remove the bearing on the pinion end the pinion would first have to be taken off. The oil



LOWER FIELD OF NO. 50 C MOTOR

receptacle is packed with waste to prevent oil from spilling through the motion of the car. A wick embedded in this waste feeds both sides of the axle, making a continuous self-oiling bearing. If too much oil is poured into the receptacle the surplus is led outside through a tap into the street, so that there is no chance of the oil leaking inside of the motor. The top half of the field is furnished with two lugs for safety suspensions.

All motors are dust proof and shed water.

The Kansas City, Lawrence & Topeka Railway Company has been incorporated, with a capital stock of $2,000,000, to construct an electric railway from Kansas City, extending through Lawrence and the counties of Leavenworth, Douglas and Shawnee, to Topeka. The directors of the company are: John D. Bowersock, of Lawrence; C. C. Baker, of Topeka; John W. McDaniel, of Bonner Springs; John W. Hirst, of Omaha; W. C. Endsley, Henry G. Pert, George J. Hensinger, Walter A. Bunker, and W. E. Winner, of Kansas City, Mo. Mr. Winner's address is No. 711 Main Street.

Rail Joints

BY W. F. ELLIS, C. E.

It is an admitted fact that the weak point of railroad tracks is the joint, and, although the conditions on paved street railway

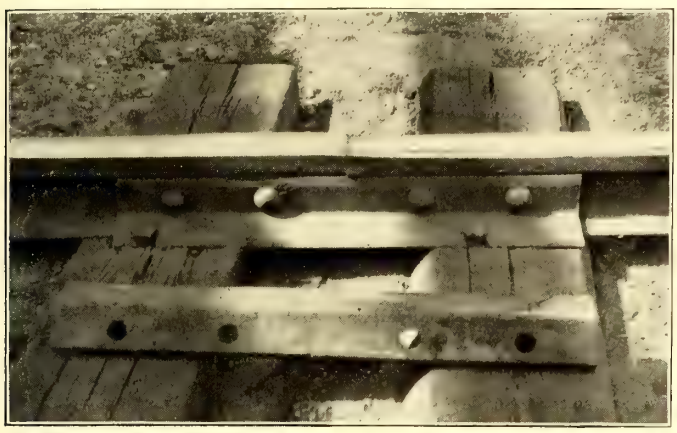
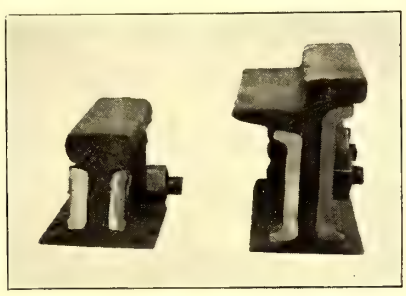


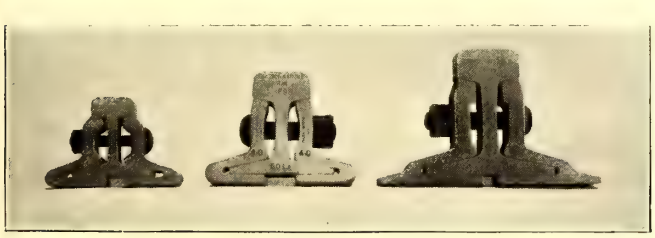
FIG. 1.—DEFECTIVE JOINT

track are not the same as on steam railroads, yet on suburban and interurban roads, construction somewhat similar, though with a lighter T rail, can be employed.

The joint fastenings on street railway track have been patterned somewhat after those in use on steam railroads, so that the failures on the latter will assist in finding a remedy for street railway joint troubles. When the old-fashioned chair joints were abandoned and "fish plates" (two straps of iron) were adopted, a change for the better as regards vertical strength, was secured, though all support of the base of the rails was sacrificed, being dependent on the bearing or support these straps gave at the point of contact under the head of the rail, assisted somewhat by a one-tie support at the rail ends. As creeping of track had to be prevented without slotting the base of the rails, suspended joints came into use with a flange to the "fish plates" at their base, extending beyond and level with the base of the rail, so as to allow a slot or hole in this foot, independent of the rail base. This gave the so-called "angle bar," which furnished greater vertical and lateral strength. Both of these types of joints are, of course, dependent for support upon frequent tamping of the joint ties. This, even on exposed track, is expensive, but for tracks on paved streets is practically impossible. As a result, the failure of



FIGS. 2 AND 3



such types of joints comes quickly, with loss to the rolling stock through pounding at the rail ends.

The reason for such failures is shown in Figs. 1, 2 and 3, where either the joint bars or rail ends at their contact, especially under the heads of the rails, give no support to carry the loaded wheel from one rail end to the succeeding one. Another frequent cause of failure of the angle bar type of joint is shown in Fig. 4, and arises where the tie is cut by the base of the rail, and not by the foot of the angle bars. This trouble can only be avoided by the most careful attention and inspection. An attempt to escape this trouble has been made on some steam railroads by making the foot of the angle bar ¼-in. above the top of the rail base, but this only aggravates the difficulty, as such joints have to carry a load

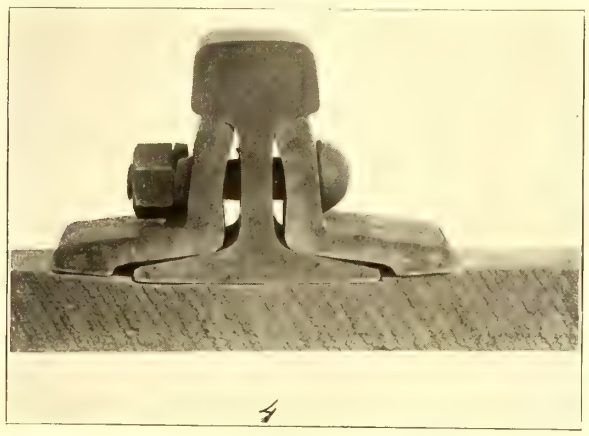
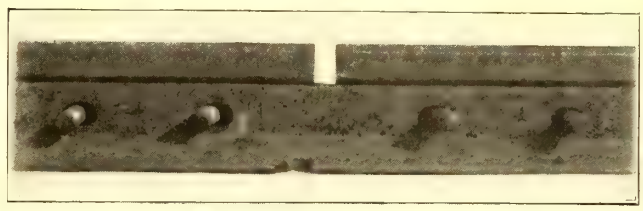
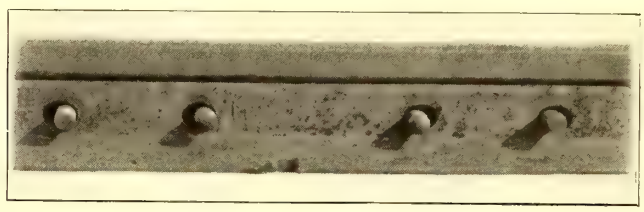


FIG. 4.—TIE CUT BY RAIL

similar to a person with no support under his feet, but hung up by his ears.

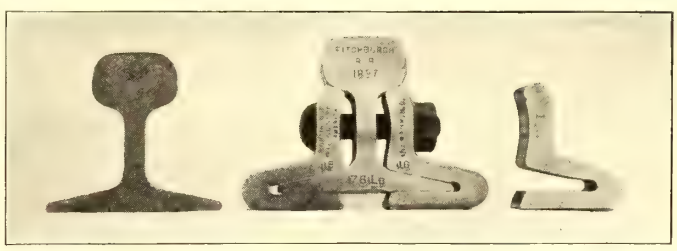
Another cause for failure is where both joint bars have oval holes for cup head bolts, with round holes in the rail ¼ in. larger than the bolt shank, so as to allow an opening of ⅞ in., as shown at Figs. 5 and 6. One remedy to prevent such joints is to have





FIGS. 5 AND 6.—DEFECTIVE BOLT HOLES

right and left bars, the inside bar to have oval holes and the outside bar to have round holes, ⅛ in. diameter larger than thread of bolt; or a better remedy, where practicable, is to have alternate oval and round holes in each bar. In both cases the oval



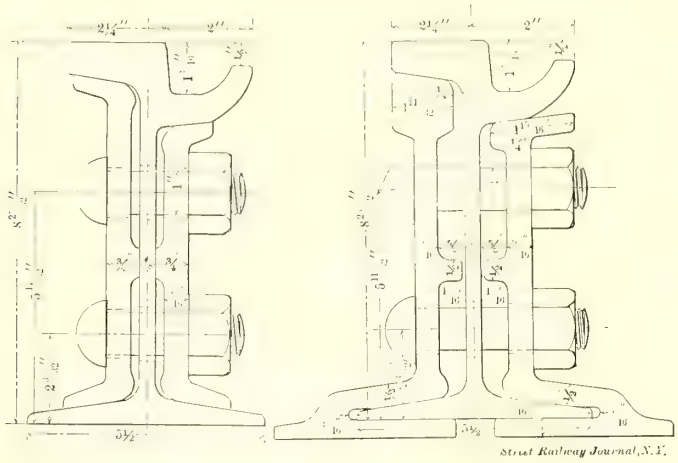
FIGS. 7 AND 8.—TYPES OF CONTINUOUS JOINTS

holes in the bars should be punched to fit tightly the oval neck of the bolt used, when driven home by a hammer. Steam railroads use no larger diameter bolts than ⅞ in., but on girder rails 1-in. bolts are used to get greater thread area, yet with the greater care given to the application of joint fastenings on street railways, ⅞-in. soft steel bolts with raised rolled threads to 15/16 in. will have a greater tensile strength and elastic limit than even 1-in. iron bolts

with cut threads, and can be used to prevent the drilling of so large holes in the rail web. An example of such use is that the guard rail has been and is held properly in its position to the T rail of the tracks in the Boston subway by 7/8-in. diameter soft steel bolts having 15/16-in. cold pressed Harvey grip raised threads, where the lateral thrust on guard rails is very severe, owing to some 50 ft. radius curves in use.

As street railway track construction should be most permanent, especially at the joint, to relieve tearing up of the streets and loss from poor bonding, a joint which gives a continuous rail and supports the rail ends so as to insure the proper life of new rails and renovate old rails, should be exceedingly welcome.

The continuous rail joint, as made for T rails, is shown at Fig. 7, and gives this base support desired, being united to the fish plate or bar itself by being rolled, not formed, to fit any section of



FIGS. 9 AND 10

rail. The several types shown give such increased bearing surface with great vertical strength as to counteract the motion or play that leads to wear at points of contact so fatal to the life of joint fastenings. This joint has also been applied to what is termed the pear-shape head rail, Fig. 8. No angle bar type of joint could give any support to this rail, yet with the continuous joint base support, such rails have had additional life with better surface and alignment than could have been secured with any other joint.

The continuous rail joint has also been most successfully applied to deep girder rails. Owing to their height and unsymmetrical design a less length of joint can be used than with the ordinary center ribbed joint plate, and the non-appearance of the flat spot on the receiving end of double-track rails in well ballasted, paved streets, is absolutely insured. These two types of joints are clearly shown in Figs. 9 and 10.

British Manufacturer of Chilled Iron Wheels

The firm of Miller & Company, Ltd., was established in the year 1867, and shortly thereafter commenced the manufacture of chilled iron wheels. This firm is the pioneer of this industry in Great Britain, and claims the position of world pioneers in scientific methods as applied to iron founding.

The chemical labratory has been the basis of the business, and success has been attained by unremitting attention to daily tests—chemical and physical—made by the company's chemists.

Messrs. Miller & Company's wheels are running on railways, tramways and in mines in Europe, Asia, Africa, Australia and South America, and the testimonials embodied in their recently issued catalogue bear ample testimony to the high quality of their products.

It seems that for many years before any other European or United States wheel makers gave heed to the chemistry of their manufactures—and were guided solely by rule of thumb—this Edinburgh firm was practising the methods and carrying out the experiments in daily practice which other founders, wheel makers and others, have subsequently adopted. The head office of Miller & Company is at Edinburgh, Scotland.

Non-Slipping Car Steps

Visitors to the street railway convention in Boston last year could not fail to observe the non-slipping steps in the various stations leading to the Subway and in very many of the finest business buildings of the city. Some will remember that the material which rendered these steps non-slipping was on exhibition at the convention, and recommended for use on street car steps, under the name of Mason Safety Tread. The patent is in

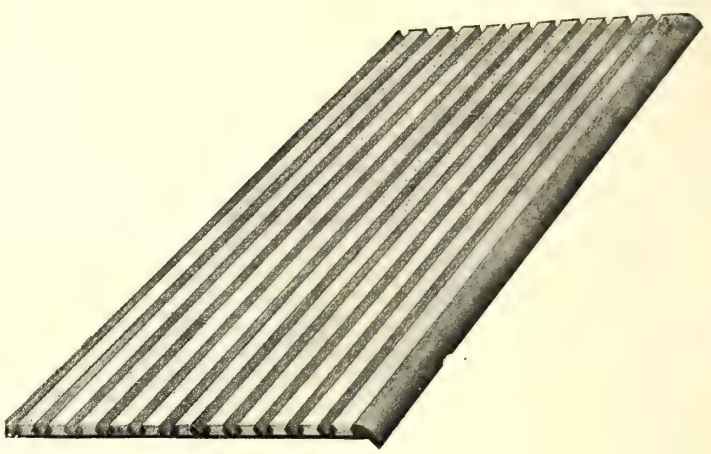


SECTION OF CAR STEP

the hands of an enterprising company having headquarters in Boston, and agencies in all the larger cities.

One year ago only a beginning had been made in the work with street railway companies. To-day over 1000 cars in various sections of the country are equipped with these treads, and duplicate orders have been given by nearly every road using them, the best possible evidence of satisfaction.

The merits claimed for this safety tread are its safety and dura-



CAR STEP

bility. It is durable because its base and ribs are of steel; safe, because there is always presented (even when the tread is half worn out) a surface of lead which holds the foot under all circumstances. Moisture, frost, light snow or grease does not affect this non-slipping quality. An open groove between every two lines of lead, as shown herewith, aids in holding the foot firmly, and catches dirt that would otherwise remain on the surface or be tracked into the car.

The safety tread will again be exhibited this year at Chicago. It is manufactured by the American Mason Safety Tread Company, of Boston.

New Carbon Works

The Speer Carbon Company is the title of a new corporation recently organized to go extensively into the manufacture of carbon brushes of all styles and types, to fit all makes of motors and dynamos. The company will be entirely independent of any existing company or combination, as it is the belief of its organizers that the extent and importance of the electrical industry at present warrant the existence of more companies in this field than now exist. The president of the new company and acting manager is J. S. Speer, who, for a long time, was secretary and treasurer of the Partridge Carbon Company, and so is well acquainted with the requirements of the trade in this direction.

The location of the company's plant is at St. Mary's, Pa., on the line of the Philadelphia & Erie Railroad, and in the heart of the Pennsylvania coal and coke region, giving the best facilities for manufacturing carbon and for shipping. Here a modern factory has been erected, equipped with improved tools required in the business. An interesting feature of the manufacture is that all baking will be done by natural gas. Mr. Speer states that he will also make a specialty of the export trade.

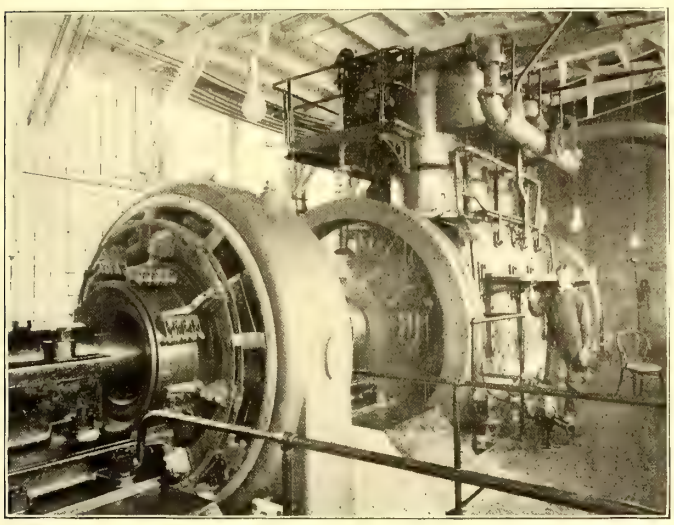
Gas Engines for Electric Railway Service

The gas engine, as a prime mover, has long promised an attractive solution of the problem of generating electricity economically, especially in small plants. The promise has, however, been slow of fulfillment, because this type of motor has been more or less handicapped by sundry imperfections seemingly inherent in its nature, which have greatly limited its utility in electric work generally, and practically excluded it from the railway field in particular.

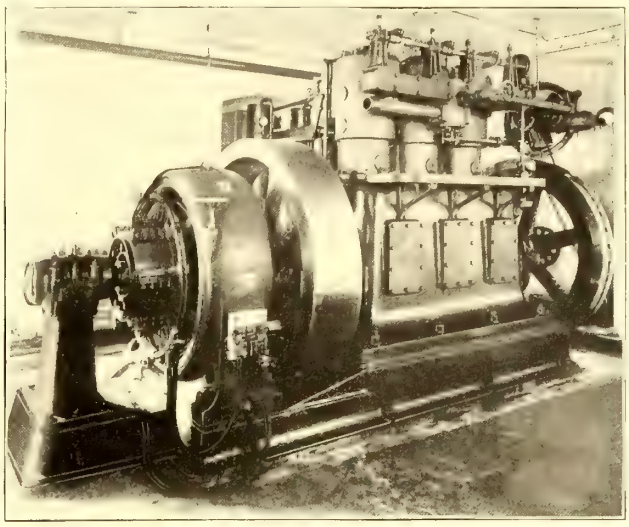
The recent announcement that the Westinghouse Machine Company, which, in a quiet, but none the less energetic way, has been carrying on a line of experimental work extending over a period of seven or eight years, has placed on the market a series of gas engines thoroughly tested, and which can be guaranteed in every particular, suited to the most exacting requirements of electric work, is therefore not without interest. It is stated that George Westinghouse has devoted much of his personal attention to this work, and that it was owing to his strong convictions of long standing as to the utility of the gas engine in various classes of railway power stations, and in other lines of electric work, that the Westinghouse Machine Company undertook with such successful results, the development of a suitable type.

In general appearance, the Westinghouse gas engines bear a marked resemblance to the Westinghouse steam engines. They are built in two-cylinder and three-cylinder patterns; the former in sizes from 10 h.p. to 70 h.p. inclusive, and the latter from 15 h.p. up to the largest powers desired. The largest engine yet built is of 650 h.p., and is illustrated in the accompanying engraving. It has been in regular and continuous use for over a year in part of the power plant of the Westinghouse Electric & Manufacturing Company, and its record there has shown in a marked degree the reliability and economy of this type of machine.

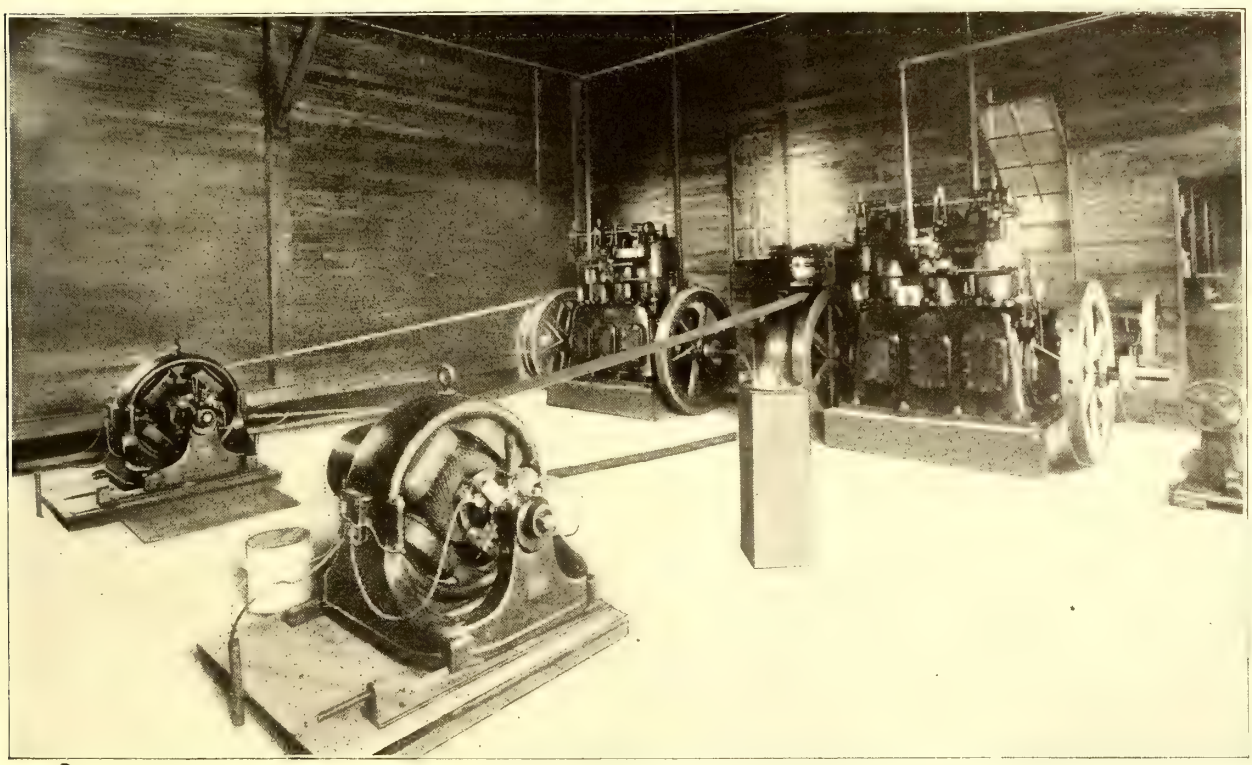
A section is given on page 718, through one cylinder of the three-cylinder engine, all three being exactly alike. This illustration and the description below will also apply with sufficient accuracy to the two cylinder engine. The engine is single acting, a feature which characterizes the Westinghouse steam engine, and which is absolutely necessary in a gas engine, for the reason that stuffing boxes and piston rods would deteriorate rapidly if exposed for half the time to an atmosphere of burning gases. The gas, which has first been mixed with the proper amount of air to fur-



650-H.P. GAS ENGINE AT PITTSBURGH

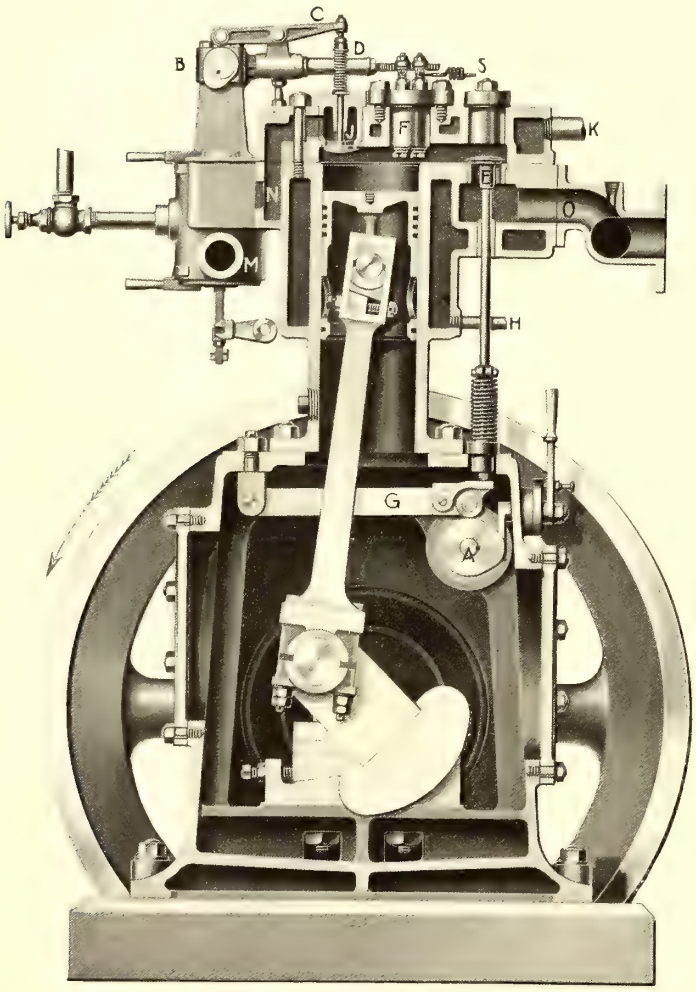


125-H.P. GAS ENGINE AT LONDON



RAILWAY POWER STATION AT HUNTINGTON, L. I., EQUIPPED WITH GAS ENGINES

nish oxygen for its rapid and complete combustion, is admitted through the opening *M*, passage *N* and valve *J*, into the cylinder. The engraving shows the piston near the top of its stroke and moving downward. Drawing in a cylinder full of mixed gas and air. On the return stroke the valve *J* closes, and this charge of gas and air is compressed into the clearance space between the top of the piston and the cylinder head. As soon as the piston commences its second downward stroke the charge is ignited by an electric spark. The igniter is shown at *F*, and will be described more fully later. The gas and air being thoroughly mixed in the right proportions, combustion takes place with a rapidity which may properly be called explosion, and the resulting heat raises the pressure to several hundred pounds per square inch. The gases under this pressure expand, driving the piston downward, and on the second return stroke they are expelled through the



SECTION THROUGH CYLINDER

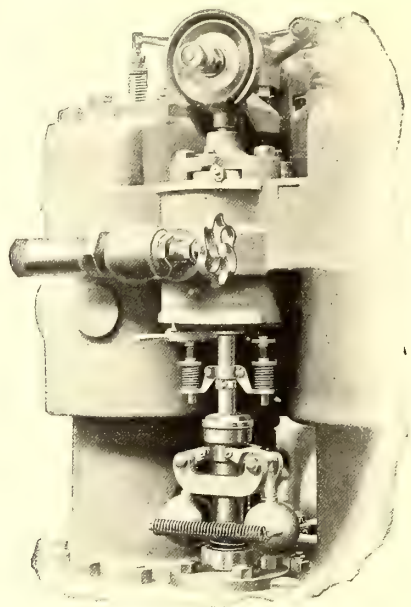
exhaust valve *E* and discharge *O*. When this stroke is completed all the parts of the engine are in position to repeat the same cycle of operations.

As will be seen, the valves and igniters perform their functions once for every two revolutions, instead of once for every revolution, as in a single acting steam engine; consequently the cams to operate these parts are mounted on shafts running only half as fast as the main shaft. Cams are used in preference to eccentrics on account of their more prompt action, and gears are employed for reducing the speed of the cam shafts.

The other main parts illustrated in the engraving are lettered as follows: *A* is the shaft which carries the exhaust valve cams, each working against a roller carried on the free end of the guide lever *G*. The admission valve is operated by the cam *B*, through the lever *C*. The guide *D* carries a plunger which actuates the igniter *F*. The cylinder heads and upper part of the cylinder are thoroughly water-jacketed, owing to the extreme heat to which these parts are subjected. The cooling water enters at *H* and is discharged at *K*.

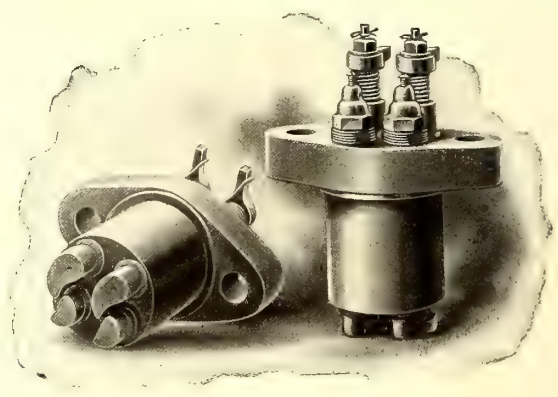
The igniter, which is also illustrated, has two binding posts and two sets of current breakers; one set only used at one time, the other being held as a reserve and ready for immediate service. The current for the igniters is furnished by a battery and induction coil, and is connected with a three-point switch, so that the action of the current through the igniting apparatus may be reversed at will. In a direct current lighting or power station the main circuit may be tapped for supplying the igniters if desired.

The governor for both the two-cylinder and three-cylinder machines is shown herewith, and differs radically from those used on other makes of engines. In the latter the practice generally followed is to admit the same amount of gas and air, whatever the load, and to vary the number of explosions according to the requirements for power. Thus, with a single-cylinder engine running with a maximum load, the impulses may be as frequent as one for every two revolutions of the crank, while for a light load the impulses may be as infrequent as one to every ten or twelve revolutions of the crank. In the Westinghouse gas engine the impulses are given regularly, but the amount of gas and air admitted is varied according to the requirements of the load. The governor is of the two-ball type, and, as the balls move in and out with the changes of the load, the regulating valve moves up and down, increasing or decreasing the quantity of mixture admitted, without changing the ratio of the gas and air.



GOVERNOR

There are many other interesting details of this engine, which have been worked out with the care and ability characteristic of all the Westinghouse work, but which cannot be given here on account of lack of space. A short reference will be made instead to a typical electric railway plant at Huntington, Long Island, in which these engines are used.



IGNITER

The power house of the Huntington Street Railway contains two three-cylinder Westinghouse gas engines, with cylinders 9 ins. in diameter x 11-in. stroke, and rated at 50 h.p. each. Each engine is belted to a Westinghouse railway generator of 37.5 kw., 550 volts. The switchboard carries the usual generator and feeder panels, with also a panel for a storage battery, which is used as a balancer. This battery consists of 265 chloride accumulator elements, type E-7.

The road itself extends from Huntington station to Huntington Harbor, Long Island, a distance of over 3 miles, and has been in successful operation for about thirteen months. During the summer the travel is very heavy, and over 5000 passengers have been carried in a single day. The yearly car mileage is about 75,000. The cost of operation during this time has averaged about 13 cents per car mile. The gas is purchased from a local gas company.

The History of a Large German Manufacturing Company

The history of the Allgemeine Elektricitäts Gesellschaft, of Berlin, Germany, has been coincident with and illustrates most perfectly the development of commercial electrical engineering in Germany. The company has recently published in book form an extended account of the development of its business; this publication is intended to serve as a means of familiarizing its readers with the policy and methods of this large European concern, and shows in a comprehensive manner the tendency of the present time, namely, the independent motor transmission, instead of counter-shafting and belting, and the introduction of alternating current machinery over small areas and in isolated plants.

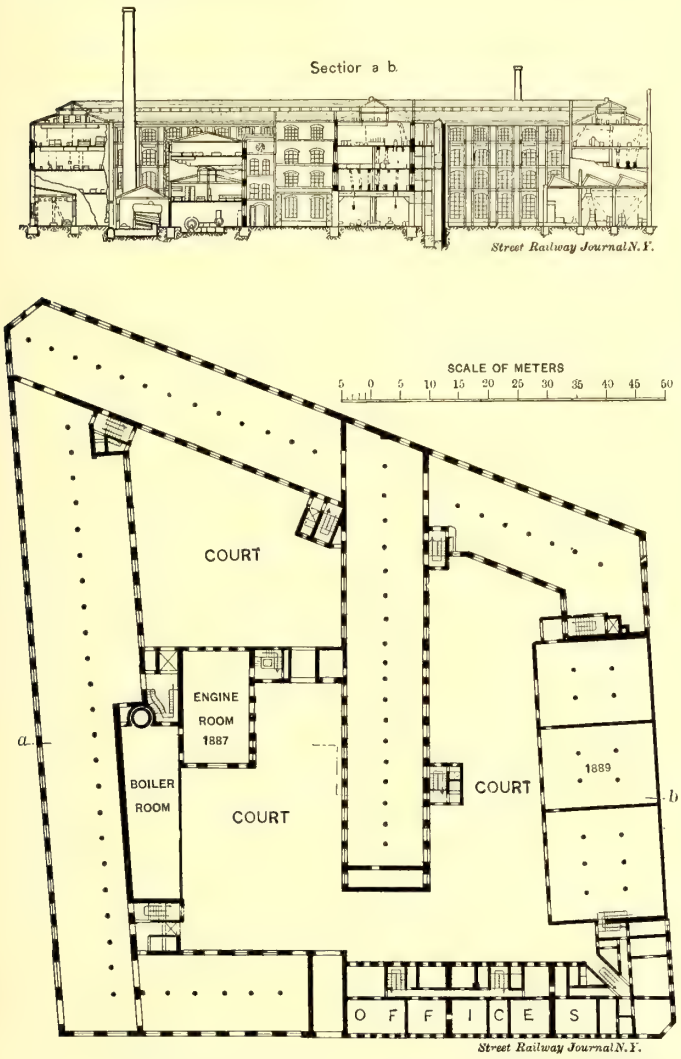


FIG. 1—PLAN AND SECTION OF WORKS OF THE ALLGEMEINE ELEKTRICITAETS GESELLSCHAFT

The company was started in 1882 by Emil Rathenau, the well-known engineer, and at present general director of the works, in order to acquire the European patent rights of Edison and to introduce incandescent lighting in Germany. After the signal success of the Munich exhibition, which was closely followed by the first illumination of a theater by electricity, the "German Edison Company for Applied Electricity" was formed, with a capital of 5,000,000 marks. This company brought into existence the first central station in Europe, which, with its various improvements, is to-day one of the most prominent and perfect on the European Continent. Entering into close business relations with the "Compagnie Contintale Edison," this original German company adopted in 1887 the name of the "Allgemeine Elektricitäts Gesellschaft," and has since grown until the balance sheet of July, 1898, showed a capital stock of 47,000,000 marks and a surplus of 18,000,000 marks.

It has been the policy of the company from the beginning to devote considerable attention to experimental work, which fact has enabled the company to continually remain in the front rank of the manufacturers of apparatus for applied electricity.

The company's works are located in Berlin, and a plan of its present works is given on this page. Of the buildings constituting these works the power station in particular should be noted, it being built separately and in the court, in exact conformity with the practice now followed in this country wherever space conditions are favorable. These works are kept running throughout the year day and night. The minimum power consumption between the hours of 3 A. M. and 6 A. M. is nearly 500 h.p., the maximum, between the hours 4 A. M. to 7 A. M. reaching nearly 2100 h.p.

The principal unit in the company's power station is a 1200-h.p. condensing engine, which is usually kept running, with its generator, from Monday 6 A. M. to Sunday 6 A. M. without stopping. The periods of larger consumption are taken care of by two 400-h.p. and several smaller high-speed direct connected generators. If it were not for the flexibility of the electric transmission system it would be impossible to run this large net of buildings from one station. The inconvenience of several smaller engine rooms and the expenditure connected therewith compared to this centralization of generating power presents a most excellent example of modern economical manufacturing methods.

In the earlier days, when the engineers of the A. E. G. realized the advantages of electric subdivision, they still adhered to counter-shafting in a way, inasmuch as they attached a motor near the ceiling of each section, and from there ran by belting and countershafting a row of milling machines, lathes, drills, etc. Although the expense of a number of individual motors is considerable, they recognized in time the desirability of still further subdivision in order to make their system as flexible as possible, and as well to permit the easy moval of machinery from one point to another. The advantages of decreased vibration, of clear head room, of cleanliness, entirely independent of any other considerations, marked a great era for the factory hands, and while these are items which perhaps cannot be expressed in dollars and cents, their advantages from the humane and ethic point of view cannot be questioned.

One great trouble in connection with the multiple introduction of small motors was the amount of attention that had to be paid to each, such as keeping commutators clean, but here, as in so many cases, necessity became the mother of invention, and the introduction of three-phase current and its distribution throughout the works obviated this difficulty most satisfactorily. The difficulties and many practical obstacles which barred rapid progress in this line of machinery were met with a will and determination for final success by the chief electrician of the A. E. G., Mr. v. Dolivo-Dobrowolsky, and in a way which not only made him

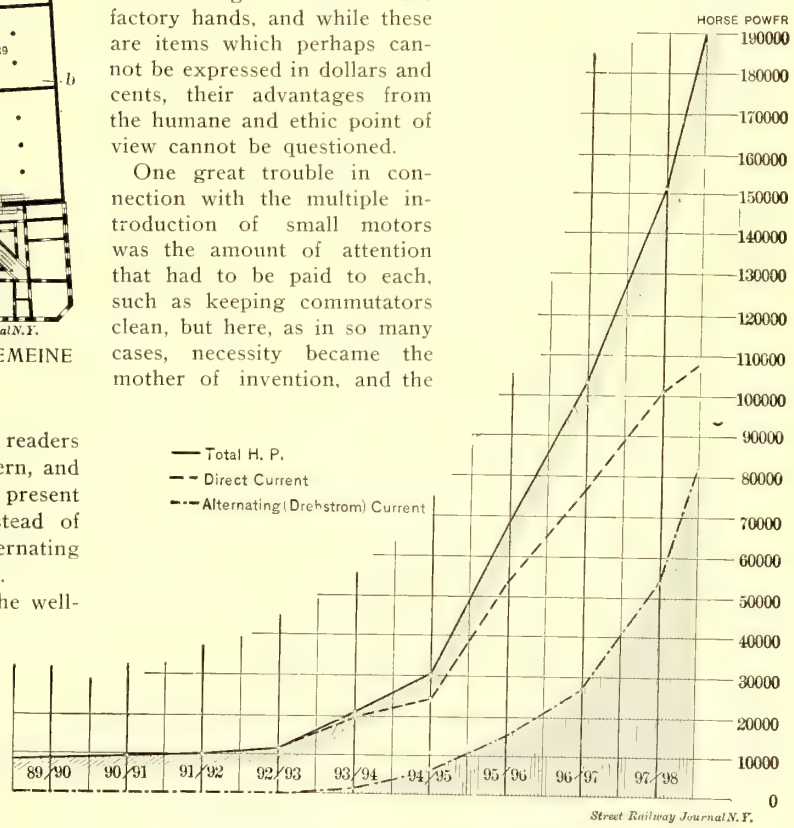


FIG. 2—OUTPUT OF DYNAMOS AND MOTORS FROM 1889-90 TO 1897-98

famous as an inventor, but assured him of the gratitude of all who, in improved apparatus, see a most concrete example of the progress of civilization.

The three-phase machinery, of which the A. E. G. was the pioneer, is rapidly coming into as general use as is direct-current machinery. This is clearly shown in the diagram Fig. 2, in which the amount of machinery in horse power, manufactured by the A. E. G. from 1889 to 1898 is diagramatically compared. While up to 1893 but 1000 h.p. of machinery was manufactured, and all of that of direct-current type only, the year 1897 to 1898 shows a

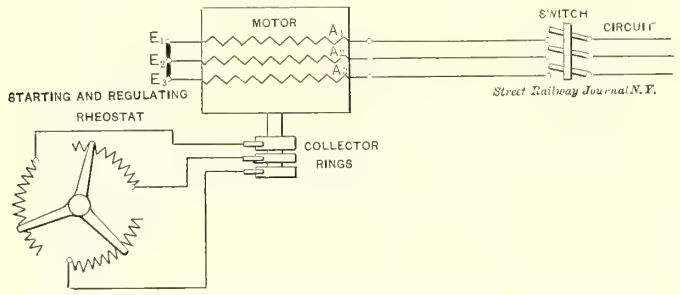


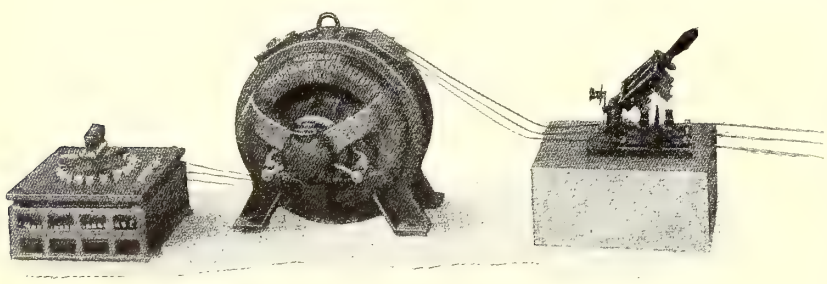
FIG. 3—METHOD OF STARTING MOTOR WITH ARMATURE RESISTANCE

total of 110,000 h.p. for direct current and 80,000 h.p. for three-phase machinery.

At present more than 12,000 people find steady employment in the company's works, and no expense has been saved in original investment to secure the most satisfactory results in practical manufacturing. The company has reaped rich rewards for its efforts.

An interesting and instructive insight into the kinds of motors of the three-phase type manufactured is given in this same book, in the form of a lecture delivered by O. Lasche, engineer of the company, before the German Engineering Society. He points out the difference between starting motors by short circuiting the armatures and by the introduction and gradual cutting out of resistance, the use and advantages of motors with collecting rings, etc.

The reduction of the phase differences is demonstrated in a very comprehensive manner to have a great bearing on the cost of running machinery and on the saving of copper conductors. Mr. Lasche explains that the phase difference between old and new type induction motors has been decreased by from 15 to 20 per cent. This will decrease the idle currents in the conductors, and,



THREE-PHASE MOTOR AND STARTING RHEOSTAT

allowing the same total actual and apparent drop, the conductors need be but 60 per cent in cross section, as compared with the old type induction motors. Four types of motors are built and used under different circumstances.

1. Motors with armatures short circuited for starting.
2. Motors with collector rings.
3. Motors with regulatable collector rings.
4. Motors with armature resistance. (Fig. 3.)

The first named is by far the simplest and is not subjected to any appreciable depreciation; it can run for weeks without attention.

The starting torque of these motors is double that of the running torque, and this makes them well adapted for lathe or milling work. In motors larger than 5 h.p. it is advisable to introduce a starting rheostat, in order to avoid heavy fluctuations, especially when incandescent lamps are fed from the same mains. It should be remembered that these starting resistances do not increase the starting torque, but simply react favorably on the main circuit and become, for reasons mentioned above, a matter of necessity when the current from central stations is used.

The introduction of resistances into the armature which necessitates the use of collector rings is more effective and economical; the starting torque can be regulated, and thus all reactions unfavorable to the supply mains can be avoided; the speed of the motors can also be properly controlled, which in many cases is desirable on account of the type of machine that may be driven. The starting with the two types of motors mentioned may be compared to the starting of a shaft by means of a toothed gear clutch vs. a friction clutch. The starting torque of a motor with armature resistance can be three times that of the running torque. Thus an ordinary armature with collecting rings can be used for starting purposes, and after the motor has acquired speed a simple device will short circuit the armature and release the brushes from the rings, thus giving this type of motor all the advantages of the first named kind, inasmuch as there are no sliding contacts whatever.

The third type of motor, that with a regulatable collecting ring armature, has no short circuiting device whatever. It is used wherever motors have to be frequently stopped and started and short circuiting devices on account of the time consumed would not be an economical arrangement. This motor finds its principal application in cases where different speeds are desirable, such as in crane work, lifts and printing presses.

The motor with armature resistance now remains to be discussed. In cases where the starting torque is not an important factor, but where the fluctuations on the mains ought to be kept at a minimum, and where, for this reason, the rapid speeding up of the motor is undesirable, this motor will be found to be best adapted for the service. Its fundamental principle is similar to that of the collecting ring armature, inasmuch as the armature offers considerable resistance in starting. The difference between these two types is the location of the resistance; in the one case the resistances are outside, and in the latter case they are built into the armature and cannot be regulated. The armature contains two sets of coils; one short circuited within itself and of high resistance, and the other of smaller resistance and closed by means of a short circuiting device. In starting, the latter is open, and the motor with the high resistance armature starts slowly. When it has reached half speed the second coil is closed, and the motor, reaching its full speed, acts like the short circuited armature motor. The cooling surfaces not being as great as in the other cases, the motor cannot stand excessive overloads, but on account of its simplicity and cheapness it finds considerable application.

The transportable and flexible shaft drill and milling machines form another important section of the A. E. G.'s output, and these machines should find considerable application in mines and such places, where the absence of brushes and consequent absence of sparking, form a valuable feature.

As a whole, this brochure furnishes to the buyer, as well as to the engineer, valuable data; to the latter it gives lucid explanations; to the former it shows in a convincing manner the attention and engineering skill devoted to the manufacture of electrical machinery.

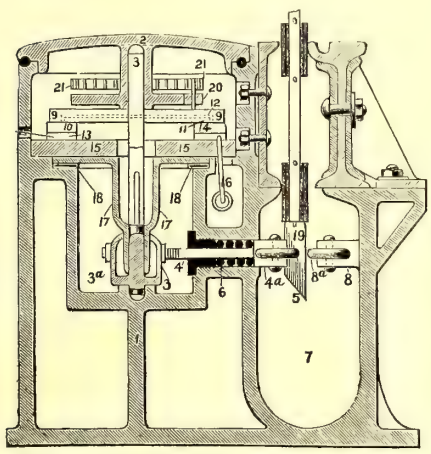
The company has recently published a pamphlet descriptive of its electric railway business, which gives a full list of the electric railways built by it or in the course of construction, brought up to May, 1899. This list comprises roads having a total of 1283 km. of track, 2268 motor cars and twenty electrically driven snow-plows. They include roads in many countries outside of Germany; among them, Spain, Chile, the Argentine Republic, Italy, Russia, and Austria. The pamphlet also contains a large number of very attractive half-tone engravings of many of these different lines, with explanatory notes in German, French and English.

The Carrollton Electric Railway Company, of Carrollton, Ky., has been incorporated, with a capital stock of $20,000, to construct an electric railway at Carrollton. The principal stockholders of the company are: James M. Grant, J. F. Jett, M. I. Barker and M. L. Downs, of Carrollton.

New Type of Conduit and Surface Contact System

The engraving below shows a section of a combined contact and surface contact system, which has recently been patented by Messrs. Stendebach & Linker, whose interests in Great Britain and the United States are represented by Estler Bros., 27 Ledenhall Street, London. The use of the open conduit is only to admit a contact closing device; it can therefore be made much smaller and shallower than where live contacts are carried in it. If desired, however, the ordinary section of conduit can be used. In this case the device illustrated is useful for keeping the contact sections dead, except during the passage of the car.

The construction of the later form of conduit is as follows: The cast iron box, in which is carried the mechanism, is partly rectangular and partly cylindrical. The cylindrical part of the box is fitted with a cover, 2, flush with the surface of the street. Inside this cylindrical portion, a bar, 3, is arranged, consisting of two parts, the bottom of the lower portion forming a pan-like flange. The lower end of the bar, 3, rests in a socket of a web of the box, 1, while the upper end fits in a socket of the cover, 2. The pan-like part of the bar, 3, is fitted with a toothed wheel, 3a, engaged in a rack, 4. The end of this rack, 4, which projects into the conduit, 7, has a widened head, 4a, with a roller, 5, and this is pressed outward by the spring, 6. Opposite to the roller, 5, in the conduit, a bracket, 8, carries a second roller, 8a. The bar, 3, is fitted on its upper end with a disc, 9, of insulating material to which the contacts, 10 and 11, are fixed and connected together by a wire, 12, embedded in the disc, 9. The bar, 3, is encased by the small cylinder, 17, which is screwed on to the box, 1, and the lower part of which rests in the pan-like part of the bar, 3, and this is filled with mercury to exclude moisture from the space containing the contacts, while the upper end of the cylinder, 17, is made air-tight by means of the India-rubber ring, 18.



SECTION OF CONDUIT

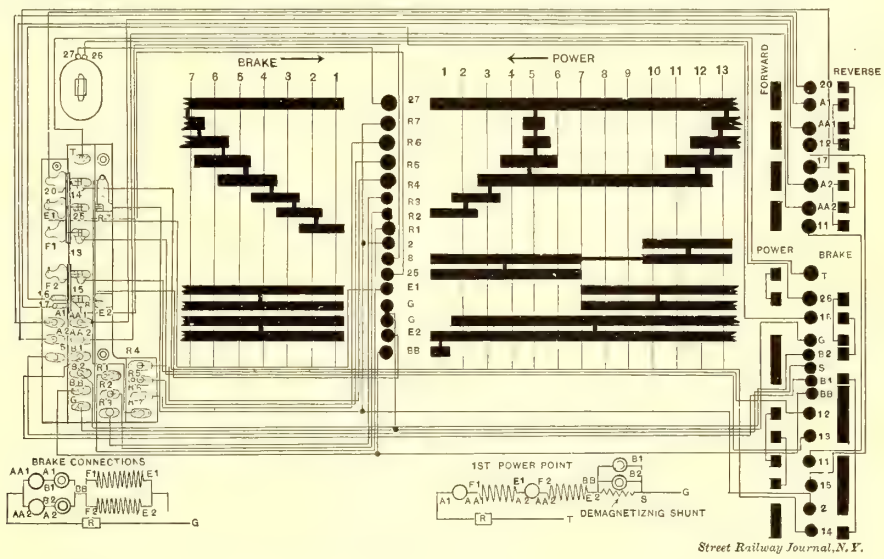


DIAGRAM OF ELECTRIC BRAKE CONTROLLER

If the contact closer fitted to the car now passes through the conduit between the rollers, 5 and 8a, the rack, 4, is forced into the box, 1, and this imparts a circular motion to the bar, 3, which in turn causes the disc, 9, to revolve, bringing the contacts, 10 and 11, and the counter contacts, 13 and 14, respectively, together. The contact, 14, is joined to the feeder cable, 16, while from 13 the current is led to the contact studs in the center of the track from which the current is taken up by the motor car in the manner described above. As soon as the contact closer passes the roller, 5, this is set free, and the rack, 4, is pressed back to its original position by means of the spring, 6, which is reinforced by the spiral spring, 21, fitted in the cover, 2, on a pin, 20, of the disc, 9. Instead of the springs counterweights could be used.

Improvements in Electric Brakes

The General Electric Company has made certain changes recently in the arrangement of the motor and brake circuits of its electric brake which modify to a considerable extent its method of operation. This brake, it is well known, consists of a cast iron disc keyed to the car axle, and a circular electro-magnetic shoe, which forces the disc and is held so that it cannot revolve. Both disc and shoe are split diametrically for convenience in installing.

When the brake is installed on the same axle with the motor, the brake shoe is supported and kept from revolving by horns projecting from a special motor axle cap. When the brake is mounted on a free axle, i. e., an axle without a motor, the shoe is fitted with a standard axle bearing sleeve and kept from revolving by a bar connecting it to the truck frame. In the case of double-truck cars, two brakes are installed, one on each axle of a truck without motors. Under these conditions a bar will connect the two brake shoes.

The controller for operating the brake is similar in appearance to the well-known "K" type of series parallel controller. The controller handle, however, is not blocked at the "off" position, but may be moved beyond it to a series of notches operating the brake.

The changes in connections referred to have been introduced with the view of decreasing the liability of producing flat wheels, and consists principally in connecting each brake shoe directly in series with the armature of the motor on the same axle. These connections are shown in the lower left hand corner of the diagram herewith, which is the development of the company's latest two-motor electric brake controller.

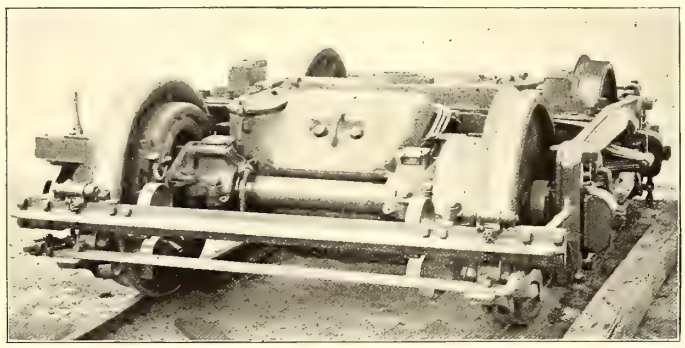
With such an arrangement it is practically impossible for the wheels to slide for a distance of more than 2 ft. to 3 ft., as the brakes automatically release when the wheels start to slide. The theory of this is that if either axle ceases to revolve, the motor armature in series with the brake shoe ceases to generate current, thereby releasing the brake. In addition, however, there is an actual demagnetization of the shoe by the current from the other armature, which tends to flow in the reverse direction through the armature of the first motor, and the brake shoe in series with it. It is claimed, therefore, that a much greater braking effect can be applied without danger of skidding the wheels than with any other form of power brake, an advantage which is readily appreciated in making emergency stops.

The method of demagnetizing the brake shoes has also been changed, and, instead of passing the current from the trolley through the shoes on the first power point, a portion of the main current passing through the motors is shunted through the shoes. The connections for demagnetizing are shown in the small diagram in the lower right hand corner of the diagram mentioned.

The construction of controllers has also been much improved, and the latest two-motor controller (B-13) contains many desirable features lacking in the earlier type. The combinations of motor and brake circuits for power and braking are effected by means of an auxiliary cylinder located on the right-hand side of the controller. This cylinder is thrown in either direction by means of a cam on the main cylinder and a suitable lever. The main cylinder serves to series parallel the motors on the power side, and to regulate the resistance both for power and braking.

As the usual interlocking mechanism between cylinders is used, all arcing takes place on the main cylinder, where an efficient magnetic blow-out provides for its prompt and complete extinguishment.

Electric brake shoes have been designed for use with the various types of standard motors, and adapted either for mounting upon the motor or directly upon the axle. Where the motor



TRUCK EQUIPPED WITH ELECTRIC BRAKE

and brake are mounted on the same axle the shoe is held by a support which in some cases is combined with the axle cap, and in others is merely a steel yoke bolted to the motor frame. The axle suspended type of brake shoe is only used where double-truck cars are equipped with but two motors, and on trail cars. They are provided with brass axle linings and grease cups, and are held from revolving by a bar which passes through the horns on the shoe, and is bolted to the truck frame. Engravings of



CAR AT CLEVELAND EQUIPPED WITH ELECTRIC BRAKE

these shoes were published in Street Railway Journal for March, 1899.

All brake shoes are fitted with wearing plates, which are bolted to the shoe casting, and which can be readily renewed at slight expense when they become worn out.

The use of electric brakes on train cars is attended with exceptionally good results, as it is possible to obtain an exceedingly smooth and simultaneous braking of two cars, doing away with the bumping and jerking of the trail car, which are so objectionable.

The Ashland & Catlettsburg Street Railway Company reports a season of unusual prosperity. During July 86,000 passengers were carried without accident or injury. Most of this business was obtained by the attractions which were furnished free to patrons of the road at Clyffside Park. These beautiful grounds, which are second to none in this country, were visited by 818 picnic parties during the season, and more are booked. The park contains a beautiful lake, covering 7½ acres, numerous boat houses and boats, a dancing pavillion, ladies' cottage, Dutch oven, coffee house, arbors, swings, orchestra stand, telephone booth, refreshment stands, croquet grounds, Indian mounds and a natural theater. The company intends building a large theater next season.

An Important Chicago Engineering and Contracting Company

The Arnold Electric Power Station Company has exercised an important influence upon power station design in Chicago, through its work in connection with several stations, principally in the suburbs. One of the most recent of these is the Chicago & Milwaukee Electric Railway, a 27-mile line, extending along the lake shore north of Evanston. Its equipment, which includes the use of rotary converters and three storage battery auxiliaries, represents several steps in advance of ordinary high-speed interurban railway practice. These transformers and converters receive their energy over a three-phase transmission line extending back to the high-tension alternating current generators in the main power house. This power house also contains direct current machinery sufficient to supply the section of road adjacent to it. The construction of this entire line, with the exception of the first section and the rolling stock and track, has been carried out by the Arnold Company. This contract included the engine, direct current and alternating current generators, switchboards, transformers, rotary converters, economizer, pumps, mechanical draft, condensers, piping, cooling table and reservoir, power house building, battery room, car houses, offices, two sub-stations, overhead equipment and transmission line erected complete, ready for operation. It should also be stated that the original plans were drawn up by Mr. Arnold, and in his contract work he guaranteed a certain specified efficiency for the entire plant. This policy of working out its own solution of an engineering problem, of submitting plans and specifications with its proposition, together with an economy guarantee covering the entire installation, takes this company at once out of the ordinary class of contracting companies and places it in a position peculiar to itself. Another unique feature of the Arnold Company's methods is that it is in no way connected with any manufacturing company, which leaves it free to purchase machinery and apparatus of any make upon the open market.

The Arnold Electric Power Station Company was organized in 1896 to make and sell the parts peculiar to the "Arnold system" of power station construction, and acting in this capacity it has supplied a number of plants with magnetic clutches, shafts, quills, box stands and couplings. Among these plants may be mentioned the Fort Dodge Light & Power Company, Fort Dodge, Iowa; Chicago Board of Trade; Englewood & Chicago Electric Railway; Land Title & Trust Building, Philadelphia; University of Michigan, Ann Arbor, and W. B. Conkey Company, Hammond, Ind. Through natural development this company has gradually broadened the scope of its work until it is now in position to make a proposition for furnishing and erecting in place entire electrical properties, and it already has an enviable record along this line. Among its recent completed contracts are the entire power plant and building of the Imperial Electric Light, Heat & Power Company. This plant is a large central station using 500-volt generators working in parallel with a storage battery auxiliary. By dividing this battery into two parts a distribution system was devised which allowed the use of 220-volt incandescent lamps, arc lamps and power motors off the same mains,—a decided departure from central station practice. This system has been adopted for another large central station since the erection of the Imperial plant.

The Arnold Company was also given the contract for the complete light, heat and power plant erected in connection with the new railroad shops of the Chicago & Great Western Railroad at Oelwein, Iowa. This contract comprised not only the heating and lighting of the shop buildings, covering many acres, from a central plant, but also the application of a large number of motors for various uses. This has been the first plant to adopt the Arnold magnetic clutch for line shaft work, though these clutches have been used for some time in connection with the three-way couplings, which are a part of the company's system of power station construction. Another notable installation recently completed is the isolated plant for the Garrett Building, Chicago.

The Citizens' Traction Company, of Oil City, has been granted a franchise for the construction of an electric railway within the city limits. D. T. Borland, D. J. Geary, Joseph Manning, F. W. Bowen and others are interested in the new company.

Air Brakes

The advantages of the use of power brakes for every class of rapid transit service are now so generally recognized that few, if any, railroad men question them. In fact, the problem at present is not so much, should a power brake be employed, but which power brake should be used. The same condition faced the steam railroads thirty or forty years ago, but, after many experiments, air was finally selected as the most efficient and desirable power to use for braking purposes. It is hardly necessary to discuss here the advantages of compressed air for this service, and the attention of the reader will be directed instead to some of the most recent apparatus for braking street railway cars, manufactured by the Standard Air Brake Company, the first company to engage in the business.

The Standard Air Brake Company, which proudly claims the title of the "pioneers," makes several types of compressors for different classes of service. One of these is the geared axle-driven compressor for the use of high and slow speed electric cars. Some particulars of this compressor are published in the STREET RAILWAY JOURNAL for June, 1898, but the latest type of compressor, in which certain improvements have been made, is shown in Fig. 1. A split spur gear, keyed to the car axle, drives a second gear, which is mounted free on the pump shaft. This gear is connected to the driving shaft of the duplex compressor by means of an ingenious friction clutch, which is thrown into operation when the pressure in the reservoir falls below a fixed minimum, and is thrown out of connection when the pressure rises to the predetermined maximum limit. Moreover, when, after an application, the air in the brake cylinder is released, the clutch is automatically thrown in, although the reservoir pressure may have been reduced but a pound or two, giving maximum pressure for all stops. By an ingenious arrangement the engagement of clutch members takes place only when the speed of the car is reduced and the pressure removed from pump cylinders. The company also builds the same type of compressor without the clutch attachment. Its structure, however, is much heavier than that of the "clutch" machine, as it is generally used where the service is exceedingly hard on the car mechanism.

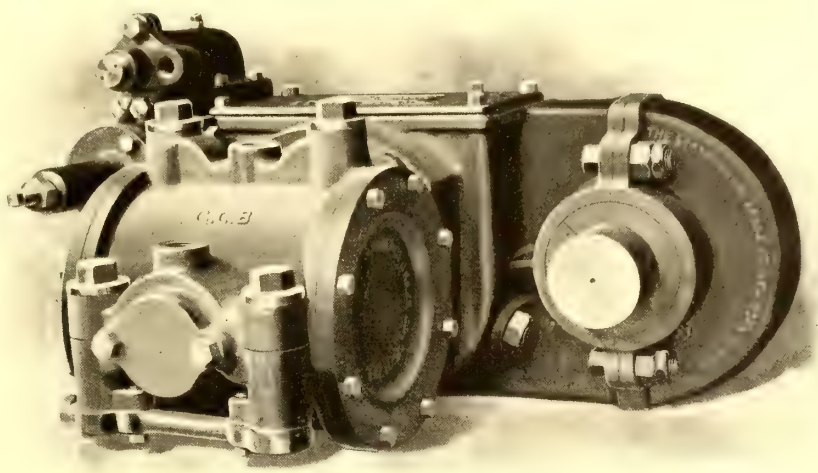


FIG. 1—AXLE-DRIVEN GEARED COMPRESSOR

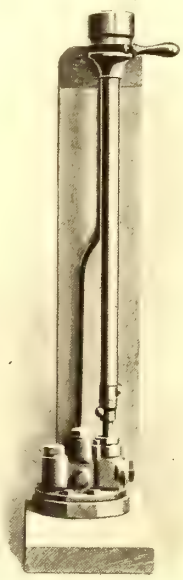


FIG. 2—OPERATING HANDLE

An idea of the compactness of the machine can be derived from the statement that only 7 ins. of actual space between the motor and the hub of the wheel are required for mounting this compressor. All parts are dust proof, and operate in a bath of oil. There are no stuffing boxes used, and the piping is reduced to a minimum. There is an instantaneous application of the brake, and quick release. The parts are few, and there are no bolts inside the compressor casing. The power per car mile of operating the compressor, it is said, does not exceed ⅛ h.p.

For trains and heavy electric service the company builds a motor compressor. Full particulars of its motor-driven braking system were published in the STREET RAILWAY JOURNAL for April, in which number an extended description, with illustrations, was also given of the company's automatic current controller, which is one of the most ingenious and efficient devices for the use for which it is intended ever constructed. No reference, however, was made at that time to the operating valve employed. This device is a valuable portion of the system, and is illustrated in Fig. 2. The Standard Air Brake Company has long followed the practice of combining the pressure gage with the operating head, and, by means of a staff, transmitting the movements of the handle to the valve, which may then be placed down out of the way, either on the platform or underneath the car. It will be noted that the gage is where it must constantly be seen, and, being covered with very thick plate glass, cannot be damaged unless deliberate force is exerted. The handle operates in the slot shown under the gage, and when withdrawn, the staff is locked in its position, so the brakes cannot be tampered with when the motorman is at the other end of the car. The head is of polished bronze, which, with the black tubular casing of the staff, presents a very neat appearance—a point much appreciated by managers who take pride in the appearance of their cars.

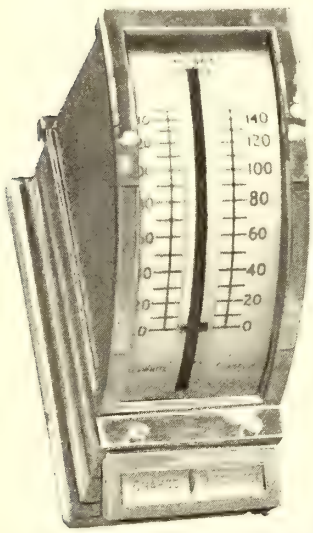
The company makes three types of operating valves that are manipulated by this operating staff. The O V M valve shown in the cut, and the O V N, have slide valves which will remain tight; they are provided with ports for service and emergency applications, and the manipulation is so simple that it can be learned by any motorman in a few minutes. The O V M, which is located on the platform, is used with motor compressor equipments, while O V N, of which there is but one per car, is used with the geared axle compressors. It is located under the car directly on the brake cylinder head, unless trailers are used, when it is placed on the train pipe line and a special bracket supplied for its support. The use of the single valve on the brake cylinder admits of an instantaneous application of the brakes, a much quicker release, and is very economical of air. The motion of the handle is transmitted through a pulley on the end of the staff below the platform, and a single line of chain and rod from either end of the car, to a bell crank lever, which in turn pushes the valve stem in and opens the valve.

The company's shops in Jersey City present a most busy appearance. They measure 100 ft. x 200 ft., and so many orders have been received for air brakes as to require their operation for twenty-four hours a day during the past summer. The present facilities of the shops are ten equipments a day, but if necessary the company could turn out fifteen equipments a day. One hundred men are employed, and the machinery equipment is of the latest and most complete type. The company makes a specialty of testing all equipments before shipping, and has a special department where these tests are carried on. This activity would indicate that street railway companies are taking a great interest in the air brake question. The company has some very large orders on hand, and in several instances has been obliged to refuse orders from roads which put off the placing of contracts until the last minute and then demanded early deliveries.

The Railway Construction Bureau of Japan, it is said, has at last decided upon a plan for an elevated railway between Shinsenza and the central railway station, to be built at Eirakucho. The work is to begin within one year, and $1,800,000 is to be appropriated for buying the necessary land. The requirements of this work will be very large. Further particulars can be obtained by addressing the Minister of Public Works, at Tokio.

Electrical Measuring Instruments

The accompanying engravings show two of a series of electrical measuring instruments manufactured by James White, of Glasgow, under patents granted to Lord Kelvin. Mr. White makes a specialty of all kinds of electrical measuring instruments, including ammeters for direct, alternating or multiphase circuits, of the dial or edgewise type, with 5-in., 7½-in. or 10-in. scales. These

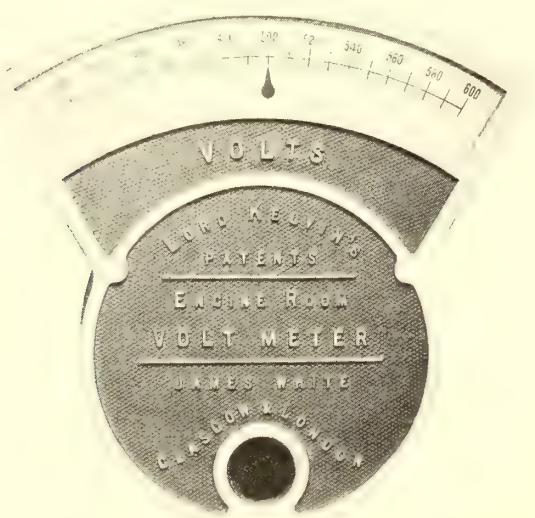


5-IN. SCALE KELVIN EDGEWISE OVERTYPE AMMETER

appliances have no temperature error, and are made in sizes to measure up to 1000 amps. He also manufactures the Kelvin direct reading wattmeters for direct, single-phase or multiphase systems, and the Kelvin millicellular electro-static voltmeter. The instruments illustrated are respectively a 5-in. scale edgewise overtype amperemeter, and a 12-in. scale, moving coil, voltmeter.

Improved Type of Car Heater

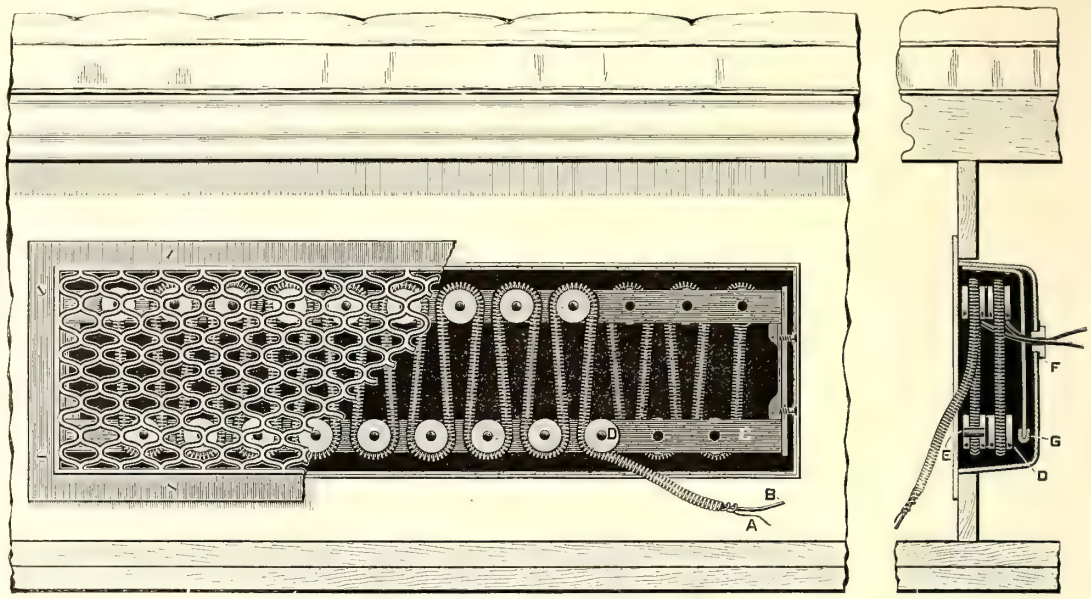
The latest and improved type of American Electric Corporation panel heater, which is manufactured and sold by the Simplex Electrical Company, of Boston, is illustrated herewith. The view exposes the details of construction, which are as follows:



12-IN. SCALE KELVIN MOVING COIL VOLT METER

The case is the conventional one of cast iron, bronze finish, as are all the cases of the different types of heaters. The electric heater consists, as shown, of two coils of special non-corrosive wire that is not affected by high temperature, moisture or acid fumes, and consequently, is practically indestructible. These coils have a stout asbestos cord *(B)* running through their center from end to end. The oblong steel frame *(C)*, provided with suitable pins projecting from either side, furnishes supports for the round grooved porcelain insulators *(D)* on which the coils are mounted. The asbestos cords are drawn taut and fasten on their respective sides to the terminal porcelains at either end, to which also the coils are made fast independently of each other.

The asbestos cord furnishes a continuous support throughout



NEW ELECTRIC CAR HEATER

the length of the coils, preventing the possibility of a coil getting out of place, and maintaining it in place without tension on the coil.

Connected to the coils by good mechanical joints and soldered, are rubber covered, flexible, terminal conductors, which pass through porcelain bushed holes *(F)* on the outside of the case. This form of heater is used in all the different types of the coil spring car heaters, of which the company makes eight different sizes and styles. As indicated in the engraving, this heater is of great simplicity in construction and it is claimed by the makers that any part, except the case, can be replaced from the stock room or repair shop of any electric railway company.

The company also makes the panel type heater, the popular form for side seat cars having paneled risers underneath the seat. The American electric heater for cross seat cars, it is claimed, takes up less space underneath the seat than any other. It is only 2 ins. thick, while giving a maximum possible distribution, as these heaters are made in several different sizes so as to fill the entire length of the space between the seat uprights of the different manufacturers of car seats. One special point made in favor of this heater is that passengers cannot injure it by bracing their feet against it, or produce short circuits, or scrape mud and slush into the heater on to the coils when using it as a foot warmer.

The company also makes many other types of heaters, among others a new type known as the "enameled heater," in which the heating coils are embedded in enamel resistance on cast iron plates. These heaters are light, strong and entirely insulated, and while useful in any cross seat or side seat without risers, are particularly adapted to elevated cars.

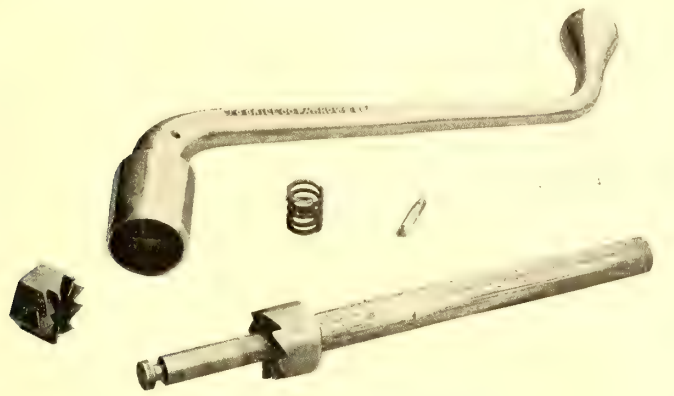
The Simplex Electrical Company also does a large business in American switches, and in the D. & W. fusible cut-outs, which it furnishes with all equipments, and claims to have been the first to introduce the non-explosive fusible cut-out.

It will be of interest to know that the American heaters were selected for use in all the first-class staterooms of the new White Star Line steamer, "Oceanic," and that these heaters were not bought until after a competitive test had been had with other heaters. Many other electric heating devices are used on this and other transatlantic steamers manufactured by this company, but this is the first ocean greyhound (as well as the biggest) to have her staterooms heated electrically.

The company has recently published a catalogue giving full information about its different heaters.

Ratchet Brake Handle

The Brill ratchet brake handle is one of those small but complete details of car building which form, however, a most important part of a car equipment. Besides the handle itself and the brake staff it is composed of but four pieces, and of these only two move. To the unobservant eye it presents no difference from the old-fashioned fixed handle. At the base, however, it is slightly enlarged to accommodate a hexagon ratchet, and beneath this ratchet a



PARTS OF RATCHET HANDLE

fixed round ratchet upon the brake shaft. These are shown in the accompanying engraving. The upper ratchet is held down by the spring. To prevent the handle coming off a groove is cut in the top of the brake staff and the pin is screwed into the handle at a point where it engages the groove in the brake staff and prevents the handle from being removed. The hexagon nut rises and is forced down by the spring when the handle is reversed in a hexagon chamber in the handle.

Feed-Water Purifiers and Heaters

Among the auxiliary appliances of a steam power station located in a district where solids are held in solution in large quantities in the available feed-water supply, none is more important to the economical operation of the boilers than purifiers or combined purifiers and heaters. These devices anticipate the heat effects that would naturally take place in the boilers, by bringing about the action in a receptacle that is easily cleaned, and so deliver comparatively pure water to the boilers. As the principles on which these appliances operate are found in nature, nothing was more natural than that some one should employ machines based on the principle of the formation of stalactites in natural caves, in fact, this is the principle upon which are based the heaters and purifiers built by the Hoppes Manufacturing Company, of Springfield, Ohio.

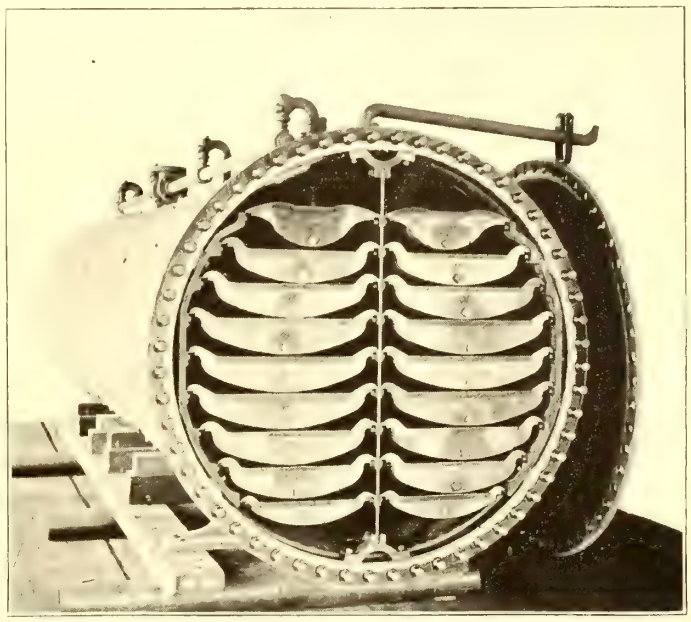
The system embraces a live steam purifier and an exhaust steam feed-water heater, which are very similar in design, the latter having in addition an oil-separating device and some auxiliary attachments. The structure of these heaters, as shown in Fig. 1, includes a boiler shell, within which, supported by suitable brackets and bars, is a series of curved pans made of steel plate. These pans are placed in one or more tiers, depending upon the size of the heater, and are so designed that after the feed water is let into the top pan it flows over the edges in a thin film and adheres to the under side till the lowest part is reached; it then drops into the next pan, and so on to the bottom of the shell. Steam is admitted direct from the boiler, and is brought in direct contact with the thin sheets of water, causing the water to relax its hold on the impurities in solution, so that these are deposited on the under side of the metal pans.

The pans are made in lengths of from 5 ft. to 6 ft., so that by removing the head of the shell the pans can be readily drawn out, cleaned and returned. Attention is given to the use of asbestos packing, which is placed in a groove under the head and prevents leaking, and also to a swinging arm or crane provided with a trolley wheel, by which the head is swung out of or into position with little outlay of muscular strength.

The live steam purifiers are made in capacity from 50 h.p. to 1000 h.p., and the latter are 5 ft. in diameter and 24½ ft. in length, while the exhaust steam heaters are from 50 h.p. to 5000 h.p., and the dimensions of these largest sizes are 68 ins. x 26½ ft.

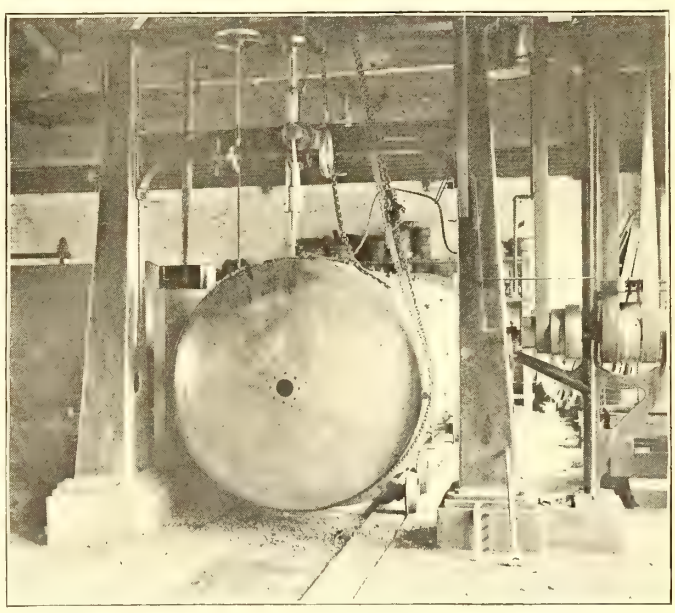
The products of the works also include steam separators and oil eliminators bearing the same name as the purifiers.

The works of the company are located in the suburbs of Springfield, and occupy a long one-story brick building with three "L's," two of which extend across a railway siding, so that all unloading and shipping are done under cover. The office occupies a separate building on a slight elevation overlooking the works.



PURIFIER, SHOWING PANS

The stock room, which is 48 ft. x 60 ft., occupies one of the "L's" and here are found great quantities of steel plates of various dimensions and thicknesses, for making the shells and pans. This department is provided with an overhead traveling crane, which runs in every direction, and delivers the plates to the rolls, punches or other machinery in the boiler department, where the laying out



DRILLING CYLINDER OF PURIFIER

and shaping is accomplished. This department is 60 ft. x 100 ft. The erecting department is 60 ft. x 80 ft., and contains a number of interesting tools and appliances designed to facilitate the work; among these is a plate milling machine or planer, on which the plates are planed to a bevel edge by means of a revolving cutter or milling tool. This is a novel machine of its class, as by its use the edges of a plate may be milled to correspond to any desired curve or arch in the plate. This machine was designed and built in the works, and the company contemplates manufacturing them

for the trade. Another interesting and rare tool (Fig. 2) is a drill for tapping the shell after it is finished. The shell or boiler is mounted on low trucks, and is run along the track under the drill, which is supported by two pillars sufficiently high and wide to receive shells of the largest diameter. The cutting tool is arranged to be driven from a separate head, and is so arranged that holes can be drilled at any angle. The equipment has recently been increased by the installation of a large set of plate bending rolls. Stud bolts for fastening the heads are manufactured on a specially designed machine, which cuts a smooth, fine thread on the best of steel bolts. The most striking illustration of the efficiency of the purifiers and heaters manufactured by this establishment are the great number of repeat orders which are constantly being received, and it is very seldom that the company equips a plant with these appliances that it does not get a second order when the capacity of the plant is to be increased.

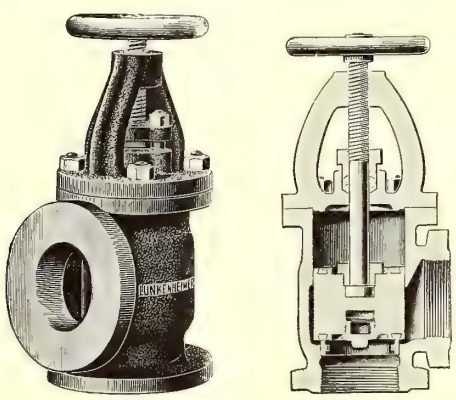
The present company was organized in 1886, and the affairs are now under the direction of the following officers: John J. Hoppes, president; Robert Johnson, vice-president; J. A. Hayward, treasurer, and A. G. Spencer, secretary.

Iron Body Angle Blow-Off Valves

The iron body blow-off valves, illustrated in this connection, are manufactured by the Lunkenheimer Company, of Cincinnati, and have been employed so extensively by steam users that some particulars of them will be of interest.

All parts are made of iron, excepting the stem, disc-locknut, disc-plug and seat ring, which are of bronze, while the reversible bearing faces in the iron disc are filled with Babbitt metal.

Reference to the sectional illustration will show that the disc is solid and fits closely in the barrel of the valve shell, so as to prevent scale and sediment from becoming entrapped on top of the disc, thereby preventing it from being readily raised when necessary. The disc is reversible, having two valve or seating faces, which can be changed at will, thereby increasing the durability and efficiency of the valve considerably. These valve or seating faces in the disc consist of dove-tail slots, which are filled with Babbitt metal, and when both are cut or worn out the old Babbitt can be melted out and new metal poured into the slots. The faces can then be faced off, thus renewing the principal wearing parts of this valve, and making the parts as efficient as new. The brass seat ring in the body of the valve can also be renewed when cut or worn.



BLOW-OFF VALVES

To reverse the disc it is only necessary to remove the valve bonnet, and take the entire trimming out of body of valve, then the small plug at the bottom of the disc and disc-locknut around valve stem can be unscrewed. The position of the disc can then be reversed so as to present a perfect bearing face to the seat ring in the shell of the valve.

All valves are carefully made of the best materials, and are thoroughly tested in every particular, all parts are made to gages and are interchangeable, so that any broken or worn out piece can be renewed.

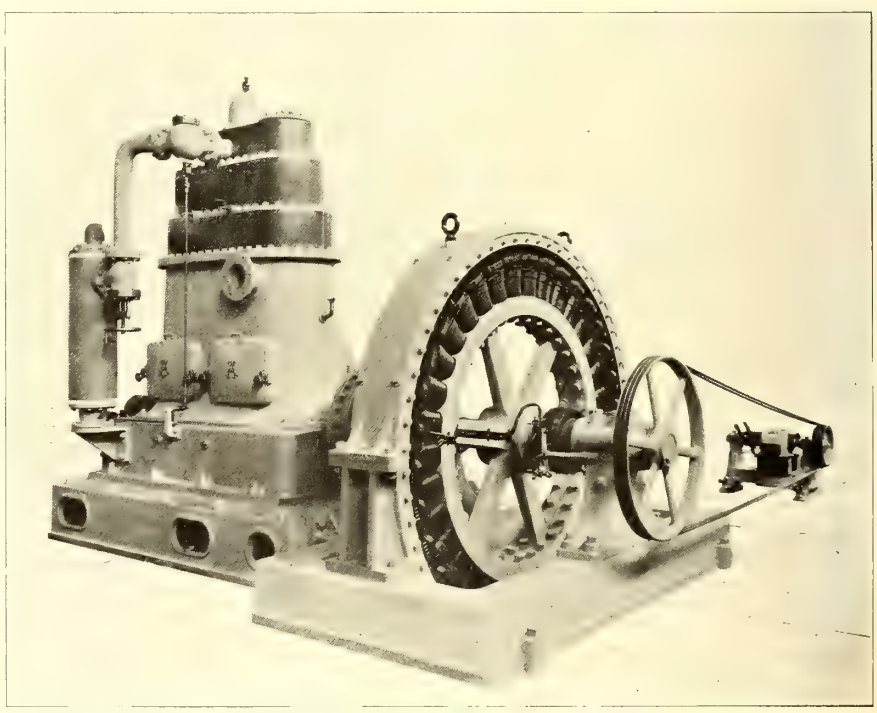
Large Storage Battery Installation at Plymouth, England

A large storage battery has recently been installed at Plymouth, England, by the Tudor Accumulator Company. It is composed of 260 Tudor cells of the type LB 11, and is capable of giving an output of 120 amps. at 480 volts for five hours, i. e., it has a capacity of 288 kw. hours. The boxes are made entirely of lead, which is strengthened by stout horizontal and vertical ribs of antimonial lead. Each cell contains eleven plates, 14 ins. x 12 ins., the positives being ½ in. thick, and the negatives ⅜ in. The complete cell, filled with acid, weighs about 400 lbs. The cells are capable of giving a maximum output of 90 kw.

New High Speed Engine

The accompanying illustration shows a new type of high speed engine now being manufactured by Alley & Maclellan, of Glasgow, Scotland, and of which they are making a large number for central stations and other electric lighting and power works.

This engine is of the single acting or constant thrust self-lubricating type, and is arranged with the cylinders placed tandem wise on two cranks at 180 deg. apart, or three cranks set at 120 deg. The valves are of the balanced piston type, and are driven direct by an eccentric on the crank shaft. The lubrication is effected by the most approved method of an oil bath in the crank chamber, the oil being lavishly, yet economically, splashed over all the bearings.



HIGH SPEED ENGINE

Governing can be effected either by a variable expansion governor or by a governor built on the end of the crank shaft, and operating the throttle valve. The latter type is adjustable by hand while running. Very close governing is effected in these engines with either type. The workmanship is of the highest class, and all parts, as far as possible, made to gage or jig. A special point in the construction of these engines is their durability, the wearing surfaces being exceptionally large and thoroughly lubricated.

The illustration shows an engine of 250 i.h.p. direct coupled to an alternating current dynamo, both running at 350 r.p.m., the running being exceptionally good and free from vibration or noise. These engines are made in sizes of 10 h.p. and upwards to 500 h.p.

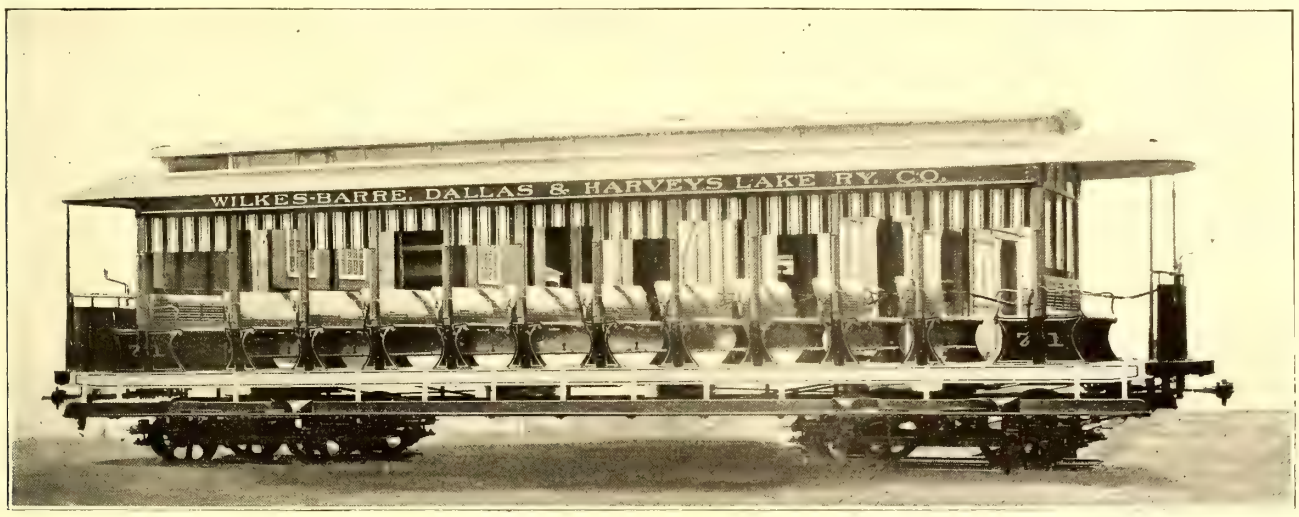
The Liverpool tramway committee has made application to the City Council for authority to reconstruct and equip with electricity the tramway lines extending from Old Haymarket, along Victoria and North John Streets, to Lord Street. The estimated cost of the work is £6,013.

A Large Trailer

The trailer illustrated in the accompanying engraving is a fourteen-bench open car for the Wilkesbarre, Dallas & Harveys Lake Railway Company. A number of cars of this type have just been completed by the Brill Company, of Philadelphia. The cars are 39 ft. 4 ins. over the crown pieces, and are 7 ft. in extreme width. They are mounted upon No. 23 trucks, with 5-ft. 2-in. wheel base. The wheels are 30 ins. in diameter.

There are ten seats with reversible backs, and four stationary seats. Leather covered chains close the openings between the seats. The ends of the seats are round, and the panels correspond with them, greatly widening the opening at the immediate entrance to the seat. Spring roller curtains come down to the floor, closing the side of the car completely. The inside finish is of cherry and ash, with a three-ply handsomely decorated headlining. There are no alarm gongs, no trap doors nor trolley boards. The grab handles are of ash, set in bronze sockets. There is a five-light cluster set in the center of the car, and four-light clusters at each end, one light being placed under the hood of each platform. The drawbar centers are 30 ins. above the head of the rail. These long cars are arranged to radiate very freely, and they can run round curves of only 30 ft. radius. Such a car gives seating capacity for seventy persons. What its carrying capacity is it would be difficult to say. In some cities cars of this type are often crowded with one hundred or more people. This car, although having so large a capacity, weighs but 18,300 lbs. The trucks themselves weigh less than 4000 lbs. each.

While the car is amply strong for the purpose, the absence of the motors and arrangements for carrying them greatly reduce the total load carried.



FOURTEEN-BENCH TRAIL CAR FOR WILKESBARRE

Feed Pumps as a Specialty

It is a truism that specialization is the note of latter day engineering, and this characteristic of our time is seen more distinctly in auxiliary plants than almost anywhere else. In this field firms are to be found who have devoted their energies to the perfection of a certain portion of engine or boiler room equipment, with the result that concentration and experience have enabled them to take the lead in their respective lines. An instance of this may be cited in the firm of Messrs. G. & J. Weir, Ltd., Cathcart, Glasgow, whose boiler feed pump is the outcome of long experience devoted to the question of boiler feeding and cognate problems. The rise in boiler pressures of recent years, and the increasing adoption of water tube boilers have produced many new and difficult conditions, rendering the familiar crank shaft pump quite unsuited to modern requirements. For many years the duplex pump held the field, but the increased attention now given to the steam consumption and efficiency of auxilaries has gone to show that a more economical type is desirable. For years the Weir direct acting feed pump has been the standard pump in the mercantile marine, and it has been fitted for such enormous boiler installations as those of the "Kaiser Wilhelm der Grosse," "Kaiser Friedrich," "Oceanic," "Campania," "Lucania," etc. For water-tube boiler feeding on Belleville, Thorneycroft, Normand, Babcock & Wilcox, and other installations in H. M. Navy, it is used almost exclusively and is largely adopted by almost every navy afloat. Messrs. Weir have for some time been putting on the market an adaptation of their pump for land boiler feeding, and attention is called herewith to a few of the points of this specialty.

The Weir direct acting feed pump of the single cylinder type, double acting and vertical. It has positive valve gear, actuated from the piston rod, so that there is no dead center, and it starts at any part of the stroke on steam being turned on. The steam valve consists of a main valve and an auxiliary valve, and is arranged to cut off before the end of the stroke. In fact, economy in steam consumption is one of the features of this pump, and it is claimed that in steam economy the Weir single pump is distinctly superior even to the compound duplex pump, while it has also the advantage of fewer moving and working parts, thus requiring less attention and upkeep. Compared to the motor driven pump the balance of advantage is claimed to be also with the Weir pump, as numerous experiments have demonstrated. Under certain conditions, such as when exhausting into the atmosphere and compared with the motor driven pump at full load, the advantage of economy may certainly be on the other side to a slight extent, but the exhaust from the steam pump may be utilized for expansion in the low-pressure cylinder of the main engine, or it may be used to heat the feed water, say by means of a Weir feed water economizer, and in this way the ultimate economy of the Weir pump, it is claimed, exceeds that of the motor driven pump at any speed.. It is, moreover, a much less complicated piece of mechanism than the motor pump, and has fewer points to get out of order. Its first cost is likewise smaller, it takes up less floor space, and does not require expensive or elaborate foundations.

Not only is the design the outcome of long experience in pump problems, but the construction and material of the Weir pump are of the highest grade, and its details have been most carefully studied and perfected. The standard type for land installations has the water end of cast iron, fitted with gun metal liner, gun metal bucket, bronze valves, and bronze valve seats of the Weir patent group type. The pump is compact and neat in appearance, and is an ornament in any engine or boiler room. For small pump installations Messrs. Weir also supply their differential type of feed pump, which is designed for more moderate sized installations. It is single acting on the suction side, and double acting on the discharge side, but is able to run quicker than the ordinary bucket and plunger pump. It is very easily overhauled, as the entire pump barrel may be drawn up along the plunger, thus exposing the bucket rings and the suction valves for examination if desired, and it is capable of feeding boilers up to 200 lbs. pressure.

The works of the firm at Cathcart, Scotland, are thoroughly modern and up-to-date, organized and equipped with the latest

American, British and Continental tools, many of them specially designed for the manufacture of the firm's boiler feeding specialties. Many of the most recent electric light and power stations have adopted the Weir pump, such as The City of London Electric Light Company, The County of London and Brush Provincial Electric Light Company, St. James' & Pall Mall Electric Supply Company, Corporation of Leicester, Corporation of Sunderland, Stafford, Glasgow, Manchester Electric Light stations, etc., etc.

Economical Power Generation

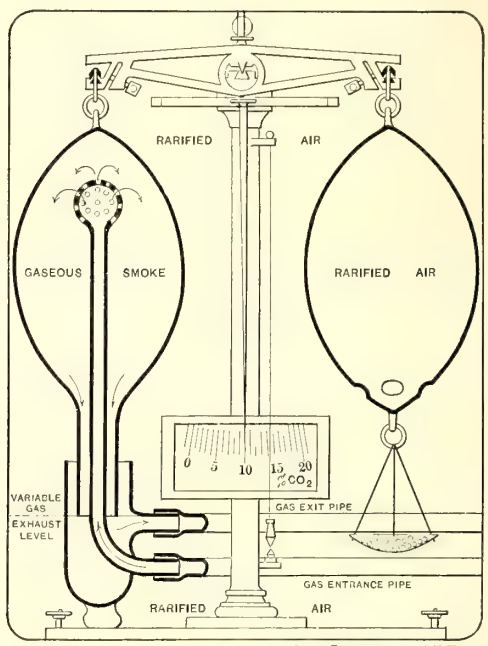
Economy in power generation is constantly receiving greater attention, and street railway and tramway managers are now studying every avenue of expense to learn whether there is any posibility of making a saving, however small, in this or that department. For this reason many engineers in America are looking with great interest on the subject of the use of refuse as a fuel in their power stations, and investigating the successful results secured in this direction in England by the Simplex Destructor manufactured by Meldrum Bros., of Manchester. The principles of this destructor were fully described in the STREET RAILWAY JOURNAL for May and July, 1898; but since the publication of these issues Meldrum Bros. have greatly increased their sales, and their well known device has gained even greater popularity. One of that firm's most recent installations, and one which has just been completed, is at Darwen, Lancashire, where all the power is to be obtained from refuse, and no supplementary boilers are being put in for coal firing. This installation marks the confidence of the authorities that they can rely upon refuse alone for obtaining light and power for tramway purposes.

The manufacture of the refuse destructor, however, forms only a department of the extensive business of Meldrum Bros., who have made a specialty of the construction of a variety of economical machinery for steam uses. Another product for which they have an extensive sale is their mechanical stoker. The results obtained by this stoker are remarkable alike for boiler efficiency, for weight of steam obtained per hour, and for fuel efficiency, i. e., pound of water evaporated per pound of fuel burned. The stoker is said to be the only one that will burn coal dust and (breaze) successfully. It combines forced draft with stoking on the coking principle, with surprising results, as shown by the above test on a Lancashire boiler 30 ft. x 8 ft., which is a sample only, and with results which compare very closely with others. The boiler was fitted with two flues 3 ft. 3 in. diameter, and an economizer was not used during the test. The duration of each test was eight hours continuous running. The heating surface of the boiler was 1000 sq. ft., and the total grate area 35.75 sq. ft.

RECORD OF TESTS MADE WITH STOKER

Kind of coal used (Lancashire)	Arley Nuts.	7 ft. Nuts.	4 ft. Slack
Total water evaporated per hour in lbs.	12625 lbs.	10500 lbs.	8625 lbs.
Water evaporated per sq. ft. heating surface per hour	12.62 lbs.	10.5 lbs.	8.62 lbs.
Water evaporated per lb. of coal as fired	7.65 lbs.	8.18 lbs.	8.12 lbs.
Water evaporated per lb. (from and at 212° F.) per hour	9.09 lbs.	9.57 lbs.	9.35 lbs.
Temperature of feed water entering boiler	63.3° F.	79.1° F.	96.1° F.
Mean steam pressure in boiler	77 lbs.	67.5 lbs.	64.5 lbs.
Weight of coal burnt per hour	1650 lbs.	1283 lbs.	1062.5 lbs.
Weight of coal burnt per hour per sq. ft. of grate	46.15 lbs.	35.89 lbs.	29.72 lbs.
Percentage of heat transferred to boiler	62.96 p. ct.	64.11 p. ct.	65 69 p. ct.
Percentage of CO_2 in flue gases	13.0 p. ct.	11.6 p. ct.	11 0 p. ct.

Still another apparatus manufactured by Meldrum Bros., which has received a most favorable reception from steam engineers, is the Arndt patent coal-saving gas-weighing apparatus. This device is termed an "econometer," and is illustrated herewith. It is a well known fact that for the combustion of a fixed quantity of fuel of a certain quality a definite quantity of atmospheric air is required. If more air than is necessary for perfect combustion is conveyed to the fuel a loss of heat arises, caused by the superfluous air being unnecessarily brought to the high temperature at which the gases leave the steam boiler. How great this loss may be and how small it only need be, may be seen from the table here-



ECONOMETER

with. This table shows the loss of heat and fuel with from 2 to 15 per cent C O_2 in the combustion gases. The proportion of air actually used to the theoretical amount required is, in the case of coal (according to Bunte) $\frac{18.9}{K}$, being the amount per cent of carbonic acid in the gases.

TABLE SHOWING LOSS OF FUEL WITH ADMISSION OF DIFFERENT PERCENTAGES OF AIR IN FURNACE

For Coal of medium quality.

If there is	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Per cent. carbonic acid.
Then the quantity of air passing through the flues is	9.5	6.3	4.7	3.8	3.2	2.7	2.4	2.1	1 9	1.7	1.6	1.5	1.4	1.3	Times the theoretical requirements.
With a surplus supply of air of 30 per cent. or about 10.4 Cub. M. of necessary air per kilo. of fuel, there will still be a further excess of about	6.56	40.0	27.2	20.0	15.2	11.2	8.8	5.6	4.8	3.2	2.4	1.6	0.8	0.0	Cubic metres of superfluous air heated to a temperature of usually 270° Centigrade.
And the loss of fuel at 270 C amounts to	90	60	45	36	30	26	23	20	18	16	15	14	13	12	Per cent.

The "econometer" is designed to indicate the exact percentage of C O_2 in the gases. These are admitted to the left-hand bulb of the scale, and as carbonic acid is about 50 per cent heavier than atmospheric air, the amount and percentage of this gas can be readily determined by reading the scale. Filtering chambers, drying chambers, etc., necessary for obtaining correct results are provided with the equipment.

Absolutely no smoke was made during the whole of the tests.

Another interesting point was the high reading of C O_2 in the chimney gases, as ascertained by the Orsat apparatus, proving little excess of secondary air.

The company has received a number of excellent testimonials to the valve of this forced-draft furnace—among others from Arthur Ellis, M. I. E. E., borough electrical engineer of Bolton; John H. Barker, A. M., I. C. E., general manager of the Cambridge Electric Supply Company, of Cambridge, and Henry W. Bowden, manager and chief engineer of the Kensington Central electrical lighting station.

That some railway companies have already taken precautions to keep their lines open during the coming winter is shown by the fact that since Aug. 1 last, Messrs. Wendell & MacDuffie have taken orders for sixty-three Taunton electric plows and ten sweepers. For so early in the season this is certainly an excellent indication of the value of these machines. The same firm also reports doing a large export business in the many street railway supplies for which they are agents.

The Electric Railway and Tramway Carriage Works at Preston

The opening of the electric railway and tramway car works at Preston, England, last Spring, was an excellent indication of the extent to which electric railroading has gained popularity in that country. The difficulty of obtaining new tramway cars on short or even moderately long notice had long been felt, and with the increasing number of electric roads in the United Kingdom there was a large demand for an extensive addition to the car building facilities of the country. For this reason the support of prominent home capitalists was enlisted, and the extensive works at Preston were the result. The directors of these works are Chairman George Richardson, Richard H. Prestwick, George F. Fry, Robert B. Barningham, Robert S. Boddington, John Kerr and Geoge Flett. The manager of the company is E. A. Stanley, formerly of the Jackson & Sharp Company, of Wilmington, Del., and the secretary, J. Baynes.

The works are close to the Albert Edward Docks, and the River Ribble, and have sidings into them from the London & North Western and the Lancashire & Yorkshire Railways. There is every facility for the receiving and dispatch of materials and goods, whether by sea or land. The buildings are so extensive that of the thirteen acres to which the property extends, from four to five acres are under cover. System and orderly sequence, resulting in efficiency and economy, form the key-note of the whole plant. Beginning at the entrance, and taking those in the south and afterward those on the north, the buildings include the following: To the right of the entrance, general stores; to the left, the offices of the company; at the south end of the ground, a building for cutting and storing timber and lumber; at the north end of the ground, boiler and engine rooms, bogie fitting, machine and smiths' shops, carpentry and erecting shops, paint shop, and pit shop where the numerous pits between the tracks admit of the motors being fitted to the electric cars. The experimental track in the grounds is also a prominent feature.

The steam is generated by two Galloway boilers, each 28 ft. long by 7 ft. 6 ins. diameter, and having a nominal rating of 225 h.p. The engine is of the horizontal compound type, with automatic fly-wheel governor, and is coupled direct to a Mather & Platt multipolar dynamo. The size of the engine is 14 in. and 25 in. x 24 in. stroke. Its output is 325 i.h.p. at 150 r.p.m., the steam pressure being 120 lbs. per sq. in. This plant is now being duplicated, and any possible breakdown will thus be avoided.

The main switchboard consists of slate panels, mounted on an iron framework, and from it there are run separate distributing feeders for lighting and for power in each of the shops. The pressure is 230 volts, which is considered the most suitable for combined distribution to motors, incandescent and arc light, and by a special arrangement of the switchboard the dynamo and a storage battery, which under normal conditions are operated in parallel, can be connected in series to a special bus-bar when it is necessary to test motor cars on the experimental track mentioned hereafter.

The storage battery consists of 140 chloride cells, having a capacity of 440 amp. hours, and is intended for use in lighting the buildings during the night, or should it be found necessary to work in one section of the works for a few hours overtime, the motors can be operated from the storage battery, and thus avoid running the main engine.

The whole of the machine tools throughout the works are operated by electric motors. In the case of the larger tools an individual motor is used, but for the smaller machines two or more are grouped together on a single motor. By this arrangement the heavy losses of line shafting are obviated, and at the same time the objection to a larger number of small motors all of different sizes is avoided. Thus throughout the works there are over twenty-five motors, but in only three sizes of 10 h.p., 25 h.p. and 40 h.p., and



GENERAL VIEW OF PRESTON WORKS



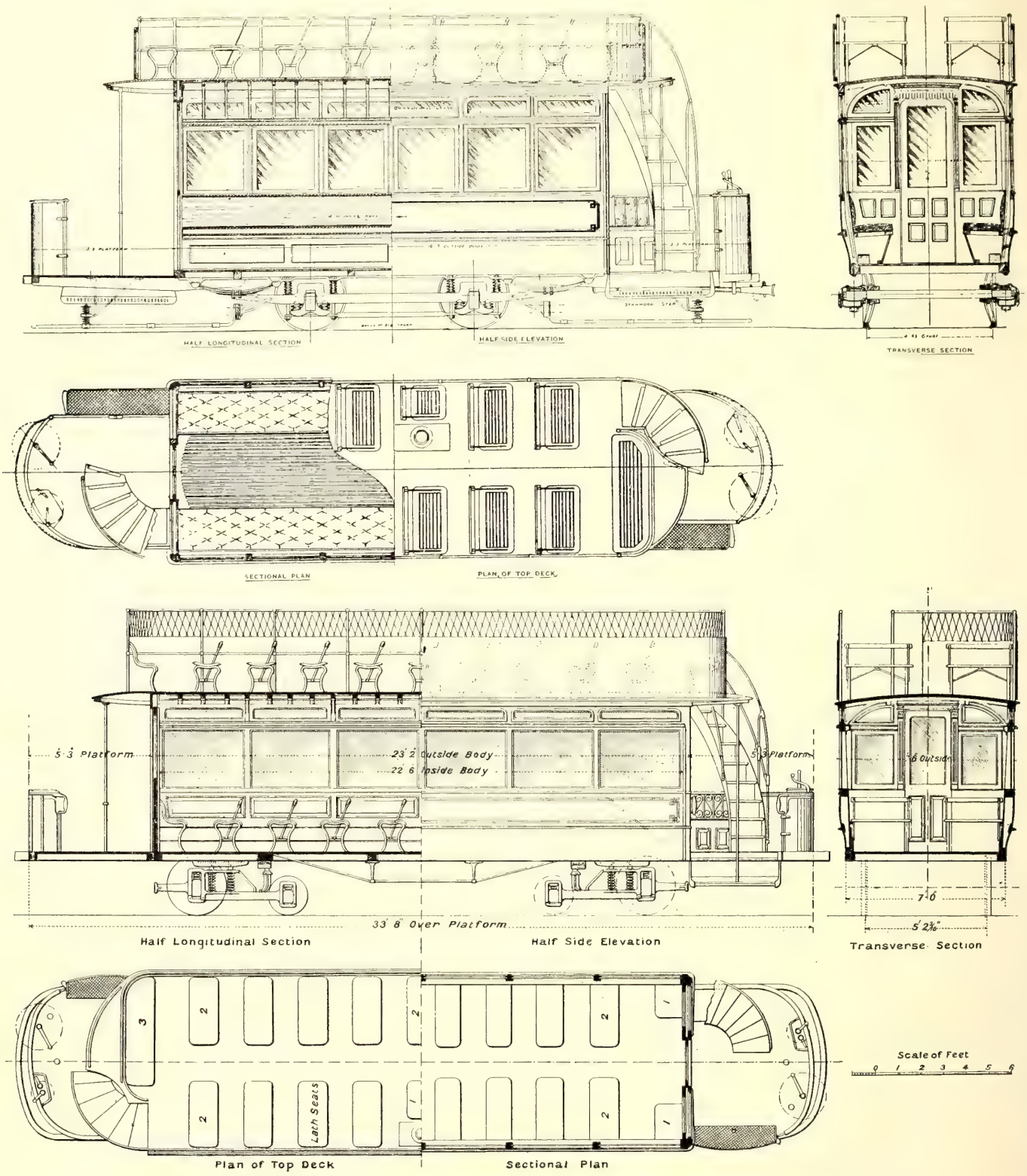
END VIEW OF MAIN BUILDINGS, PRESTON

as each size is of the same make and interchangeable, only a minimum quantity of spare parts are required to be kept in stock.

Timber is brought on cars into the store room, which is a plain brick structure 225 ft. long by 50 ft. wide, and one story high. The railway track runs right through the building. At the east end is a log band saw mill where the logs are rapidly sawn into planks of whatever thickness is desired. The mill can deal with logs up to 48 in. in diameter, and from 30 ft. to 40 ft. long. Storage space for an ample stock of timber is provided, a very large portion of which is already occupied with selected and naturally seasoned timber of the highest grade, the fundamental importance of securing and having in stock a sufficient supply of carefully seasoned timber having been one of the first points to receive the attention of the management.

The sawn timber is conveyed from the storage shed on the railway track direct into the wood-working machinery and erecting shops, which occupy the two central bays of the main building. The shops now referred to have light iron truss roofs, are well lighted, and have a concrete floor between each railway track. They are equipped with machines of the latest and best type, which have been obtained from America. Here the timber is sized, shaped, and put together, and as the car body grows it is passed along to the north end of the shop, and then across to the paint shop on the west side, where in the various surface finishing processes, outside and inside, it is worked back southwards to the pits, where the addition of the truck and motors takes place.

In connection with the wood-working machinery an apparatus called a cyclone dust collector has been provided, which by a sys-



TYPICAL DOUBLE-DECKED SINGLE AND DOUBLE TRUCK CARS RECENTLY BUILT AT PRESTON

tem of piping, conducts all wood dust and shavings to the boiler house, where they are deposited for use as fuel. Good storage capacity is provided for this material close to the furnaces.

Iron and steel materials which have to be forged go round, on coming into the works, to the east side of the buildings and are passed on the railway wagons into the smithy. While the company manufactures trucks for electric cars it is also prepared to supply and fit to the car bodies any make of trucks. When the trucks which are built on the premises are finished they are brought out in front of the bogie shop and taken along by a traverser, which runs along the front of all the shops, to the pits at the end of the paint shop, where they are fitted to the car bodies. The other iron work of the cars is worked northward to completion, and is then passed across to the paint shop and fitted in place. In the iron fitting shop two large galleries run the entire length of the building on each side, and in these a large amount of work is done, while the space below is of course still available. The smaller and lighter machine tools are placed in the galleries, and the heavier are underneath. Nearly all the machinery and machine tools for the iron working part of the establishement have been bought from English makers.

The paint shop requires only little special fitting, but heating arrangements have been provided to keep the temperature uniformly at 65 deg. After the finishing touches are put on the car bodies, they are moved along to the pits where the trucks and wheels are attached, and, in the case of electric cars, which will form the majority of the output, the motors are fitted. There is really but one large pit extending the full breadth of the shop, but between the tracks it is covered over. As there are eight tracks in this shop, and two pit openings in each track, the effect is to give sixteen working pits. The depth is ample, so that the men can conveniently work underneath the cars and get everything properly fixed.

When the cars are mounted, and the electric connections and fittings have been adjusted, they are ready for testing. The car is brought out of the paint shop on to the testing line, part of which also serves, as already described, for bringing the material into the works. The ground is fairly level, though at the east side where it rises a little some cutting was necessary. The track is carefully laid with 56-lb. rails, on creosoted ties, and fully ballasted. Its length is a little over half a mile. Including the fifteen sets of tracks inside the buildings, the total track length of the works is about 2 miles. The testing line is equipped with overhead trolley wires in the usual fashion, as in the case of an electric tramway. Curves of various degrees of sharpness have been provided on the track, so that the trucks may be tested under a variety of conditions, including those of maximum difficulty. The sharpest curve has a radius of 35 ft., and it is obvious that if a car can go round a curve of this sort in the works it will be able to do the same thing in actual service. Further on there is a curve of 50 ft. radius, and subsequently another which is of 90 ft. radius. All severities of curvature are thus provided for. There is no test for gradient, but that is a matter which mainly concerns the power of the motors, and this company does not build motors. It fits the motors which are provided by the electrical manufacturers, and these machines at the present time are thoroughly standard- and tested for the various classes of work which they are intended to perform. The car, having successfully gone through the ordeal of the testing track, is now ready to be put into service.

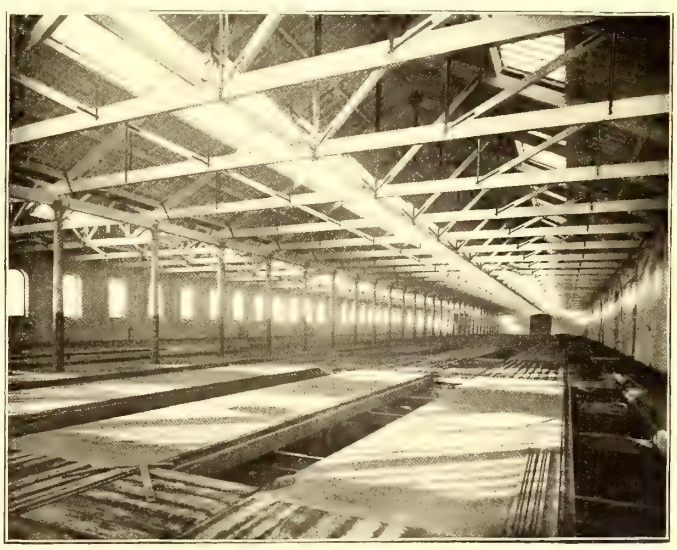
On the basis of the ordinary size of tramway car with roof seats, the capacity of the works is about 800 cars per annum. Larger cars of the eight-wheeled type, both for electric railways and



STORAGE YARD AT PRESTON



WOOD WORKING DEPARTMENT



PAINT SHOP

tramways, will be turned out when required, and the company will be able, if necessity arises, to build railway carriages. The number of men employed will range from 600 to 800. The first order undertaken was one of seventy-five cars for the North



ASSEMBLING ROOM

Metropolitan Tramway Company, of London. Since that time the company has built cars for many other roads, including tramways in Aberdeen and West Hartlepool, and the Waterloo & City Underground Railway, of London.

Automatic Lubrication

In most of the large electric power plants which are being built the installation of some system of automatic lubrication for the journals and bearings of the engines and other running machinery is the rule, and not the exception; for electrical engineers now generally admit the saving and economy, as well as the better lubrication, afforded by mechanical means over that when hand lubrication was depended upon. A good idea of the saving secured by automatic lubrication is shown by the record of the Missouri Edison Electric Light Company, of St. Louis. Mr. Wagner, general superintendent of that company, said recently that during the six months or more in which he had had automatic oiling apparatus in operation a saving had been effected of over $300 per month in the cost of oil, and $150 per month in wages. All of the saving in wages was attributed to the use of the oiling system, and about half the saving in oil, the balance being due to a change in the character of the grade of the oil itself. The system used at this station is that of the Siegrist Lubricator Company, of St. Louis, which has made a specialty of the construction of automatic oiling systems, and manufactures not only special oil cups for the use of the system, but also piping, pumps, etc., automatically controlled by special governors to maintain a constant pressure on the pipe lines to which they are connected.

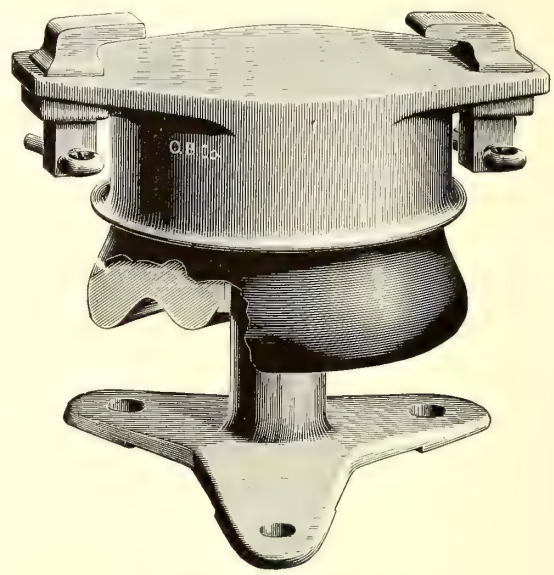
The pumps are usually located in the engine room, and are mounted on a table, the top of which is of iron, polished and japanned black, to give it a bright and lasting finish. On this table are four specially made pumps, two for the engine and generator bearings, and two for the cylinder oil. Only one pump of each set is used at a time, the other being held as a reserve or duplicate to be thrown into service if required. All connections are of polished brass, making this part of the equipment exceedingly ornamental. As will be seen, the system does not depend upon gravity pressure, but upon a high steam pressure. The oil is stored in two tanks, placed one on each side of the table, or wherever desired, and connected to the pumps by suction pipes, which run down to, and under the floor, and then into the tanks. In addition there are two main discharge oil pipe lines, carried usually under the floor to the engines, with branch lines to each bearing on which lubrication is necesary. A valve placed in a convenient place on each branch line controls all the oil on that engine automatically, and the starting or stopping of one or more engines does not affect the others.

The automatic sight feed iubricators are made extra heavy to stand any steam pressure, and glasses are imported directly from Scotland. They have large, clear openings, with a 1-in. glass and gate valve connections for the free passage of oil. Each lubricator is also furnished with a back connection for steam, which keeps the oil hot, and as well closes the lubricator in case the oil pressure gets below that of the steam. The automatic oil cup is also made extra heavy, and can be regulated by a thumb-screw to give any quantity of oil required. When once set this oil cup requires no attention, unless a different feed of oil is wanted. The system also includes an improved filter, to which the unused oil is returned automatically, after which it is pumped back to the tank. After the oil is taken from the barrel and is put into the tank it is under complete automatic control.

Third Rail Insulator

Frequent inquiries for an insulator adapted for the third rail system have resulted in the Ohio Brass Company, of Mansfield, Ohio, bringing out for the market a device similar to the illustration shown herewith. This is of the same general character as many of its predecessors, but presents several new features which give it originality; in fact, a patent has recently been allowed the Ohio Brass Company upon it.

This insulator consists of a malleable iron standard rigidly secured to an insulating body of vitrified clay, or some similar



THIRD RAIL INSULATOR

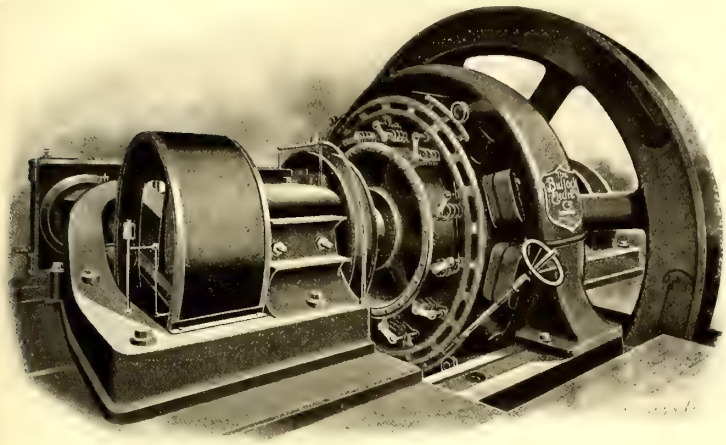
material, which is of the proper size and design to support the third rail with safety, and also present sufficient surface leakage of the current over its exterior. Upon this insulating body is fastened a malleable iron cap casting which supports the third rail, and, by means of lugs on each side, holds it in alignment horizontally, but permits vertical play or motion to obviate the trouble arising from the breaking of the insulators, which has occurred in the past, from the rail being secured too rigidly to the insulator.

Head-Lights for Electric Cars

The Multiplex Electric Company has recently published a short catalogue descriptive of the various styles of corrugated reflectors manufactured by it for steam and electric railway cars. These reflectors are spun out of a heavy gage of brass, and their form consists of a series of convex and concave shells, the size and radius varying with the style and kind of light to be used. Each corrugation is a powerful reflector by itself, and the reflector is thereby enabled to produce a light of great intensity. The company also makes a specialty of furnishing these reflectors to persons who desire to substitute them for others which they now have. It also supplies special incandescent lamps for railway head-lights. These lamps have certain features which particularly adapt them for this use. The company also makes oil head-lights.

A New Street Railway Generator

During the ten years of its existence, the Bullock Electric Manufacturing Company, of Cincinnati, has established a high record for its electrical machinery, and Bullock motors and generators have become famous the world over as being thoroughly reliable and up-to-date. As a result the company's business increased to such an extent that in 1898 it determined to erect new



800-KW. GENERATOR

works which were occupied in January of the present year. Encouraged by this success, the company has now determined to enter the railway field. To this end, a complete line of engine type railway generators has been designed up to and including the 800-kw. unit. Bullock railway generators will possess all of the features that have made this company's present standard machines so popular, and also some new features that cannot be found in other machines.

Among the more important may be mentioned a scheme for oscillating the brush holder mechanism in a direction parallel with the shaft. The movement is very slow and results in constantly changing the line of travel over the commutator face and thus removes all tendency to cut or groove the latter. The action is the same as secured by the end play of an armature in a belted generator or that produced by the electro magnetic device used at the ends of shafts on rotary transformers, and which is recognized by engineers as a means of greatly prolonging the life of the commutator.

The pole pieces and coils may be removed without disturbing the yoke or armature, and with two of them removed, it is possible to remove one or more armature coils should repairs be necessary.

The armature coils are made of continuous bars of copper without joints between the commutator connections which materially adds to the life of the machine. These coils are all thoroughly insulated, pressed and baked before being placed on the core, no additional core insulation being necessary.

All armatures are thoroughly ventilated by slots perpendicular to the shaft through which the air rushes when the machine is in operation. A liberal rating permits of constant operation at full load with low temperature rise.

One of the 800-kw. machines has been sold to the Oakland Rapid Transit Company, of Oakland, Cal., and is shown in the engraving. This machine operates at a speed of 80 r.p.m., and at this speed develops 550 volts at no load. It is over-compounded for a rise of 50 volts at full load making the full load voltage 600.

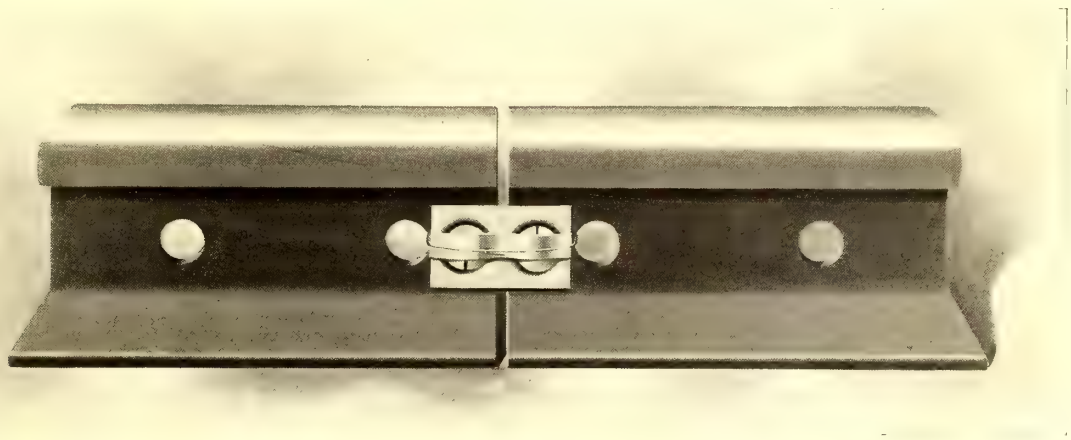
A New Copper Bond

A new type of bond, called the solid copper bond, has been designed by Harold P. Brown. It is not intended to take the place of his plastic bond for heavy duty, but it is intended for loads proportioned to its section. Its compact shape enables it to be sold at a low price.

The solid copper bond is made of a rectangular piece of rolled electric copper, 3 ins. long, ⅛ in. thick (or thicker) and 1½ ins. or more high. A cup-shaped projection is pressed near each end so as to give a contact against rail web close to the end of each rail. Inside the cups is a piece of sheet steel supporting a pair of special steel springs; the steel is used to keep the springs from wearing into copper. These pieces are held together by a small iron strap until the bond is applied when the sharp web on the outside of the spring cuts it away and it enters the angle plate, thus aiding the conductivity of bond.

The entire bond is amalgamated to prevent rusting, and the contact surfaces are covered with the plastic alloy. The springs are proportioned to give a pressure of 1000 lbs. per square inch when the angle plate is bolted up. The bond is always laid out to fit each particular rail and joint and does not interfere with the mechanical fit of angle plate. When in service the springs serve merely as distance pieces so long as the joint is tight; if the nuts loosen or the plate wears, the springs still hold the bond in firm contact. Then tightening the track nuts also tightens the bond. The use of lock washers is advised on the track nuts to keep them fast. The springs then take up merely the wear of the plate.

To apply this bond it is only necessary to brighten the web of the rail beyond the end bolt hole with the usual hand power grinder and emery wheel. The surfaces are then amalgamated by the Edison process and covered with a thin layer of plastic alloy. This unites with the amalgamation of the bond and maintains an electrical contact of low resistance which will not rust.



NEW COPPER BOND

The lubrication afforded by the plastic alloy permits the rails to move in any direction without wearing away any metal of the bond.

The size of the copper will be varied to suit requirements of purchasers, up to the full area of the space between rail web and angle plate, and between end of bolt holes in rail. The manufacturer will not make a smaller size than No. 0000 since less than that amount of material will not give sufficient mechanical strength for durability.

The bond shown has a vertical cross section of more than 0.218 sq. in., while the section of a No. 0000 wire is but 0.166 sq. in. The bond, therefore, has a conductivity equal to one and three-tenths No. 0000 copper wires.

The depth of the special steel spring is varied to suit the clearance between rail and angle plate and is always so proportioned

that the spring is perfectly flat when joint is tight. The steel is made for this purpose and will maintain its tension for years. On covered track in wet or alkaline soil where steel is apt to rust rapidly, both the springs and the sheet steel base, when desired, can be treated with a petroleum compound which will permanently protect them. This, however, will prevent the angle plate from taking any portion of the current through the bond contacts.

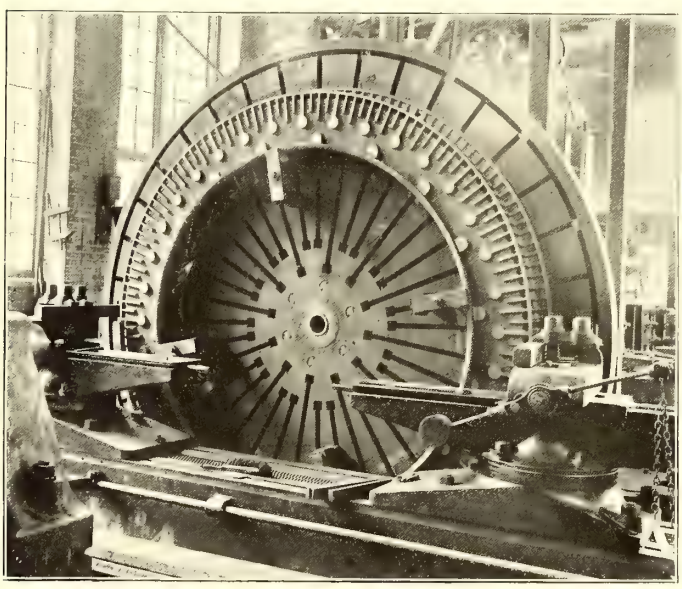
Amalgamated copper bonds of this type (but without the spring feature) have been in satisfactory service for several years. The springs are a safeguard against poor contacts when the joints loosen. As long as the joints are kept tight the bond will do its work. There is no bending nor shearing strain on the copper since the bonds have sliding, lubricated contacts.

Extensive Electrical Works in Chicago

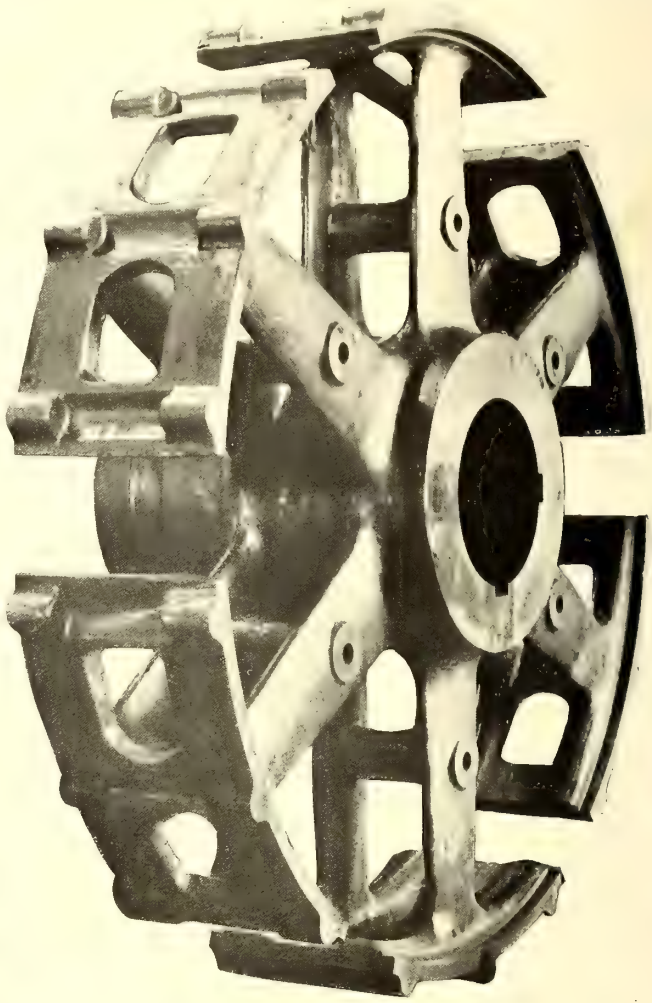
One of the chief points of interest to the delegates of the coming American Street Railway Convention at Chicago, will undoubtedly be the extensive manufacturing works of the Siemens & Halske Company, of America. This company, as is well known, has supplied a very large proportion of the large street railway generators in Chicago, particularly for the Chicago Union Traction Company and Chicago Consolidated Traction Company, operating on the north and west sides of the city. Within the last year, however, the company has been reorganized and has changed in a number of points, the design of its large railway generators. It has also entered extensively into the manufacture of small motors for automobile service, wattmeters and other measuring instruments for all varieties of current, and, in fact, into nearly all classes of electrical machinery, with the exception of street railway motors, in which field the company has not as yet engaged. It is understood, however, that the manufacture of large generators for lighting and power work will be made an important specialty of the company, and as the designs for the improved type of the railway generators have been finished, and as many of these large machines are in various stages of completion at the company's works in Chicago, an inspection of these shops will prove of especial interest to railway managers and engineers. The works, it should be stated, are equipped throughout with the best of modern machinery and orders have been received in such large quantities as to require the operation of the shops day and night during the past summer.

Among the special machines noticed by a representative of the Street Railway Journal during recent trips to the shops, were two 1000-kw. generators, one for the Northwestern Elevated Railway Company, of Chicago, and one intended for use in Kansas City, Mo.

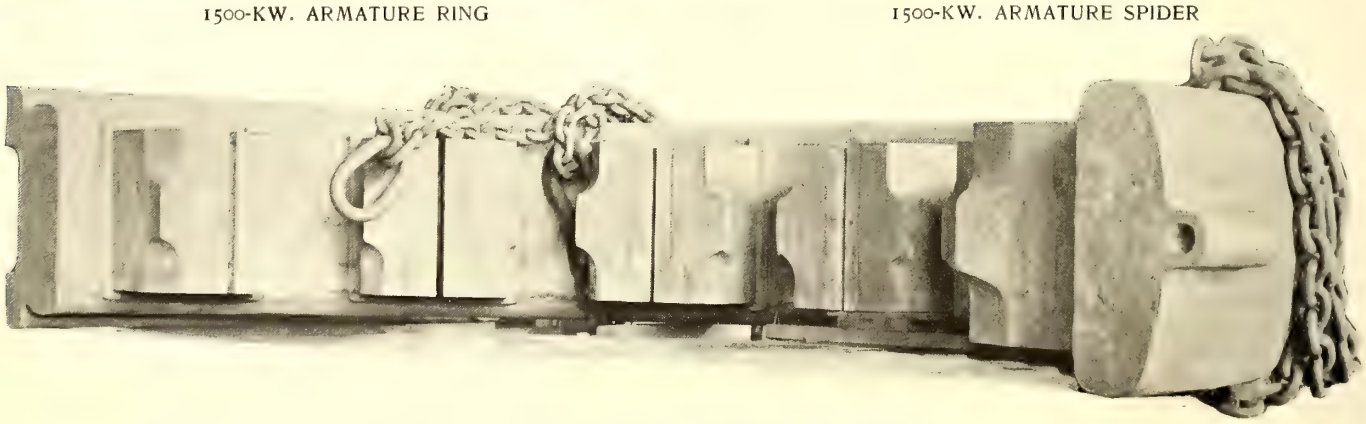
As the company's new design of railway generator will be of the greatest interest to the street railway reader, a description of it in detail will now be given. The magnet frame is a circular yoke of cast steel, divided either horizontally or vertically. The former construction is used for generators to be installed in stations equipped with traveling cranes and the latter where the halves are to be mounted on guides and drawn apart. The field poles differ



1500-KW. ARMATURE RING

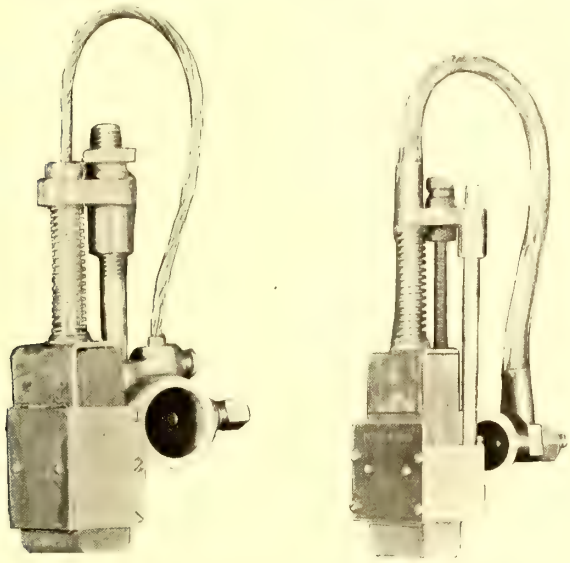


1500-KW. ARMATURE SPIDER

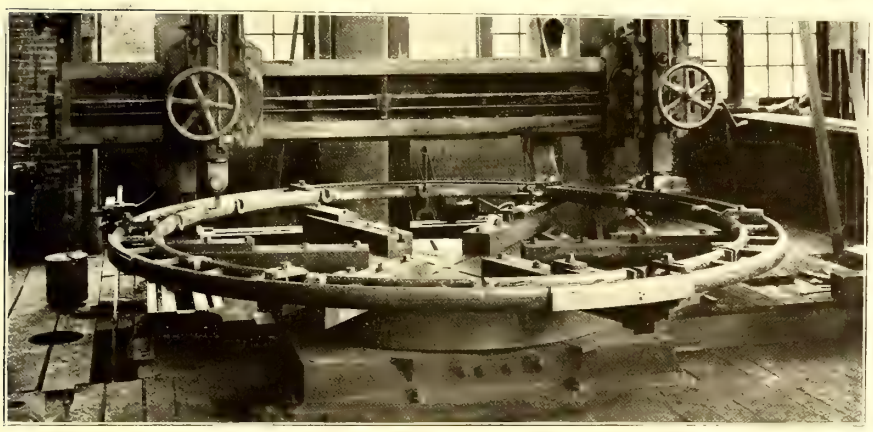


1500-KW. MAGNET FRAME, SHOWING POLE PIECES

from the ordinary praetice, in being shoeless, and are so proportioned that perfect commutation can be obtained, it is claimed, under all conditions, from no load to 50 per cent overload. The field coils are wound on spools and heavily insulated, the shunt and series coils being wound separately, so that either may be removed from the spool without disturbing the other. Any spool can so be removed from its pole piece by taking out the retaining non-magnet pins which hold it in position. The series coil is so proportioned and located that it acts directly on the armature coils, eliminating the distortion of the field magnetism, and thus obviating the sparking. This method is claimed to be much more advantageous than that in which the main effect of the series coil is upon the iron of the field magnets, pole, shoes, etc., because the latter when saturated change their permeability as the load increases. The field coils are machine wound and protected with heavy insulation at points of mechanical strain. The pillow block and bearings are separate castings, fitted to the main casting on an arc. This allows the armature to be accurately centered and perfect alignment to be permanently maintained.

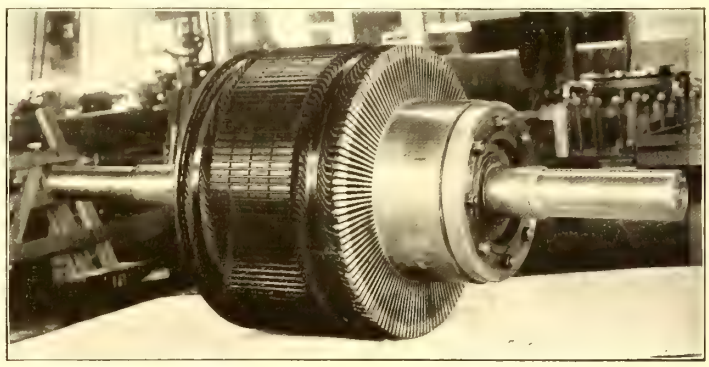


BRUSH HOLDERS



TURNING A 1500-KW. BRUSH HOLDER SUPPORTING RING

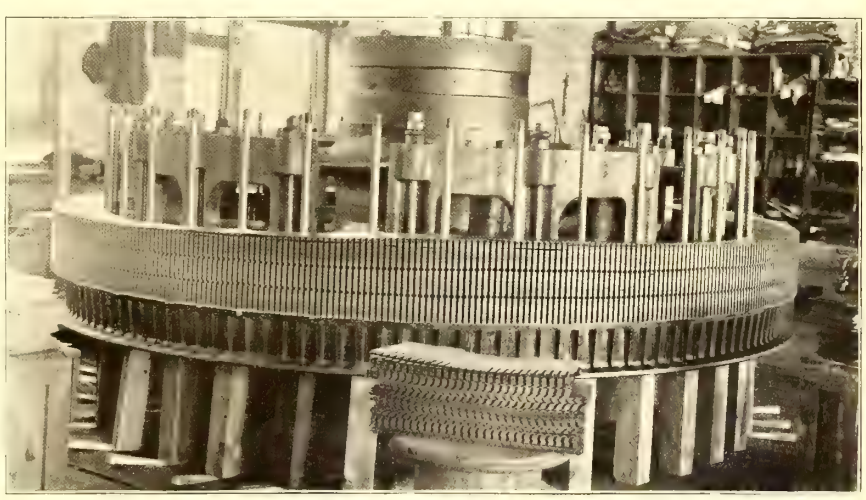
The armature is of the drum type, having a uniformly toothed core, built up of laminations of special soft steel and assembled in a cast iron frame. The first point which strikes the observer in looking at this core is its great surface and diameter, with comparatively little depth. The object of this is two-fold. The first reason is to permit the use of a large number of commutator bars, with consequent small differences of potential between adjoining bars. As a matter of fact, the maximum difference of potential between adjoining bars in the company's latest 550-volt generator is not over 6 volts or 7 volts. The second object of this construction is to secure good ventilation. In fact this object, to which we will refer to more particularly later in connection with the construction of the armature spiders, has been very carefully followed in the construction of all parts of the machine. Air ducts radiate frequently through the laminations outward from the center and provide a constant and effective ventilation. The armature windings are all copper bars, formed, insulated and tested before application. They are placed in the slots and rigidly held in position by wedges, no band wires being used. This method of construction, while it decreases the loss due to armature resistance, reduces heating to a minimum and increases the efficiency of the machine. All connections between the armature and commutator bars are soldered.



ARMATURE FOR 50-KW. GENERATOR

The armature spider itself is cast solid, and is pressed over the shaft, to which it is also keyed. The spokes are so designed that the spider shall be self-ventilating and arranged to throw blasts of air through the armature air ducts against the field coils.

The commutator is of extra large diameter, though not located outside of the armature coils and field, as with the original Siemens & Halske machines. The commutator segments are built up on a shell extension of the armature frame, and the maximum number of bars is employed, only one turn per coil being used. The bars themselves are of hard drawn copper and are held in position by a special retaining holder, which allows any bar to be readily removed without disturbing the balance of the commutator. The only wear on the commutator is the friction of the brushes.



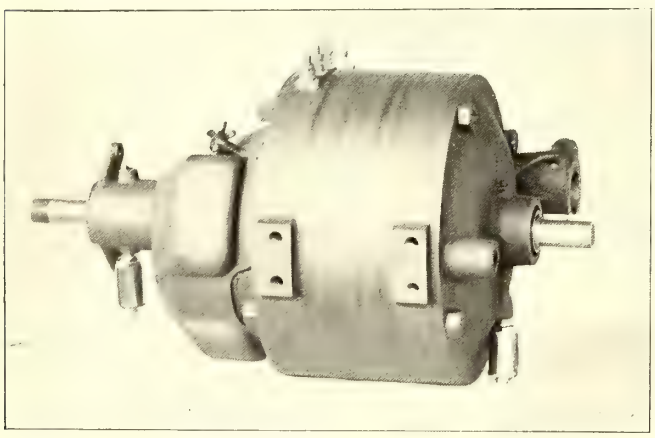
CONNECTING A 1500-KW. ARMATURE CORE

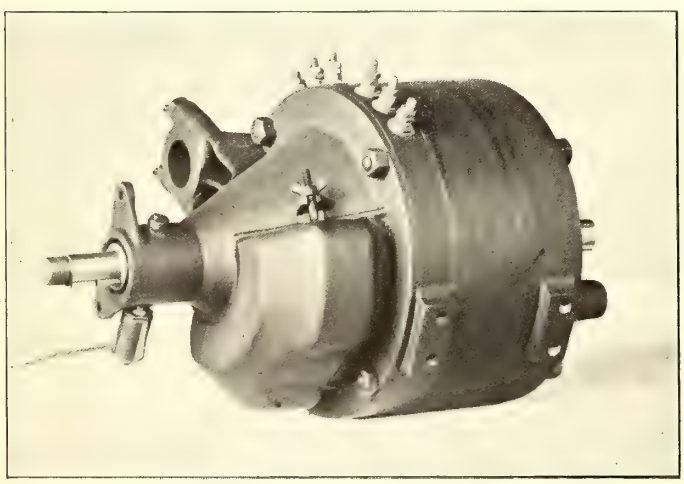
The bearings are self-oiling and self-aligning. The oil is automatically raised from the reservoir in the pillow block to the shaft and distributed evenly by the ducts in the bearing shell over the entire bearing.

The brushes and holders are of special type, invented by Mr. Churchward, chief engineer of the company, and designed to secure constant pressure of the brushes against the commutator, together with the minimum drop in voltage between the commutator and the generator leads, due to electrical resistance. Carbon brushes which are self-feeding, self-adjusting and independently adjustable, are used. They are located radially to the commutator as shown in the accompanying engraving. Their pressure against the commutator is kept constant by a spiral spring, insulated so that its tension is not varied by heat. Attached to the outer end of the brush is a brass rod, to which the lead is soldered, making the path for the current of the lowest possible resistance. The generator lead itself is made up of a vast number of No. 36 copper wires, which give enough flexibility to take up all vibrations of the brush. On the large generators the brush holders themselves are carried on a substantial ring supported from brackets bolted to the frame. By means of a hand wheel and worm gear all of the brushes may be shifted simultaneously. The construction of all these parts is shown in the accompanying engravings.

All of the engine type of generators made by the company are carefully tested during construction and after completion, and no machine is accepted for shipment unless it has withstood the full series of tests prescribed by the company's engineer. All tests are made much more severe than the machines are likely to meet under actual conditions of service.

Special attention is given in these tests to temperature readings and no machine is sent out in which, after a continuous run of

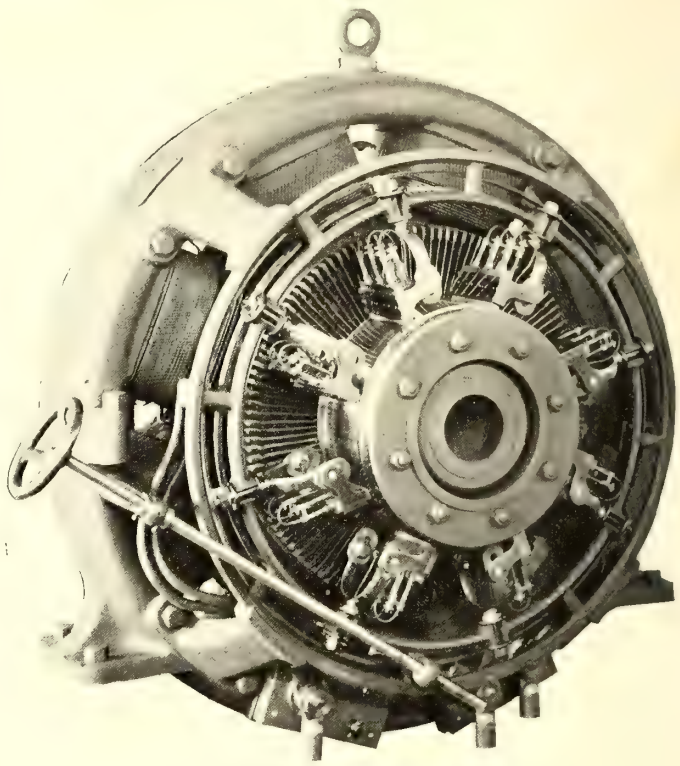




AUTOMOBILE MOTORS

ten hours of full rated load, the temperature of the armature and field wires has risen more than 40 degs. centigrade above that of the surrounding atmosphere. The company also designs its engine type of generators to operate for one-half hour at 25 per cent over load and for a shorter time at 35 per cent over load without injurious heating. All parts of the machines are also made to gage and are interchangeable.

In the manufacture of automobile motors, in which many railway companies are now taking special interest, Siemens & Halske Company, of America, has made rapid progress. An inspection of the company's work shows many of these motors in process of construction and ready for shipment, and the automobile department has a capacity of 125 motors a week. Special attention has been given to the design of these motors. To secure maximum output with minimum weight, the fields are made up of laminated iron. The armatures are of the drum type and the brushes of the same radial pattern as that used on the larger generators. The motors are four pole machines and are generally of 2 kw. and de-



50-KW. DIRECT CONNECTED GENERATOR

signed to run at 800 r.p.m. maximum. They are tested to 300 per cent over load, which must be carried with a rise of not more than 65 degs. centigrade, and are designated to run continuously at 4 h.p. with a rise of not more than 40 degs. centigrade. Another important department of the company's works is the manufacture of boosters and rotary converters. The former are built for both motors and engine driving and the latter with a special mechanical attachment which prevents hunting and pumping, while not reducing the efficiency.

Among the rotary converters noticed in the works during a recent tour of inspection, was some for the Wyoming Valley Electric Company, Wilkesbarre, Pa. These converters form a part of a third order recently given this company for this class of machines, a good indication that satisfaction has been given by them. The company also has a large business in the manufacture of electric lighting apparatus, including enclosed arc lamps and wattmeters. The former are a design of Thomas Duncan, and have proved so popular that the meter department has had to be increased several times to keep up with the orders.

The foundry department alone of the company is most extensive. The company makes all its own brass, copper, iron and steel castings, and its foundry has a capacity of 50 tons a day.

The officers of this company are Isaac L. Rice, president; Charles S. Knight, vice-president and general manager; Williard T. Block, secretary and treasurer; chief engineer, Alexander Churchward. Mr. Knight, under whose general supervision all the work is turned out, is well known in electrical circles and has had many years of experience in the manufacture of electrical apparatus. Mr. Knight became interested in the Fort Wayne Electric Company, of Fort Wayne, Ind., in 1881; later when this company was placed in the hands of a receiver he became director in the new company, the Fort Wayne Electric Corporation; this connection continued until Feb. 1, 1899, when he accepted his present position. Messrs. Churchward, Duncan, Sessions, with many others of the Fort Wayne Company, also became con-

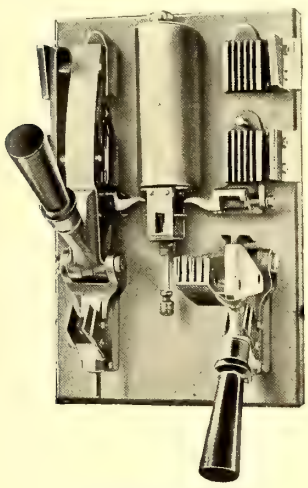
nected with the Siemens & Halske Company, thereby securing to said company such patents as were owned or controlled by the parties above specified in addition to the many secured from the parent company.

Ward-Leonard Circuit Breakers

The illustration, herewith, shows the Ward-Leonard circuit breaker which has come into very extensive use, although it has been on the market only about two years. Prominent among the concerns who use this circuit breaker is the United States Navy, which was quick to appreciate its important advantages.

This circuit breaker has two independent switch arms, each of which has an individual handle and an individual latch. Both latches are simultaneously tripped by a common plunger in case of overload. In closing the circuit breaker the operator first closes one switch and it is held closed by its latch. He then closes the second switch, which is in series with the first one in the same circuit. If an overload or short circuit condition exists upon the circuit when the operator attempts to close the second switch and establish the circuit, the plunger of the iron clad solenoid magnet instantly releases the latch of the switch, which was closed first, and it instantly opens the circuit. It is therefore impossible to close this circuit breaker except when the condition of the circuit is normal and there is no danger of damaging the apparatus in circuit or the operator when this circuit breaker is used.

A novel and important feature is the so-called hammer blow. Each switch has really two arms on the same pivot; one arm carries the switch blades and the other the handle and the roller



CIRCUIT BREAKER



EXHAUST HEAD

which engages with the switch; this latter, or "hammer arm," has a spring constantly tending to move it outward so as to open the switch. When the hammer is released by the plunger of the solenoid upon overload it is moved freely by the action of the spring through an angle of about 20 degs., when it engages with the switch arm and delivers to the latter a strong hammer-like blow which starts the switch blades surely and quickly, even though the friction of rest between the switch blades and their jaws is very great; the spring then rapidly opens the switch. It will be noted that by this novel feature the reliability of action of the switch is very greatly increased, and also that at the time of opening the switch the switch blades are moving at an extremely rapid rate, instead of slowly as in the case of other types where the spring has to accelerate from rest a large mass of material against a strong friction. On this account the arcing is reduced to a minimum. The final arc occurs on auxiliary carbon contacts so as to insure freedom from any arcing at the copper switch contacts.

For railway work, where overloads and short circuits are so frequently met, this circuit breaker gives the greatest possible safety to the apparatus and the operator in closing the circuit breaker after it has been automatically opened by overload.

When this type of circuit breaker is used the auxiliary hand switch which is customarily placed in series with the old type of circuit breaker is entirely unnecessary and thus a considerable saving of space on the switchboard is effected.

A nice mechanical point is that when the circuit breaker is open it does not extend outward from the switchboard any farther than when it is closed, which is an important point, as the central station operators are continually passing before the circuit breakers in close proximity to them where the old type in opening might cause serious injury to the operator. The circuit breakers are finished throughout in polished copper and present a very handsome appearance on the switchboard.

A New Form of Exhaust Head

One of the important features of a modern steam plant is an exhaust steam pipe head. To be effective it must thoroughly separate the water from the steam, and thereby prevent the constant spraying of roofs and walls with consequent deterioration and expensive repairs. In the form of exhaust head built by the B. F. Sturtevant Company, Boston, Mass., and illustrated herewith, the principle of centrifugal force is utilized to secure perfect separation.

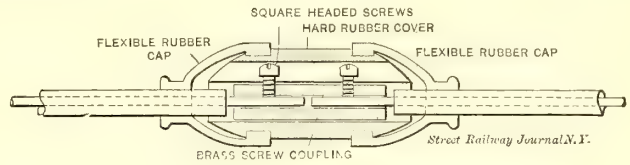
Dry exhaust steam weighs only .038 lb. per cubic foot, while water of the same temperature weighs 59.36 lbs. per cubic foot. It is therefore evident that inasmuch as centrifugal force is proportional to the weight of bodies in motion, the water will be thrown outward with $\frac{59.36}{.038}$ equals 1562 times the force exerted upon the steam. In the Sturtevant exhaust head the steam passes up the interior pipes, is discharged tangentially close to the shell, and is thereby given a whirling vigorous motion. The entrained water—likewise the oil—flies outward, strikes the cool side and trickles down to the outlet at the bottom. The steam, now perfectly dry, finds ready escape through the central opening above. The action is positive and absolute. Perfect separation must be the result.

These heads are built in sizes to fit pipes from 1 in. to 20 ins. All sizes above 10 ins. are flanged instead of tapped.

New Insulating Connector

It is well known that the old method of making the two-way connections of motor leads is a great consumer of time, and on a road where there are many motors the aggregate amount of time required for making and disconnecting these leads is considerable. To overcome this difficulty is the object of the connector illustrated in this connection. It is intended not only to avoid the use of tape, but also to produce an insulating jacket that can be easily attached and removed, and at the same time constitute an absolutely tight and waterproof joint.

The connector consists of three parts, viz.: a brass sleeve with two square-headed screws at each end and surrounded by a stiff rubber jacket, and two soft rubber jackets, one for each end of the joint. The method of making the connection is then as follows: The soft rubber caps are slipped over the ends of the wires, as shown, but bent backwards. The wire terminals are then inserted in each end of the sleeve and held in position by screwing down the set-screws. The soft rubber caps are then rolled back over the jacket, completely covering all the metal parts. The advantage of using square-headed screws is that they cannot work loose in the jacket and let the wires drop out, as the sides of the



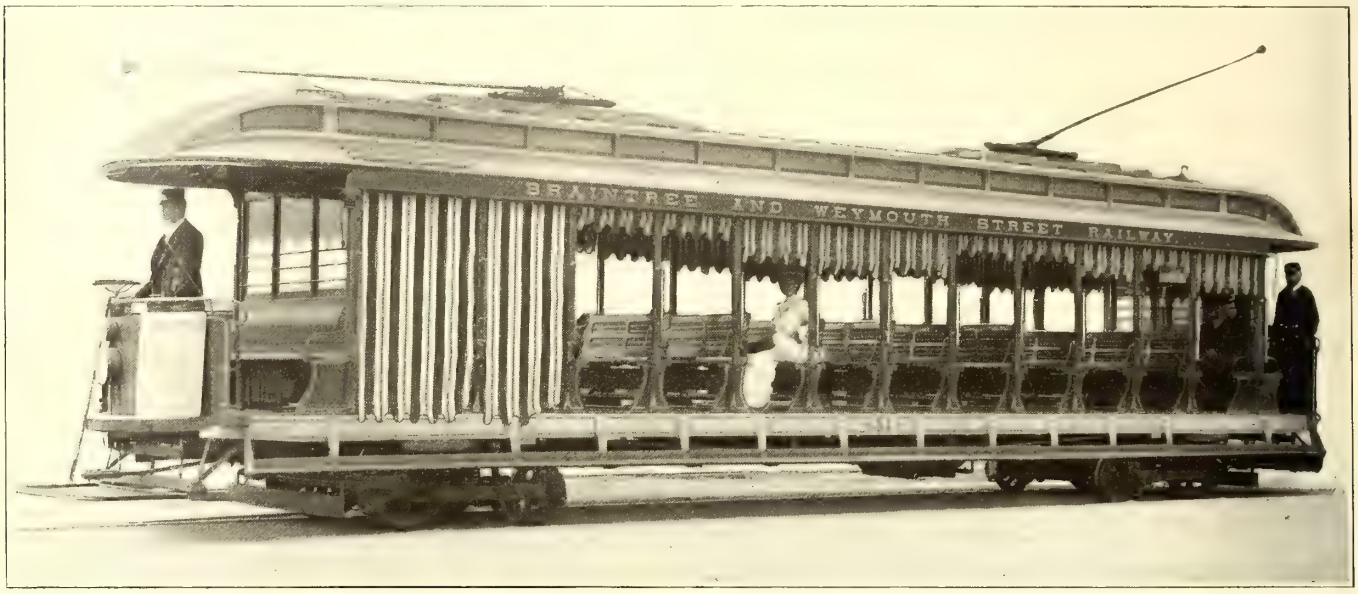
CONNECTOR FOR MOTOR LEADS

insulator are flush with the sides of the screws. These screws are also easily tightened, as common pliers can be used as well as a screw-driver.

The device illustrated is manufactured by C. S. Knowles, of Boston, who makes a specialty of street railway supplies to meet requirements. Among the specialties in which Mr. Knowles deals are cotton and linen hose, oil and electric headlights, paper for insulating purposes, tape, glass and porcelain insulators, trolley wires, carbon brushes, wires, cables, etc.

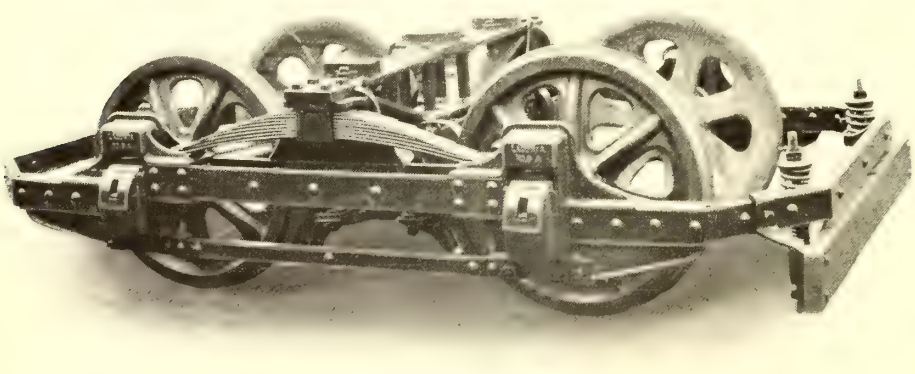
Handsome Cars for the Braintree & Weymouth Street Railway

The accompanying engraving shows an attractive fifteen-bench open car, of which a number have recently been built for the Braintree & Weymouth Street Railway Company by the Laconia Car Company Works, of Boston. This car, which is the standard fifteen-bench open car of the Laconia Company, has proved very popular on some of the electric railways where large crowds are carried. It measures 45 ft. 6 ins. over bumpers. The width of the car over posts is 7 ft. 3 ins. The distance between seats in the center of the car is 33⅝ ins., and the distance between seats at the end 45⅜ ins. The car is built with closed ends, in each of which are three sashes, dropping into pockets. The car is attractively finished, and has a monitor extending the full length of the car over the dashers. The side curtains are arranged to reach to the floor; all inside trimmings are of solid bronze, highly polished; the inside finish of the car is of white ash; the ceilings are of white beech, and the seats of maple.



15-BENCH OPEN CAR FOR BRAINTREE

The second engraving shows a new type of double truck recently placed on the market by the Laconia Car Company. This truck has been tested under the cars of a number of electric railway companies, and is giving excellent satisfaction, especially on roads having short radius curves. The truck is built compact in order to have a short wheel base, and has center-bearing elliptic springs outside the motor extension, allowing for one or two motors, and inside hung brakes, with either adjustable or solid brake heads. The brake mechanism is extremely powerful, and yet simple in construction, and all parts of the brake are extremely simple and strong, and when worn can be easily replaced.



NEW DOUBLE TRUCK

Large Chicago Mica Company

As a result of business enterprise and eternal hustle, for which Chicago and her business men are noted, she claims the leading house in America in mica and electrical insulation, which is of paramount importance to the street railway fraternity, as without perfect insulation railway equipment is useless. William H. Sills, one of the oldest and best known men in the trade, who has been supplying his many friends and customers with mica since 1885, was joined in 1897 by Clarence B. Wisner, well known in Chicago as the West Pullman banker, and these young men as the managers of the W. H. Sills Mica Company have, by the judicious use of capital and sound business acumen, rapidly forced their way to the front.

The business of this company requires in its various departments a force of 200 people, and one of its secrets of success is in the thorough organization of its work and the care shown in the selection of its executive force. The business is divided into four departments, viz.: mining, electrical mica, micabeston and stove mica.

Its mining department is under the supervision of Charles Guertin, whose office is at Ottawa, Canada. He is also in charge of the Canadian branch. The Saint Anthony mine, located at Gracefield, Quebec, is the largest and most famous mica mine in Canada and is owned by this company. It is equipped with modern steam mining machinery and 100 people are employed in mining and preparing its product for the market. The mine is worked day and night and its product is equal to that of all other mines in Canada. Its electrical mica department is in charge of Henry Velten, a man thoroughly conversant with every feature of the electrical mica trade. He keeps a force of forty men busy to prepare the orders received by his department.

Its micabeston department has for its superintendent William Cooper, an expert workman, who has done much toward bringing manufactured mica insulation to its present high efficiency, and the trade mark "Micabeston" is a guarantee of the excellence and high standard of the article on which it is found. Mr. Cooper has from forty to fifty people constantly employed in making micabeston plates, flexible plates, cloth, segments, rings, tubing, armature slots, washers, etc. Its stove mica department is in the hands of Charles Going, who has been with the house for years.

The company occupies the entire second floor of 60, 62 and 64

Michigan Avenue, and from here its principal business is transacted. Its New York office is located in the Mills Building, with A. L. Wisner in charge to look after the needs of its Eastern customers. In addition to this, the company has agencies in London, Berlin and Calcutta, India, through each of which large



MICA MINE AT GRACEVILLE, QUEBEC

quantities of Indian and other foreign micas are purchased.

The W. H. Sills Mica Company claims to be the largest importer of mica in the United States. Its shipments from Canada alone are



WORKS OF THE SILLS MICA CO.

one car each month and quite often two cars per month, and a car will hold a fortune in itself of material, running into dollars for each pound. The product of this house is distributed to manufacturers and street railways and dealers from Berlin, Germany, to Tokio, Japan, and its trade is constantly growing.

The Lete Mediterranea railway authorities have awarded the Thomson-Houston Company the contract for the conversion of the railways between Naples and Castellamare, Frascati and Rome, and Milan and Gallarate, into electric lines.

Car Cleaning

The subject of car cleaning has been given a good deal of attention recently by the master car builders and superintendents of motive power, representing the steam railroads of the country, and it has been shown not only that a great deal of attention has been devoted by these officials to that subject, but also that some of the most natural suppositions on the subject of car cleaning are erroneous. The large number of cars owned by a steam railroad system makes the subject of car cleaning one to which considerable attention must naturally be given. The advantages from the traffic standpoint, of perfectly clean cars on steam railroads are well recognized, but it is perhaps not so well recognized a fact that frequent cleaning of cars when properly done actually preserves the inside and outside finish, and as a result the cars do not have to be sent as often to the repair shop. It is said that on some roads the saving made in this direction more than pays the entire cost of cleaning. Again, a perfectly clean equipment is usually found a most profitable investment, as well as an attractive advertisement.

The Modoc Soap Company, of Cincinnati, Ohio, has made a specialty of the manufacture of soap and cleaning compounds for railroad cars; in fact, this company is at present supplying over four-fifths of the steam roads of this country, and is also gradually extending its trade among the street railways.

Among the street railway companies using the Modoc soap and car cleaner is the Paterson Railway Company, of Paterson, N. J., the general manager of which, M. R. McAdoo, spoke of the soap in a recent issue of the Street Railway Journal, in terms of the highest commendation. After one year of careful cleaning he reported that the expense of revarnishing the cars was reduced one-half. This more than repaid all the expenses; in addition to which the company always had most attractively clean cars at its disposal. The Consolidated Railway Company, of Grand Rapids, Mich., and the Birmingham Railway & Electric Company, of Birmingham, Ala., have also found this material most satisfactory.

Mr. Johnson, president of the Consolidated Street Railway Company of Grand Rapids, says: "We warm the water enough to take the chill off, and put in enough Modoc soap to make a weak suds; then take a sponge or soft brush and wash the inside of our cars twice a week. In this way all stains or grease spots are removed from the woodwork and the car is left in a very clean and presentable condition. We are very well satisfied with our use of the material."

The Modoc Soap Company publishes a set of instructions in regard to the use of its soap and cleaner, and which embodies the best experience with it on steam railroads, and which will be found useful as a guide to its use in cleaning street cars.

Additions at St. Joseph, Mich.

The St. Joseph & Benton Harbor Electric Railway & Light Company has in the last nine months completed an additional brick boiler room to its station, and has increased the general efficiency of its system by the installation of one 300-h.p. Babcock & Wilcox water tube boiler, one 250-h.p. tandem compound condensing engine, one 120-h.p. Brush arc light machine, one 2000-light General Electric alternator, one 300-h.p. Worthington condenser, six open trail cars, three open motor cars, and an electric sweeper. The company has secured a contract to light and heat the county court house and jails, having demonstrated to the satisfaction of the city authorities that they could furnish the necessary light and heat for three years at $1,100 less than it would cost the county to do it from their own plant, by comparison with their own figures. A 5000-gal. tank, 50 ft. high, with automatic sprinklers, has been erected at the car barn for fire protection.

A New Enterprise in Germany

The firm H. H. Böker & Company, Berlin, W., to whose extensive works frequent reference has been made in these columns, has extended its business in a direction which warrants special mention at this time. As previously stated, this firm has undertaken to introduce in Germany American street railway appliances, which were formerly handled by the Bergische-Stahl-Industrie, of Remscheid, including the brakes of the Standard Air Brake Company, of New York. Since then the firm has made arrangements to act as agents of the St. Louis Car Company for the sale of its cars. The entire wood work of the cars is finished at St. Louis, and shipped to Germany, where it is assembled in the shops of H. H. Böker & Company, where from eight to ten cars can be turned out per week. The works are located at Grosse Lichterfelde-Lankwitz, and connected with the Anhalt railway by a siding. The cars are made according to measurements furnished by the consumer, and, according to American practice, wood is used extensively in places where German manufacturers employ iron or other material. It should further be stated that in none of the cars manufactured by H. H. Böker & Company is paint used for interior decorations; all ceilings, doors and panels are of highly polished natural wood, the principal wood employed being bird's eye maple, mahogany and cherry.

H. H. Böker & Company are now completing an order received from the Grosse Berliner Strassenbahn Gesellschaft, and by arrangements made with the Bergische-Stahl-Industrie, of Remscheid, they are in a position to furnish completely equipped cars by using the trucks made by that company.



WORKS OF H. H. BOKER AT GROSSE-LICHTERFELDE

Machine for Tearing up Old Track

The accompanying engraving shows a new machine for tearing up old track, designed and patented by George W. Baumhoff and Otto Schmid of the United Railways Company, of St. Louis, Lindell Division. This machine, with three men, will tear up nearly 2 miles of track in one day and breaks the rail in any lengths, usually about 4 ft. to 8 ft. in length.

It is not only a great labor saving device for the actual work of tearing up the track, but by breaking the rail in small pieces the rail is made less expensive to load and haul, and commands about $1 per ton more for scrap than rail in full lengths.

The rail shown in accompanying engraving is section U, 78-lb., 6-in. Johnson rail, but this machine has broken 7-in. rail and is capable of breaking 9-in. sections or larger. The United Railways Company, of St. Louis, has torn up 7 miles of track with this machine during the last three weeks. It is especially adapted for tearing up welded track. All the track taken up has been old track, which has been in use for some eight years and which is to be replaced by new track.



MACHINE FOR TEARING UP OLD TRACK—ST. LOUIS

Toledo, Fremont & Norwalk Electric Railroad

Announcement was made last month that contracts were closed for construction of a 60-mile electric road to connect Toledo with Norwalk, Ohio. The construction will be carried out by Westinghouse, Church, Kerr & Company, who will act as engineers, architects and contractors for the new line.

The three-phase alternating system will be employed for power distribution. The power stations will be erected at Fremont, and the current transmitted at a high voltage in either direction. The power station will be furnished with five 300-h.p. Babcock & Wilcox boilers, equipped with Roney mechanical stokers and coal and ash handling machinery. Two 4000-h.p. Worthington jet condensers will be installed as will also the Westinghouse mechanical draft system, feed water heaters, purifiers, etc. Four Westinghouse Columbian type engines will be direct-connected to four 500-kw. Westinghouse "engine type" three-phase generators, each engine with its generator being mounted upon a massive bed plate, insuring accuracy and permanency of alignment. Two 9 ins. and 15 ins. x 9 ins. Westinghouse single acting compound engines will be direct-connected to two 30-kw. exciter generators.

In addition to the Fremont central power station six sub-stations will be built about equi-distant from each other along the line of the railroad, while a seventh sub-station will be provided within the power house at Fremont. The current will be transmitted to the sub-stations at about 15,000 volts. Each sub-station will be equipped with three step-down transformers and two rotary converters, together with a switchboard and controlling ap-

paratus, and will be connected by feeders with the trolley line and direct current feeders.

The roadbed will be very substantially constructed, as it is intended to run the cars at a speed upward of 40 miles an hour.

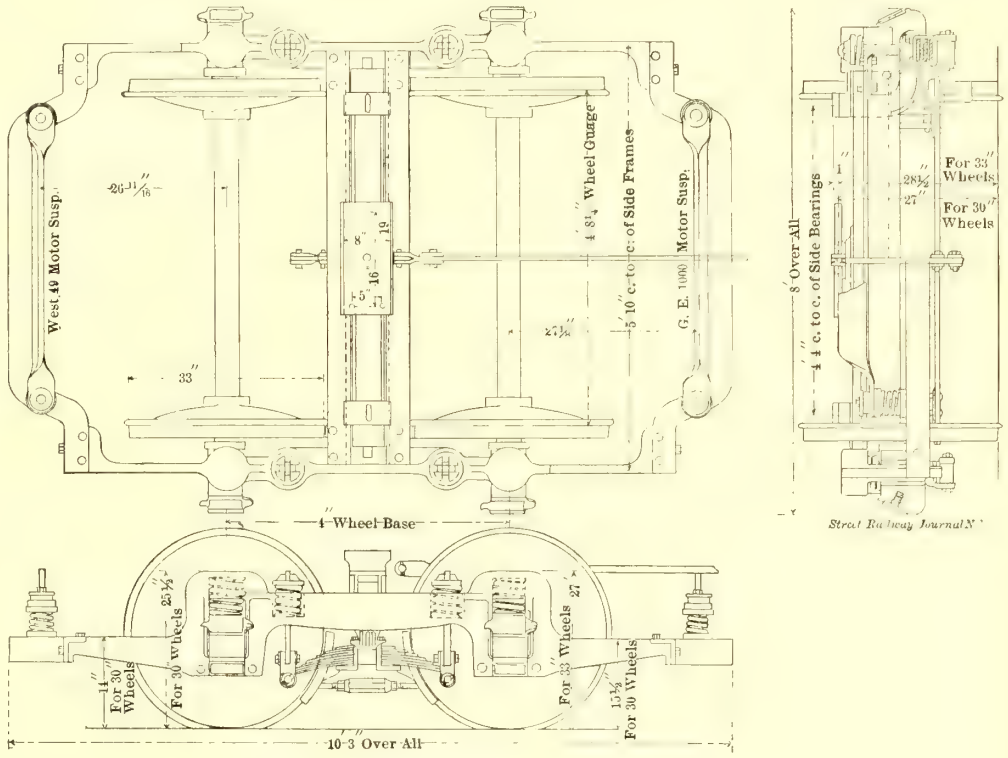
By adopting the alternating current it is possible to supply the entire 60 miles of the Toledo, Fremont & Norwalk Electric Railroad from one central power station. The saving in copper wire alone by using a high tension transmission is estimated at considerably more than $100,000.

The power plant at Fremont is designed to admit of ready extension without destroying the symmetry of its design. The building will have a fireproof roof and a traveling crane will span the engine room. The sub-stations will be arranged so that they will be operated with very little extra attention, being combined with passenger and freight stations.

The No. 14-B-3 Double Truck

The Peckham Truck Company has recently added to its well known series of trucks for all conditions of railway service, another truck, designed for use under double truck cars, on roads having short radius curves. This truck, which is known as the No. 14-B-3, has a short wheel base, with outside hung motors and swinging bolster, and is built exceedingly compact.

This truck is composed of cast steel side frames, two 4-in. x 4-in. x ¾-in. angles forming the end cross sills, and two 4-in. x 6-in. x ¾-in. angles forming the transom, between which the bolster plays. Each of these four angles is secured to each side frame by two ⅞-in. turn bolts, which are driven into holes reamed through the angle iron and casting after the truck has been erected, thus insuring an accurate and positive fit of bolts and angles and making a very rigid construction to maintain the truck in square.

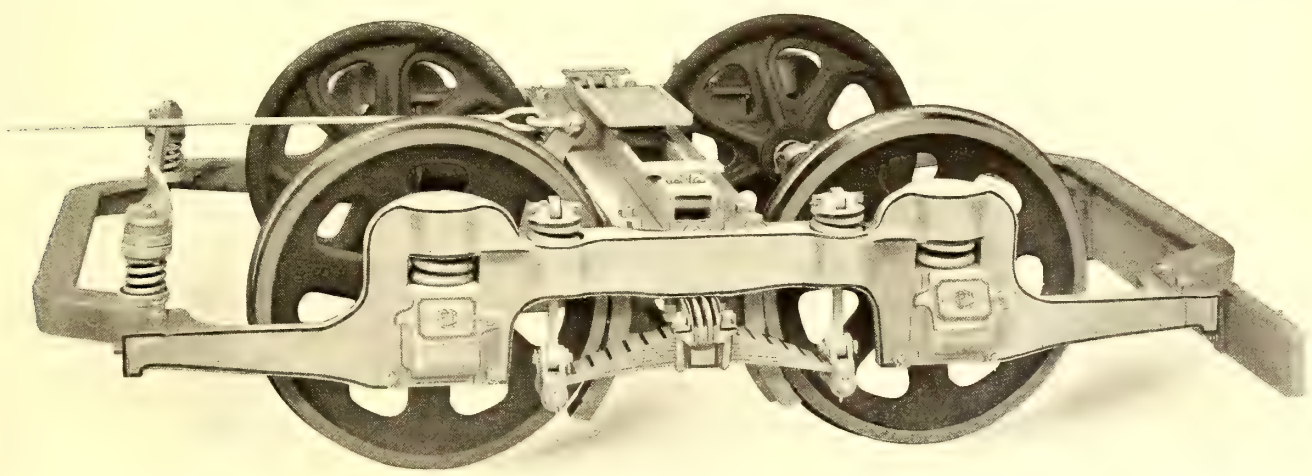


PLAN AND ELEVATIONS OF NO. 14-B-3 TRUCK

The side frames and all other parts of the truck, as well, are proportioned to carry with safety a load of 30,000 lbs. per truck. The cast steel in these side frames is capable of standing the following tests: A 3-ft. 4-in. square bar can be bent cold and the bend closed tight without breaking off. The minimum strength of this steel is 5500 lbs. per sq. in.

The bolster is carried on two half elliptic springs which in turn are carried by coil equalizer springs. Large coil springs are also placed over each journal box, making three separate sets of springs between the rail and car body and assuring a very easy and steady riding car under all conditions of load. The journal boxes are of ample size to provide for a large space for receiving packing.

The brake beams of this truck are placed between the wheels instead of outside and with this construction the beams are out of the way of the motor, which is also carried outside of the axles to enable the truck to be built with a wheel base of 4 ft. The location of the brakes between the wheels simplifies it to the last degree, as the whole rigging outside of the shoes, bolts and hangers, consists of but eight pieces, one live lever, one turnbuckle, one turnbuckle jaw, one dead lever, one dead lever jaw, one live lever jaw and two brake beams.



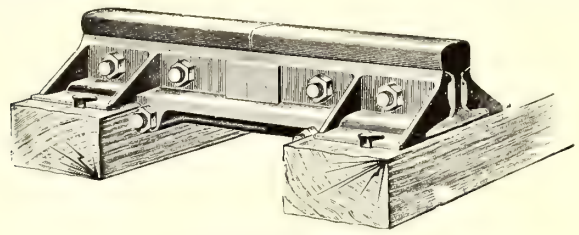
THE NO. 14-B-3 SHORT WHEEL BASE DOUBLE TRUCK

On account of its very few parts the operation of this brake is very quick and powerful, and there is no lost motion to be taken up before the shoes are applied to the wheels.

The Union Railway Company, of New York, has made application for permission to extend the lines of the New York, White Plains & Mamaroneck branch through Tarrytown.

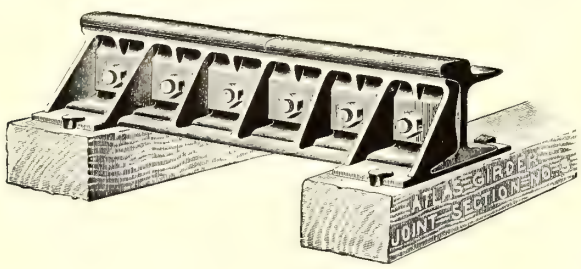
The Atlas Rail Joint

The subject of rail joints is one upon which a great deal of thought has been bestowed by both steam and street railway engineers. A good joint should be able to resist the vertical, lateral and longitudinal forces produced by passing wheel loads, and, where there is expansion and contraction, the strains and stresses of these forces also. Where ordinary angle plates are used, the first indication of any weakness in the plate is the flattening of



SUSPENDED RAIL JOINT

the plate and the points of bearing, allowing the ends of the rails to sink down and the result is the bar has a tendency to buckle. These facts show that the great need in a joint is large bearing surface to resist the pounding of the vertical wheel loads, as



NO. 5 JOINT

well as great vertical strength immediately beneath the connection of the rails. The necessity of reducing joint troubles has caused street railway managers to install 60-ft. rails to a large extent, but while these reduce the number of joints one-half, the remaining joints are just as liable to defect.

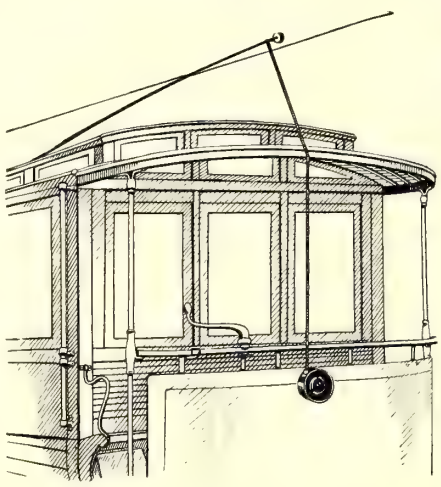
In the Atlas joint these weaknesses are overcome by giving, in addition to the splice bar bearing surface, a re-enforcement both on the outside and inside of plate, extending several inches past the connection of the rails, also a continuous bearing of metal around the lower flange and beneath the base, forming a bed plate for the base of the rail to bear on. This continuous metal forms an inclined clamp, in which the foot flange of the rail is held in a firm grip, any wear being taken up by the tightening of the bolts beneath. Views of the Atlas "Suspended" joint, applied to T rails, shown herewith, as is also the Atlas No. 5 girder joint. This is similar to the standard suspended joint, except that any splice bar may be used on the inside

The lateral force is overcome by the continuous strip of metal extended around and beneath the foot flange, and by the addition of braces extending from the flange of joint at the head to the edge of the tie plate, and in the suspended joint by the truss. The longitudinal force or the force which has a tendency to pull the rails apart on account of the creeping of the track is provided for by using in addition to the four bolts through the web of the rail, the two bolts beneath, causing the ends of the rail to be tightly gripped. These bolts beneath butt against the tie, thereby preventing the creeping of the rails and the damage to spikes.

The Atlas joint is made as a tie, suspended or compromise joint, and can be made to fit any style and weight of rails. It is composed of the best grade of malleable iron and is guaranteed to prolong the life of the rail and to hold up the rail as long as it is run over.

Trolley Pole Catcher and Reel

The engraving below shows a trolley-pole catcher and reel manufactured by Wilson & Company, of Brooklyn. The object of the device is, of course, to prevent the trolley pole from breaking down the span wires in case it should slip on the trolley wire. If this should happen the reel acts, drawing down the trolley pole below the level of the wire. The engraving shows the general arrangement of the device. The company has recently published a brochure giving a number of testimonials to the value of the device from prominent railway managers.

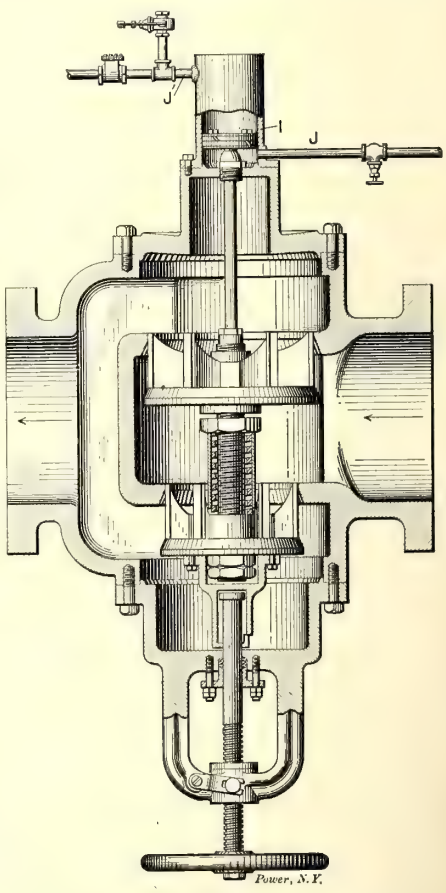


TROLLEY POLE CATCHER

Automatic Safety Shut-Off Valve

The automatic safety valve illustrated herewith has recently been placed on the market by the Locke Regulator Company, of Salem, Mass., and is designed to automatically shut off the steam from the boilers whenever there is a break at the main or at th engine sufficient to slightly reduce the steam pressure. This is accomplished by means of a steam cylinder and piston connected to a double valve, there being a pipe connected with this cylinder below the piston and running to near the steam boilers, always maintaining the boiler pressure at this point. Another pipe is then connected with the top of the cylinder above the piston and run along the steam main entering it just outside of the throttle valve of the engine. It will be seen that as long as the pressure remains nearly equal above and below the piston, the shut-off valve will remain open, but when the pressure is reduced in the chamber above the piston, as it will be when there is a breakage in the pipe, the pressure will force up the piston and close the valve.

Although this valve is under the control of the steam, which, in opening, would be liable to do damage on account of the sudden action of the steam on the piston, at the same time it is connected with the screw and wheel. This makes it a perfect hand shut-off valve, which takes the place of the ordinary valve on the main pipe, it being in every respect just as convenient to use, notwithstanding that the piston of the steam cylinder is also connected with it.



AUTOMATIC SAFETY SHUT-OFF VALVE

It may also be used to stop the engine in case of accident from any part of the mill. It has been used to cut out a boiler from the rest of the battery whenever a flue or section is blown out, thus preventing a shut-down.

New Type of Filter

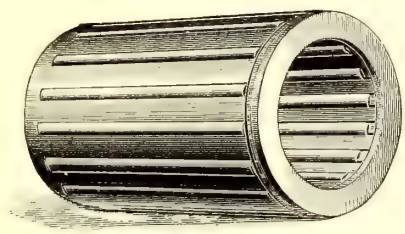
The accompanying illustration shows one of the new famous waste oil refining and purifying filters, built by the Famous Filter Company, of St. Louis, Mo., and installed in the plant of the Imperial Electric Light, Heat & Power Company, in St. Louis. This apparatus has a storage capacity of fourteen barrels, and a purifying capacity of 150 gallons per day, and embodies some new features in purifying waste oil in large power plants.

The waste oil, together with all water from the piston rod and valve stem leakages, is led from the engines by pipes directly into the separator, which separates the water and oil, and automatically discharges the water into the sewer and the oil into the removable strainer in the oil filter proper. From the strainer the oil is discharged into the refining chamber of the filter. In this refining chamber the oil is safely and properly thinned by hot air by means of the air-jacket and steam jacket combination embodied in this filter.

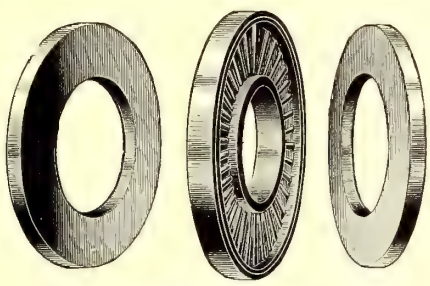
In the refining chamber all the minute carbon and suspended impurities are positively separated from the oil and precipitated on the bottom of this chamber, whence they are readily withdrawn once a day through the dirt faucets. In this manner the waste oil is first thoroughly strained, then positively settled and refined, and fully 90 per cent of the impurities are extracted before the oil overflows from the refining chamber into the filtering chamber.



OIL FILTER



SLEEVE CONTAINING BEARINGS



ROLLER BEARINGS FOR END THRUST

The oil then gradually filters through a large area of compressed white waste and a muslin cloth cover over a perforated cone; this it does by capillary action, by which all the lighter impurities are extracted from the oil. The purified and refined oil is then led into the clean oil storage tank, whence it is pumped into the Siegrist automatic oiling system, and distributed over the bearings.

The manufacturers guarantee that this oil filter furnishes, continuously, absolutely clean and bright oil, and have introduced a simple and accurate method of testing the work of their filter by furnishing a clean oil indicator with every apparatus. With this indicator the clean condition of the purified oil is inspected through a strong magnifying glass.

Roller Bearings for Street Railway Cars

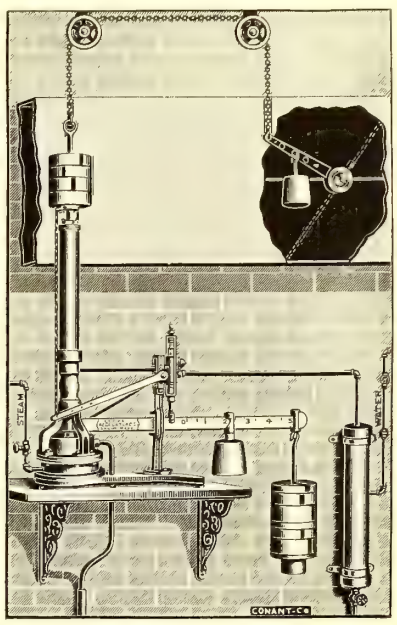
It seems strange to many people that roller bearings have not been applied to railway cars to a greater extent than they have in the past. That there is no inherent difficulty in their application is shown by the instances in which they have been used, and the fallacy of the claim sometimes made that the rattle and jar to which a railway car is subjected would prevent their employment is shown by the extent to which ball bearings, a much more delicate mechanism, have been employed on vehicles of other types.

The Mossberg Roller Bearings Company, of 6 Victoria Street, London, has devoted special attention to the subject of roller bearings for machinery of all kinds, and has obtained satisfactory results in the way of economy of power. The company is now prepared to engage in the railway field, and anticipates that the same saving that has been shown through the use of their bearings in industrial plants will follow their application to railway vehicles.

The bearings consist of a bronze sleeve containing a series of hardened and ground steel rollers. These bearings, being wholly self-contained, can be removed from an axle while the rollers remain intact with the sleeve. They run on hardened and ground steel surfaces, thus insuring durability, and the company guarantees a saving of from 10 per cent to 33 per cent in the power used. This saving varies according to the different conditions under which the bearings are applied, and the tests the company has made on different classes of machines seem to indicate that its estimated economy is by no means exaggerated.

Hydraulic Damper Regulator

The Locke damper regulator has been referred to frequently in these columns, but as no description has ever been published as to the details of its working, some particulars on this subject may be of interest. The arrangement of the apparatus can be seen from the accompanying engraving. The power used to operate the damper is water. The admission of the water is controlled by a small valve, which is attached to and operated by the lever of the steam weighing device, shown at the left of the engraving, and which vibrates with every pulsation of steam. Whenever the steam pressure increases a fraction of a pound the beam is raised enough to open a passage for the water to the damper motor, which moves the damper just enough to correct the steam pressure. A special cut-off device closes the water valve after it has been opened by the rise of steam pressure, and holds the damper partially open, moving it back and forth from ⅛ in. to ½ in., on so light a change of pressure as not to be noticed on the steam gage.



DAMPER REGULATOR

This regulator, which is manufactured by the Locke Regulator Company, of Salem, Mass., has been widely adopted by steam users, especially in electric power stations, where the need of a regulator of this kind is accentuated by the varying load.

The County Central Street Railway Company, of Easton, has been incorporated, with a capital stock of $30,000, to construct an electric railway from near Bethlehem and Easton, to Farmersville and Hallo, a distance of 5 miles. The directors of the company are: F. W. Leinbach, of Alvin Hill; T. M. Dodson, C. A. Wolle and George H. Wolle, of Bethlehem; G. A. Schneebeli, of Nazareth; Andrew S. Keck, of Allentown, and C. R. Horn.

Fender Views

Among the most interesting exhibits to be seen at the Chicago convention will be that of the Hipwood-Barrett Car & Vehicle Fender Company. The exhibit will include a large fender mounted upon a car platform, and a model showing the working of this fender, a mutoscopic picture of a recent test made at Newtonville, Mass.



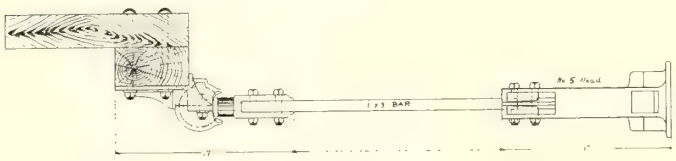
FENDER IN OPERATION

This picture will illustrate the fender on an approaching car, running at the rate of 15 miles an hour. The fender is dropped, and picks up first a small dummy, which is lying upon the track, arms extended toward the car, and then 15 ft. further picks up dummy standing, and both are held in bed of fender until car is stopped. The engraving herewith shows one view of the set.

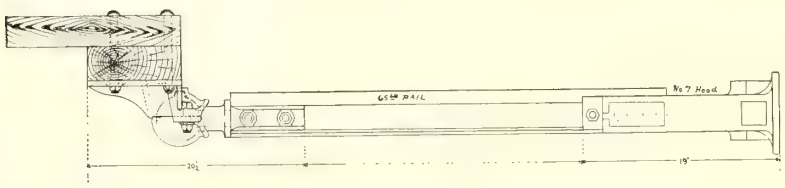
This is the first time that a moving picture of an actual test of a car fender was ever shown at a convention.

Automatic Couplers

The accompanying engravings represent two out of eleven sizes of automatic couplings, built by the W. T. Van Dorn Company, for all classes of street and elevated railroads. These couplings have now been in use seven years. More than 50,000 are now in use and they have been made a standard on practically all the



NO. 5, DRAW BAR



NO. 7, DRAW BAR

elevated roads in the United States. The company also has sizes especially adapted for mining cars to be used in mines. Everything is perfectly automatic and couples readily within 1-32 in. Every coupler is also machine fitted.

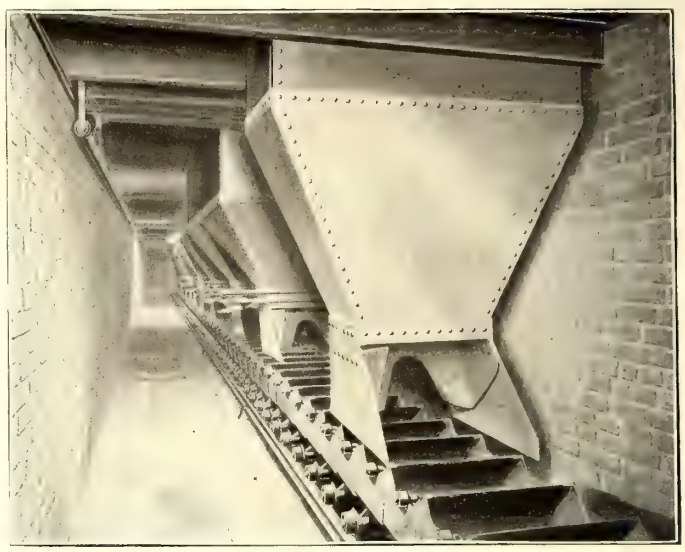
The W. T. Van Dorn Company has also done a large export trade and has furnished couplings for many of the leading street railways in Europe, couplers including roads in Glasgow, Bristol, Dublin and London, also to Australia and Japan.

Coal Conveyor of the Capital Traction Company

An extended description of the power station of the Capital Traction Company, of Washington, D. C., was published in the Street Railway Journal for January, 1898, but little was said at that time of the coal and ash handling system employed. The view, herewith, is of the ash tunnel, where ashes are taken from hoppers beneath the boiler furnaces, and from thence taken to ash storage tank. This tunnel is about 200 ft. in length, and each boiler has a feed chute to feed the ashes to conveyor. It is only necessary to open a gate in chute to allow the ashes to fall directly into the conveyor. As the latter acts exactly as a moving trough, no special feeding mechanism is required.

The coal, which is elevated to the bunkers above the boilers in the boiler house, is first raised from canal boats by a hoisting outfit, and run through a coal crusher. It is then fed to the conveyor in the tunnel, and thence elevated by the conveyor and carried to the bunkers, where it is distributed as desired.

The conveyor itself consists of a series of interlapping pans, in which are pivotally mounted buckets. The pans are bolted to the carrying axles, which are in turn connected by a steel cable, in place of the usual links employed in this class of machinery. In consequence of this arrangement the conveyor, as stated, is prac-



COAL CONVEYOR IN WASHINGTON.

tically a moving trough in the part of the run where it receives the coal or ashes, and where the material is elevated or carried on a vertical or upper run the buckets swing freely in a horizontal position. The buckets are discharged of their contents by tripping mechanisms, in the usual manner. The whole outfit is very simple in construction.

A desirable feature of this machine is that where limited space only can be had on the lower run, that is, where the material is to be fed to it, a feed chute is not necessary, a simple opening in the floor being all that is needed, as the conveyor can run in a very small tunnel and quite close to the floor, thus occupying a very small space.

This machine as installed at the Capital Traction Company's plant has been in operation for a considerable length of time, and is giving excellent satisfaction. The whole coal and ash handling outfit for this plant was furnished and installed by the Steel Cable Engineering Company, of Boston and New York.

Welding Contract in Columbus

The Columbus Street Railway Company, of Columbus, Ohio, has increased its contract with the Milwaukee Rail Joint & Welding Company from 2000 joints to 5000 joints, at an increase in price corresponding to the advance in the prices of materials. About one-half of this work is on 7-in. and 8-in. T rail just laid.

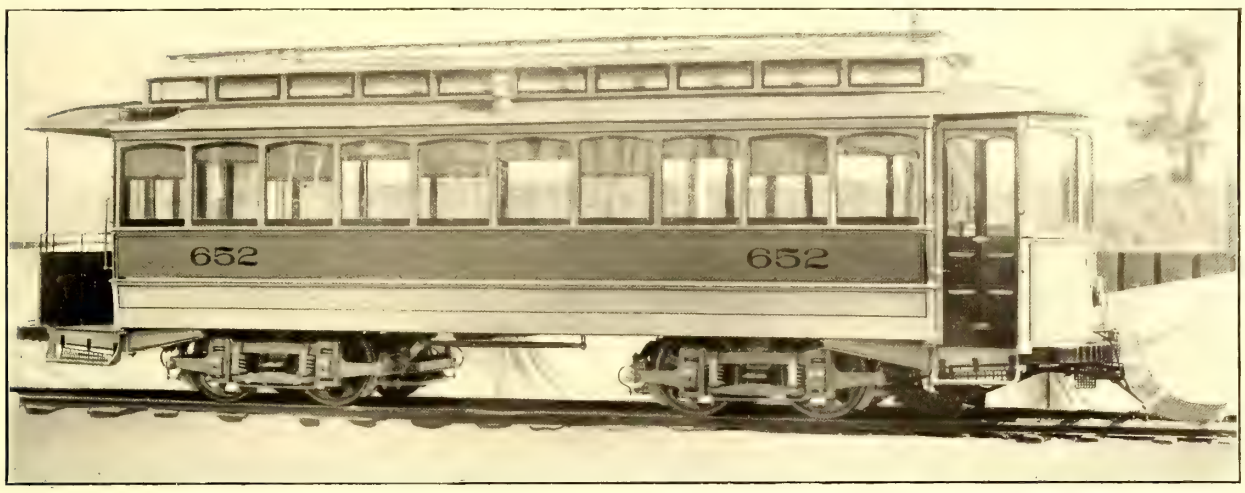
This contract was secured by Henry L. Prather, manager of the Milwaukee Rail Joint & Welding Company's Cleveland office, and the work is under his immediate supervision. Mr. Prather has had four years' practical experience in electric welding, and is frequently called upon for expert experience on the subject of welding.

Dick, Kerr & Company, manufacturers and dealers in railway and tramway supplies, has been registered as a joint stock company, with a capital of £350,000. The company has acquired the English rights of much American machinery, including the Walker patents for motors and generators. The shops at Preston, Lancashire, are being equipped with American labor-saving devices at a cost of £50,000. The company has been awarded contracts for 900 trolley cars and equipments, which will be utilized on electric roads now in course of completion throughout Great Britain.

Closed Cars for Cleveland

The accompanying illustrations show two styles of closed cars built by the J. G. Brill Company for service in Cleveland, and which illustrate very clearly the tendency toward large units and high speeds.

The upper car, which was built for the Cleveland Electric Railway Company, has nominally a 28-ft. body with a 4-ft. vestibule in front and a 4-ft. 6-in. platform in the rear. It measures over the dashes 36 ft. 8 ins., and is 7 ft. 10 ins. wide over the posts. From the head of the rail to the underside of the sill is 31 ins. The steps are 16⅜ ins. from the ground, with 13-in. risers, and an 8-in. step leads from the platform to the floor of the car. The cars stand as near as possible 12 ft. 3 ins. from the head of the rail over the trolley board. They are mounted upon No. 27-F trucks, which have a 4-ft. wheel base with 33-in. wheels. The wheels have 2¼-in. tread with ⅝-in. flange and weigh 340 lbs. Each truck is fitted with a single Westinghouse No. 49 motor.



CLOSED CAR FOR CLEVELAND ELECTRIC RAILWAY COMPANY

The seats are longitudinal and upholstered in spring cane. The headlining is three-ply maple.

As will be seen, the car, in its general proportions, is not different from many others, but the first feature which is notably out of the common run is the fact that the car is built to run on a loop in one direction. Hence the vestibule at the forward end only. This vestibule is completely enclosed, having doors and step upon the right hand side. These doors close against the body of the car. Double folding doors give entrance to the body of the car from each end. The rear platform is also closed upon one side, having its entrance like that of the vestibule on the right hand side of the car looking forward. Platforms and vestibules thus arranged have an unusual amount of space. The dashers are high, measuring 40 ins. from the floor. Externally the car is somewhat peculiar on account of the steam road hoods to the platforms, and the unusual elevation of the trolley board above the roof. At first sight the steam road hood seems inappropriate to a car of this class, but it must be remembered that the speed is unusually high, and therefore the roof is desirable. The general objection to the steam roof has been that if injured in an accident a considerable amount of damage is done to the car itself, because the framing extends through. While the car framing is somewhat strengthened by this construction, at least where there is a vestibule, the amount of damage done by trivial accidents is often very great. In this case, however, the vestibule and platform hoods are distinct from the framing of the car, the hood can be destroyed without necessarily injuring the roof frame. On the rear hood numerous strips of ash are placed, covering a considerable space. This is put on for the purpose of protecting the hood against the rebound of the trolley pole when it comes off the wire. It has been found with the extremely high speeds used on the Cleveland roads that the trolley pole whips backward and frequently destroys the hood after leaving the trolley wire. Such a contingency could hardly have been foreseen from experience which was confined to 12 miles or 15 miles per hour, but when cars, on country lines, often run at a rate of 53 miles or 60 miles an hour, conditions are entirely altered.



CLOSED CAR FOR CLEVELAND CITY RAILWAY COMPANY

The insides of the cars are very neatly finished. The backs of the seats are of cherry with the windows drop and have spring curtains. The cars, although quite simple in their design, are built with the greatest care, and in spite of their great length every rail was put in without splicing. The posts are of ash throughout. The end sub-sills are of ash and the crossings of yellow pine. Steel reinforcements are used frequently throughout the framing. The crown pieces are of oak and all the ends of white oak. They are reinforced by angle iron. The band irons covering the joints of the belt rail are in each case continuous pieces from door to door. All the joints at the corners

of the car were carefully covered either with special pieces of stamped steel or by suitable bands and crossings bedded in white lead. There are the usual inside truss rods with 7/8-in. round ends fastened upon the posts and securely anchored at the end sills. There are also inside belts running direct from corner post to corner post. The details of construction have been very carefully worked out, and wherever an improvement has been made it has been introduced. For example, the entire edge of the rear canopy or hood is bound with oval iron to prevent the trolley rope from wearing the canvas. The canopies are so designed that they cannot come in contact with a trailer when rounding a curve of 30 ft. radius. Under the vestibule are fitted Littell scrapers of the latest design, arranged to be hung up when not in use. On the vestibule is an opening or lantern just below the level of the dasher rail, the front of which is closed by a perforated metal sign showing the destination of the cars in transparent letters. Guard rails are reinforced on top with 3-16-in. steel plate laid in white lead. The floor mats are of straight grained hard maple strips. These strips are screwed to three-ply rubber belting with brass screws and the belting let into the underside of the strip flush. They run crosswise of the car and four mats are required for each car. The inside trim of the car is of solid bronze. In putting up the hand pole brackets a slight refinement is introduced, which is of considerable value to the passengers. It is an extension of the bracket toward the center of the car 6 ins. from the face of the inside ventilators. This brings the straps further out, making it much pleasanter for those who are seated and much easier for the persons who stand.

Each car is equipped with two sand boxes at the forward end. They are arranged to work simultaneously by a pedal on the front platform. The delivery pipe is made of tight coil spring wire 1/4 in. in diameter. This gives a pipe opening of 2 1/2 ins. The cars are heated by full length stoves placed on the same side of the car as the steps. The stove box is 18 ins. square at the bottom and 36 ins. high. The spring seat has a section cut from it at the center, which is removed when the stove is put in place. There are fifteen lights on each car, twelve inside, arranged four on three electroliers, one light on the rear platform and one in the lantern in the signal box in the front vestibule. There is also one for the headlight on the top of the front hood. There are eight small trap doors in each car, four at each end.

In the car there are ten ventilators, every other one hung at its forward edge so as to open outward. There are movable panels over the head of the door to give access to the door moving mechanism. At each side of the door the swing sash are fitted with bronze stiles. The doors themselves open 36 ins. The curtains are very carefully fitted as well as all the door furniture. Hand rails are of cherry and have sixteen padded straps of light leather on each rod. A part of the cars are furnished with Sterling brakes. In all cases the brake power is arranged to give the motormen great leverage in applying the brakes.

The lower view shows a car built by the J. G. Brill Company for the Cleveland City Railway. The body is 30 ft. long, 7 ft. 10 ins. wide at the belt rails and 38 ft. 6 ins. over the dashers. There is a platform 4 ft. 6 ins. in length at the rear end and a circular vestibule at the front end 4 ft. in length. It is sheathed with steel and has a folding door at the right hand side. Like most of the cars intended for Cleveland service there are openings on the right hand side only, the cars running continually in one direction around loops. A still further departure from common practice is found in the location of the doors at the corners of the cars next the platform opening. This arrangement necessitates the cutting of the longitudinal seats away at each end to give space for entrance. This, of course, diminishes the seating capacity by that amount. The seats themselves are spring upholstered, covered with plush carpeting. There are eleven windows on each side, and in the ventilating sash three at each end open sidewise. The stove is placed on the same side of the car as the doors. Externally the car is somewhat unusual in appearance. It has apparently a steam road hood. This, however, is not framed as a part of the monitor deck of the car, but is put in separately as a part of the hood. The cars are fitted with No. 27-F trucks and have four 12-A No. 30 nose suspension W. P. Westinghouse motors. This equipment will enable these cars to make the highest speed permitted in either the city or the country.

In these cars the trolley board is placed over the center of the rear truck. The bumpers are the Brill angle iron pattern. Two sand boxes are placed in the front end of the car. There are two Dedenda gongs. Bronze trimmings are used throughout. The posts are all fitted with push buttons and electric bell connections. The advantages of cars which run in one direction only are numerous. Notably there is an absence of gates and an increase in the space available on the platform. Since the entrance is from one side of the platform only, passengers, when the car is crowded, enter and leave with greater comfort and more quickly than in the ordinary style. The steps are much more easily kept clear and a greater degree of safety results.

Controlling Motors by Pneumatic Means

The growing interest in methods of controlling several motor cars from one point is shown by the adoption of this system upon several elevated railways in this country, and by the large number of patents for different methods of accomplishing this result, which the Government has granted recently. In this connection it is interesting to note that one of the early and basic patents for synchronously operating several motor controllers by pneumatic power was granted to Sidney H. Short, the well known inventor, and at that time connected with the Walker Company. This patent, No. 599,807, was issued March 1, 1898, and contains forty claims, of which the first and second are as follows:

(1) In a system of controlling motors in a train of cars, a controller for each car, fluid-pressure mechanism for simultaneously actuating said car controllers, and means mounted on each car of the train for controlling said fluid-pressure mechanism.

(2) In a train of several cars, motors mounted on one or more of the cars of the train, a motor-controller mounted on each motor-car, a fluid-pressure mechanism for actuating all of the controllers throughout the train, and means located on each car of the train for controlling said fluid-pressure mechanism.

Supplies in Chicago

The W. R. Garton Company, of Chicago, reports doing an elegant business. This company handles all kinds of electrical and mechanical supplies for railway, light, power and transmission purposes, and represents some of the best-known manufacturers in the country; thus, it is agent for and has territorial arrangements with the Electric Railway Equipment Company of Cincinnati, Ohio, manufacturers of all kinds of railway supplies, line material, tubular iron and steel poles and brackets, etc.; the Billings & Spencer Company, of Hartford, Conn., drop forgings, B. and S. commutator bars, Kelsey patent brake handle, etc.; the General Equipment Company, Camden, N. J., automatic circuit breakers; Kingston Electrical Instrument Company, Philadelphia, voltmeters, ammeters, etc.; Massachusetts Chemical Company, Boston, Mass., insulating paints, tapes, cloths, paper, etc.; the Multiplex Reflector Company, Cleveland, Ohio, all kinds of reflectors and headlights; the Eureka Tempered Copper Works, North East, Pa., the McLaughlin rail-bond; the Graphite Lubricating Company, Bound Brook, N. J., genuine Bound Brook trolley bushings; Lea Manufacturing Company, Elwood, Md., all kinds of enclosed arc lamps; Pittsburgh Steel Hollowware Company, Pittsburgh, Pa., pressed steel gongs; A. O. Schoonmaker, New York, all forms of amber and India mica; E. F. DeWitt & Company, Lansingburg, N. Y., common sense sand box; Miller-Knoblock Company, South Bend, Ind., assembled commutators, refilled commutators, armatures rewound, etc. The company also carries in stock insulating paints, "Columbia" tapes, "America" incandescent lamps, Garton lightning arresters, knife switches, etc., and makes a specialty of fine switchboard work and supplies. It also sells the National Carbon Company's carbon motor brushes, and enclosed arc lamp carbons, and Van Dorn & Dalton's gears and pinions and track scrapers, and is doing a nice business in these lines.

The Indianapolis Street Railway Company has closed contracts with the North American Railway Construction Company, of Chicago, for the reconstruction of six of its lines, and for an extension to Riverside Park, the work to be done by Jan. 1. This contract, with what the company has already expended in rebuilding lines, will aggregate $1,000,000.

Large Wire Producers

The consolidation of wire interests has modified trade conditions in the electrical field to a less extent than would seem possible at first sight. This has been partly due to the fact that one of the largest plants which manufactures copper wire and cables, i. e., the John A. Roebling's Sons Company, has remained independent. This company is said to have the largest individual plant in existence, both for producing electrical conductors and wire rope. The name of the illustrious engineer who built the Brooklyn Bridge, and was the author of many engineering achievements, has been a stamp for excellence on all of the products of the mills of the company, which is fortunate enough to be under the guidance of the present generation of Roeblings. It may be of interest to indicate briefly the extent of the works and the durability of products of the Roebling Company.

The main plant is at Trenton, N. J., situated conveniently for railroad and canal transportation. It covers upward of 25 acres of ground, and it possesses a large rolling mill, with a capacity of about 300 tons or rods a day, where a large variety of material is turned out. There are two large wire mills for producing iron, steel and copper wire, with a third in process of construction, which will be enormous. This mill is to cover 325 ft. x 60 ft., and will be five stories high, equipped with the latest and best machinery. Cleaning and annealing houses, galvanizing and tinning mills, machine and blacksmith shops complete, the plant will be devoted simply to the manufacture of wire.

It will serve the purposes of this sketch only to mention the wire rope mills, which are the most extensive of their kind, and pass to the section devoted to the production of electrical conductors. Four or more large buildings are equipped with the machinery necessary to turn out this variety of material. Arbitrarily electrical conductors may be divided into four classes: bare; insulated with vegetable fibre, dry or impregnated with various compounds; insulated with rubber, and wires which are mechanically protected by an outside metallic covering. The Roebling Company manufactures wires and cables of each of the above classes.

Under the head of bare conductors are various subdivisions, such as trolley wire, galvanized telegraph and telephone wire, hard drawn telephone wire, soft tinned copper wire and various stranded conductors and cables, for the production of which this plant is well equipped. The second class includes, among others, magnet wire, round, square and of various other shapes, which requires the nicest discrimination in choice of material and the most delicate manipulation. A variation in diameter of magnet wire of more than 1-2000 in. is not permitted in some sizes. This class also includes weatherproof conductors with solid or stranded conductors of iron or copper, office and annunciator wires, etc., etc. The Roeblings have equipped a very large number of trolley lines and electric light plants with weatherproof wire, and have a deserved reputation for excellent work in this department. The Roebling rubber mill has been in existence for only about one year, but its success was instant, and the popularity of its products demanded a speedy doubling of the plant. All kinds of conductors are made, which are included in the third class of conduction material. Under the fourth heading are comprised the most important electrical conductors of to-day, these are the so-called lead incased cables, used for telephone, telegraph, light and power purposes. Cables prepared under either of the former heads of insulated conductors, require a mechanical protection when introduced into subways and conduits.

The tendency in thickly populated centers is decidedly toward placing electrical conductors under ground for obvious reasons. The best form of mechanical protection, according to American practice, is a lead pipe, either alloyed with or coated with tin. This pipe is formed about the conductor, and when the lengths of cable are drawn into the conduits and connected up, it serves as a complete sheath, excluding moisture and preventing mechanical injury to the conductor.

The Roebling plant is equipped with machinery enabling it to turn out the best lead-encased cables of all kinds for telephone, light and power plants. Rubber and also fibre are used for insulation, according to requirements. A recent large order for New York companies of some 400,000 ft. of cable is now being filled, the conductor being rather novel. The order calls for a three-conductor cable, each conductor with an area of a 0000 stranded wire, insulated with rubber, and encased in a lead pipe, forming a complete cable about 2¾ ins. in diameter.

This company equipped the first under-running trolley system successfully operated in the United States, and claims to have supplied probably more than two-thirds of all the conductors used for this purpose. A carefully trained corps of skilled workmen installs all of the lead encased cables, and competently attends to the problems which are met in this class of work.

New Power Brake Factory

Judging from the amount of business done by the Christensen Engineering Company during the past twelve months, together with the large number of orders for immediate delivery which the company has on hand at present, it would appear that the question of power brakes for electric cars was being answered in a most emphatic and satisfactory manner. This company, after having twice within a year doubled its capacity, now finds that the demand for its air brakes is so large that another increase of 100 per cent will be entirely inadequate. Believing that the very satisfactory results obtained by all the roads using its devices, has thoroughly demonstrated that the apparatus is now reduced to a condition of efficiency and durability which insures its success, and that the amount of business already consummated, together with the large amount on hand and in sight, fully warrants the investment of sufficient capital in special machinery to insure not only prompt deliveries, but the manufacture of goods at a cost which will permit their sale at the lowest possible price, the company has purchased a factory site of 7 acres, conveniently located as to railroad facilities. On this site it is erecting a modern plant, consisting of foundry and machine shops which will give the company sufficient capacity to insure the filling of orders promptly.

The plans for the new shop have been drawn with great care and all the latest conveniences known to the trade will be incorporated. Compressed air will be used in the many capacities for which it has proven the most suitable power, and machine tools will be run by electric motors arranged in small units for convenience.

The works are so arranged that there is ample space between the buildings, giving plenty of light, and the spaces not occupied, will be devoted to well kept lawns.

The power house will be located centrally, so that the electric transmission to the motors located in various parts of the works will be effected with the least possible amount of loss.

The boiler room is immediately adjoining a railroad track and is slightly lower than the latter so that coal is easily unloaded.

The power house will, besides the boilers, contain direct-connected generators in units of 100 h.p., and various dynamos for giving voltages of 80, 110, 220, 250, 450, 550, 650, 750 and 1000 volts for testing purposes as well as power.

The foundry will be located near the power house and the coke bins and a store house for pig iron will be immediately alongside the track, within easy reach of the cupolas. The foundry will be fitted up with the latest improved machinery, having electric traveling cranes and compressed air cranes for the lighter work. The method of molding will be in accordance with the latest improved practice, compressed air being used for tamping, and wherever practical to use it. This foundry building is connected with the main buildings by means of compressed air cranes with tracks arranged in such a way that the product can be transferred readily. The machinery in the foundry will be operated by electric motors throughout, in fact, no steam will be used anywhere in the plant, except in the power house.

The main machine shop will be arranged with electric traveling cranes to handle the heavier work. The lighter work will be handled by compressed air cranes, arranged to cover practically the whole area occupied by machine tools, in which articles weighing over 50 lbs. are being finished. The machines will be so arranged that when the parts are finished, they will be near the department where the complete equipments are assembled. Immediately adjoining this department is the testing room in which also are arranged cranes of various capacities for handling the machines, and after testing, the equipments are either shipped or deposited in the warehouse, which is arranged with a railroad

track immediately in its center. The warehouse is likewise fitted up with cranes for conveniently handling the goods and is also provided with wood-working machinery for making packing boxes, both for domestic and foreign shipment.

Stored Air for Braking Cars

No department of railway practice has in recent years received closer attention and more minute study than that of brakes. The hand brake has been in use ever since the first street railway was built, and up to about 1860, was in exclusive use on steam roads. The main defect in the ordinary hand brake is its narrow limits of power, which is confined to the strength of the motorman. When the size, weight and speed of many of the modern electric cars are considered, it is not surprising that the ordinary hand brake is not considered adequate by many managers and that increased attention should be given to air and other power brakes.

Since the convention at Boston a year ago, a new air brake for electric cars has made its appearance, that manufactured by the G. P. Magann Air Brake Company, of Detroit. Coming into the field in January of this year with the recommendation from one twelve-car road entirely equipped and in operation for one year previous, the company has taken orders for entirely equipping six interurban roads, aggregating forty-two cars. These roads are as follows:

	Brake Equipments
Kansas City & Leavenworth Railway	10
Cleveland & Eastern Railway	8
Mahoning Valley Railway	3
Sandusky & Interurban Railway	3
Detroit, Rochester, Romeo & Lake Orien	6
Detroit & Northwestern Railway	12

A few of the more important advantages claimed for this brake are: (1) No complicated machinery is used, no air pumps, pump controllers, electric motors or triple valves; (2) a constant supply of air, at full working pressure, is always ready for any number of quick applications in an emergency; (3) the brakes are released positively and instantaneously; (4) it is absolutely noiseless in operation; (5) leakage of air is completely done away with; (6) there is no possibility of break-down, except in collision or derailment; (7) less than 1 lb. of air is required to the stop; (8) low first cost; (9) the cost of maintenance is practically nothing.

The Magann system differs vitally from all other present methods of air brake application. Stored air is used, confined in reservoirs fixed to the car. These are quickly charged from a stationary air compressor at the power station or any point on the line, at a pressure sufficient to allow the car to make an average of 300 stops or a maximum of 500 stops. There is very little mechanism on the car, and the moving parts of the air brake system, such as air compressor, regulator and automatic, are removed to the station, where they are under the care of the power house engineer. This reduces largely the amount of apparatus required, greatly simplifying the whole system and reduces the operating expense to a minimum.

Now as to the practical working of the brake. The risk incurred in the reversing of motors, when necessity demands a quick stop, is entirely obviated. The time required in braking is much less than is generally required to reverse a motor. It is also claimed that with this system "skidded" wheels never occur, owing to the "air cushioning" in the two cylinders, the peculiar construction of which prevents the possibility of undue pressure at the shoe. Furthermore, the brakes never become "jammed." The efficiency of the Magann air brake, under all conditions of weather, etc., has also been thoroughly demonstrated.

The system will be on exhibition at Tattersall's during the convention, where a working exhibit will be shown.

Chain Grates

The Green traveling link grate, though ordinarily designated as a chain grate and in general appearance similar to other chain grates, actually differs in many features from other automatic stokers of this kind. One of the distinctive features is that the clips or links forming the grate are so designed that they can be readily removed from or replaced in the chain without removing the joining bars or any of the principal parts. In fact, it is almost possible to take out and replace a clip without stopping the grate. Each clip is about a foot long and on the underside of the ends are oval openings which permit the links to be slipped over the bars, after which the bars are turned so as to bring their largest diameter across the opening in the link so that the latter cannot drop off. The joining bars, which as will be seen, are also oval in section, are held in position by means of binders.

Another feature of the grate is that it is provided with roller bearings on which the chain rides, giving a positive and easy movement without the use of lubricants. These bearings are housed in so that they are entirely protected from dust and ashes. The chain is moved by means of sprocket wheels which engage with lugs on a row of specially designed links. The entire grate is also mounted on a carriage, having wheels which run on a track specially provided for it so that the grate can be entirely withdrawn from the furnace without interfering with the boiler setting. The coal is fed in through a hopper.

Recent tests made on one of these grates in the large power plant of the West Chicago Street Railway Company, at Western Avenue, using Indiana shell bark screenings containing 10,300 B. T. U. showed that a grate under a 400-h.p. boiler while developing 523 h.p. gave an efficiency of 75.3 per cent. The maximum h.p. developed during a capacity run on the same boiler showed over 730 h.p. developed.

These grates are manufactured and sold by the Green Engineering Company, of Chicago. During the last three years almost 40,000-h.p. "Green traveling link grates" have been sold. Among the larger orders were the West Chicago Street Railway Company, the Milwaukee Electric Railway & Light Company, Metropolitan Street Railway Company, Kansas City; United Railways Company, St. Louis; Armour Packing Company, Swift & Company, Cincinnati Edison Electric Light Company, and a good many others. This company not only manufactures this grate, but is also contractor for complete installation of power plants for either electric lighting purposes or street railway plants. The officers of the company are W. M. Green, president; John R. Gent, vice-president; P. Albert Poppenhusen, treasurer, and Herman A. Poppenhusen, secretary. All of these gentlemen are well known and have had practical experience in the installation of steam plants, having been connected with some of the leading engine and boiler manufacturers of the country.

A Large British Supply House

One of the long established and best known British firms which has engaged in the manufacture and sale of electrical apparatus and instruments for tramway work is Elliott Bros., of London. This firm was established in 1800, and has taken the highest awards for apparatus exhibited at every exposition at which it has entered as a competitor.

One line of busines in which Elliott Bros. have enjoyed an excellent trade, has been in the sale of Weston electrical instruments, for which they are agents. Owing to the requirements made by the British Board of Trade electrical department, with a view to preventing disturbance on telephone and telegraph lines, electrolytic action on pipes, etc., certain records have to be kept by the electric railway companies to show the amount of current returning to the station through the earth, and not along the uninsulated return or rail or any return feeder. Soon after the passing of this regulation Elliott Bros. had designed a set of instruments to do this work and make the graphical records necessary. This work was followed by making and placing on the market a complete switchboard panel to carry out all the tests required by the electrical department of the Board of Trade. This line of apparatus has been most cordially received by the trade. The firm is also intending to increase its manufacturing facilities to enable it to undertake a more extended position in electric traction work, which it is now prevented from doing through lack of space. In addition, of course, the firm is supplying a great many traction stations with many other accessories, such as speed indicators, steam engine indicators, etc., which form a regular part of its manufactures.

In connection with three-phase transmissions of power for electric traction or whatever may be required, the company is also planning to manufacture recording wattmeters for such circuits.

Some Recent Electrical Work in England

Laing, Wharton & Down, Ltd., have recently done a considerable amount of electrical work in different parts of Great Britain. In the line of electrical traction the firm has completed and turned over to the Glasgow Corporation a pair of generators and engines of 900 h.p., to be used in their combined station, has completed a small electric railway in the West Riding of Yorkshire for private use, and has delivered to the Corporations of Glasgow, Manchester, Leeds and Hull large numbers of Brill trucks—those for Hull being fitted with roller bearings. It has also recently filled orders from the Bristol Tramways Company for both trucks and cars, and from the Hull Corporation Tramways for cars. The firm has also practically completed the delivery of several large switchboards for the Glasgow Corporation of various sizes to suit the large generators, the largest one being 1800 amps. 600 volts; has completed the extension of the Halifax Corporation Tramways switchboard, and has supplied a large switchboard to the Barking Urban District Council, the West Riding County Council, and the County Council of Hertfordshire. In connection with traction may be classed the firm's extensive business in Vril electric launches, which is constantly on the increase. The problems in connection with electric launches are of as much interest as those in railway work, but, of course, do not involve such large powers. In connection with these launches and also with general industrial motor work, the firm has manufactured a large quantity of Callow-Eck controllers, which have again been improved recently in the way of simplification and greater efficiency.

For tramway track work the firm has received large orders for rail saws, drills and Pearson jacks, as well as for Okonite wires and Okonite and Manson tapes. The wonderful durability of Okonite insulation, and its resistance to the attacks of oil, acids and alkalies have rendered it particularly popular for tramway service in Great Britain.

Laing, Wharton & Down also do a large busines in the allied business of electrical work. In connection with lighting the firm has executed a large number of contracts, among which may be mentioned seven churches, three hospitals, four theaters, and the same number of post offices, as well as for a large number of warehouses, mills, banks, offices and private dwelling houses. Another specialty of the firm is the erection of electric advertising signs. Such signs have been installed by them in London, Nottingham and Sheffield, each containing over a thousand lamps, and capable of advertising without any change except on the card, and producing in a few minutes any desired advertisement. A similar sign will shortly be erected in New York, and possibly also in Paris.

The firm also manufactures a large quantity of high tension apparatus, as well as switchboards, switches and various other electric appliances for trade consumers, including theater battens and other special theater devices. They have taken up the handling of three-phase apparatus in Great Britain, and anticipate to have a fair demand in connection with power installations and isolated factories.

An Electric Snow Sweeper Train

The McGuire Manufacturing Company, of Chicago, has decided for the month of October, a rather novel method of advertising. It has arranged for a special train of forty-three platform cars, each car carrying one of its snow sweepers, decorated with banners and mottoes. The train will leave Chicago during the convention, after being exhibited for one day on a side track at a point nearest the Convention Hall. It will then proceed on its way to New York via Washington, delivering sweepers en route and stopping at places where the company thinks sweepers are likely to be sold, where a representative of the company will invite the railway officials of the place to review the train. When the train reaches Washington, it will be reduced to seventeen cars. Leaving ten there for the Columbia Railway, it will proceed to New York, dropping one at Chester, Pa., and completing the trip by delivering six at New York City for the Metropolitan Street Railway Company. This will undoubtedly be the largest train of this sort of freight that has ever been made up in any country. Sixty sweepers are now being constructed in the shops of the McGuire Company for shipment in the month of October. To accomplish this and at the same time take care of the large truck business of the company, about 350 men are working night and day. It is a singular fact that they have sold sweepers as far west as Portland, Ore., south to Augusta, Ga., and east to New York City.

Forced Draft

The argument is sometimes advanced against the use of forced draft instead of induced draft, that it burns out the grates, seriously injures the boiler, and blows gas and smoke from the fire doors. The basis of this opinion lies in the experience of some engineers with plants equipped with fans operated at far above the proper speed. This is usually the result of installing, through ignorance, a fan too small for the work, and then forcing it above its normal speed in order to secure the desired air volume. As a consequence, instead of creating an ash pit pressure of ¾ in. to 1¼ ins., which is all that is ordinarily required, the presure is forced up to even 5 ins. or 10 ins., with the attending objectionable results.

In a recent instance the engineer complained of gas discharged from the fire doors with incidental effects, and condemned forced draft in toto, although he was favorably disposed toward induced mechanical draft. Investigation showed that the fan was being operated at about 12 ins. water pressure, which at once accounted for all the trouble.

When forced draft is used, the air as it passes from the ash pits to the combustion chamber is greatly reduced in pressure, owing to the resistance of the grates and the fuel. Coincidently, the stack, even if a short one, tends to produce a partial vacuum in the furnace. As a result it is practically impossible to create under proper conditions more than a slight excess of pressure in the combustion chamber, and this should not be enough to force the gases out at the fire doors.

Electric Tramway Apparatus for Sheffield, England

The following is a list of the machinery and apparatus purchased by the Sheffield Corporation for their tramways, and supplied by the British Thomson-Houston Company, Limited.

Boilers.—Three boilers of marine type each 10 ft. diameter x 10 ft. long, made by John Brown & Company, Limited, and fitted with Ellis & Eaves induced draught system. They are fitted with Purve's ribbed furnaces and "Serve" ribbed tubes. Each boiler will evaporate 8000 lbs. of water per hour, the working pressure being 160 lbs. per sq. in. Two fans, each worked by an inverted vertical steam engine, are furnished for the three boilers.

Boiler Feed Pumps.—There are two "Manchester" vertical duplex type pumps made by Frank Pearn & Company, Limited, of the following dimensions: Diameter of steam cylinders, 5½ ins.; diameter of rams, 3½ ins.; stroke, 5 ins.

Surface Condenser.—One Wheeler Admiralty Surface Condenser containing 1900 sq. ft. surface with combined air and circulating pumps as follows: One 14-in. steam cylinder, one 16-in. water cylinder, one 16-in. air cylinder, all 16-in. stroke cylinders.

Feed Water Heater.—There is one horizontal Wheeler feed water heater, located between the feed pumps and the boilers, for working in conjunction with the exhaust steam from the auxiliary plant.

Feed Water Filter.—One pair Edmiston feed water filters arranged on the twin system, so that the feed water can filter through one, or all, or, in the event of their becoming out of use, to feed through an independent by-pass, thus making feed line entirely independent of the filters.

Piping.—The steam and exhaust piping is made of lapweld steel pipe with flanges screwed on at the ends. All circulating water pipes are also of lapwelded steel pipe. The fittings in all cases being of best quality cast iron. The valves are of the straight way or gate type made by Messrs. Hopkinson, of Huddersfield; the pipe all having been furnished by the Best Fox Manufacturing Company, of Philadelphia.

Engines.—Three Allis horizontal tandem compound engines: Cylinders, 12-in. x 22-in. x 30-in. stroke; r.p.m., 135; initial steam, 150 lbs. per sq. in.

Overhead Traveling Crane.—One 20-ton overhead hand traveling crane, made by Joseph Booth & Bros., of Rodley.

Generators.—Three British Thomson-Houston generators, multipolar type, having six poles, and a rated capacity of 225 kw., designed for a working potential of 500 volts when running at a speed of 135 r.p.m. These machines are compound wound so as to maintain the voltage constant within 2 per cent for all loads up to rated full load, the speed being maintained constant, and the position of the brushes remaining fixed. These generators are direct connected to the engines mentioned above.

Switchboard.—This consists of three generator panels, one feeder panel, one Board of Trade panel. The generator and feeder panels carry automatic circuit breakers of the magnetic blow-out type, Weston illuminated dial ammeters, and all necessary switches, etc., for the complete control of the generators and feeder circuits. There are also two illuminated dial Weston voltmeters supported on a bracket at one side of the board in such a position that it can bee seen by the attendant when manipulating the apparatus at any part of the board. The Board of Trade panel is of the British Thomson-Houston standard type, containing all the necessary instruments for making the records and tests as called for by the various Board of Trade regulations.

Cables.—Are of the Callander well known type, insulated with jute saturated with fine bitumen, lead covered, taped and braided with a specified insulation resistance of not less than 700 megohms per statute mile after twenty-four hours immersion in water at 60 degs. F. When laid and jointed the cable should withstand an application for one hour of a potential of 1000 volts. In addition to the feeder cables, Messrs. Callander have supplied the cables connecting the trolley wire with various feeder pillars. The return feeder cable and the three-core test cable, aggregating over 13 miles of cable.

Overhead Line Construction.—The poles and brackets being supplied by J. Spencer, of Wednesbury; the suspensions, etc., are of the standard British Thomson-Houston type. The feeder pillars are of the standard British Thomson-Houston type, and in accordance with Board of Trade requirements, and are so placed as to divide the line into quarter-mile sections.

Cars.—Twenty-five motor cars, complete, were supplied; the car bodies being of the top-seat type, built by Messrs. Milnes & Company. The cars are capable of seating twenty-two passengers inside and twenty-nine out. They measure, overall, 27 ft. 6 ins., and have a width of 7 ft. The height inside at center from floor of under side of roof is 6 ft. 6 ins., and the approximate weight is 65 cwt.

The trucks are the Peckham extra long cantilever extension type, supplied to the British Thomson-Houston Company by R. W. Blackwell & Company. The electrical equipment of each car consists of two G. E.-52 railway motors, two series parallel controllers of the magnetic brake type and the electric brake equipment, the shoes and discs being mounted on the truck frame and axles respectively.

The above apparatus is that covered by the original contract between the British Thomson-Houston Company and the Sheffield Corporation, since the signing of which the following additional orders have been received by the British Thomson-Houston Company for extension: Two eight-pole, 500-kw., 90 r.p.m. generators, similar to the 225 kw. described above; two generator panels and one feeder panel, twenty-five double motor equipments with magnetic brakes, and thirteen double deck cars and trucks, also overhead line material, cables, etc., for the Walkley and other extensions; all of similar kind to that described above for the original contract. The Sheffield corporation also placed with the British Thomson-Houston Company, Ltd., last month, an order for thirty double motor equipments similar to those already supplied.

Personal

MR. W. B. ROMMEL, of London, who is in this country for several weeks, is now at Niagara Falls enjoying a brief vacation.

MR. PATRICK McARDLE has been appointed assistant superintendent of the Easton, Palmer & Bethlehem Street Railway, of Easton.

MR. EDWARD A. BROWN has resigned as master mechanic of the Greenfield & Turner's Falls Street Railway, to accept a position at Boston.

MR. G. F. GREENWOOD, manager of the Havana Electric Railroad Company, was in Pittsburgh last month, contracting for general good time had.

MR. D. LILLIBRIDGE has resigned the position of advertising manager of C. W. Hunt Company, and is spending a vacation among the Thousand Islands.

MR. H. S. COOPER, formerly superintendent of the Schenectady Railway Company, has been appointed general manager of the Ithaca Street Railway Company.

MR. WM. ATKINS, secretary and treasurer of the Tuscarawas Railroad Company, of New Philadelphia, Ohio, has recently been appointed general manager of that company.

MR. ALEXANDER E. ORR, president of the New York Rapid Transit Commission, has just returned from a trip to Great Britain. Mr. Orr's trip was purely for pleasure.

PROF. WILLIAM S. ALDRICH, formerly of the University of West Virginia, has accepted the position of professor of electrical engineering in the University of Illinois at Urbana.

MR. EDWARD D. PAGE has been elected president of the South Orange & Maplewood Traction Company, of South Orange, N. J., to succeed Mr. Frank Brewer, who recently resigned.

MR. FRANK BREWER has resigned as president of the South Orange & Maplewood Traction Company, of South Orange, N. J., with which he has been connected since the road was placed in operation in 1895.

MR. C. W. FOOTE has resigned the general managership of the Zanesville Railway & Electric Company, to accept a position with the Cincinnati & Miami Valley Traction Company, of Cincinnati.

MR. EUGENE A. WISE, train master of the Manhattan Railway Company, of New York, has resigned his position after twenty-one years of service in the company. Mr. Wise was a member of the Municipal Council of New York.

MR. P. H. GADSDEN, of Charleston, S. C., formerly attorney for the Charleston Consolidated Railway, Gas & Electric Company, has been elected vice-president and acting president of that company, vice Dr. J. S. Lawrence, deceased.

MR. E. W. POOLE, who for the past 3½ years has been cashier at the main office of the Waterbury Traction Company and Connecticut Lighting & Power Company, has been transferred to the general office of the company, at New York.

MR. HENRY SCHNITGER, former lessee and superintendent of the Davenport & Rock Island Railway Company, now the Tri City Railway Company, of Davenport, died in Oklahoma City, Sept. 16. He is survived by a wife and four children.

MR. BURT VAN HORN, general manager of the International Traction Company's lines in Buffalo and Niagara Falls, is to spend next winter in Europe, on account of Mrs. Van Horn's health, but Mr. Van Horn will be again at his post in the spring.

MR. S. POTIS, who designed and built a number of the principal electric railway power stations of Chicago, has recently accepted the position of chief engineer of the Illinois Telephone Construction Company, with headquarters in the Rookery Building, Chicago.

MR. H. R. FEHR, superintendent of the Easton, Palmer & Bethlehem Street Railway Company and former city engineer, gave a banquet at the American House, Bethlehem, recently, to the members of the Highway Department, city officials and representatives of the press.

MR. PAUL K. BRAWD, chief engineer of the Russian Electric Company Union, of St. Petersburg, Russia, sailed Sept. 2 for France. Mr. Brawd is to return to this country in December next to arrange with manufacturers for the representation of their interests in Russia during 1900.

MR. JOSEPH S. MINARY, the retiring general manager of the Southern Electric Railway, of St. Louis, was pleasantly remembered by his former employees, who presented him with a handsome chain and locket. Mr. Minary has been transferred to the northern division of the United Railways Company.

MR. A. W. LYNN, who, since 1885, has been identified with Milwaukee street railway interests, has resigned his position as superintendent of construction and maintenance of the Milwaukee Electric Railway & Light Company, and will become general manager of the Milwaukee Railjoint & Welding Company.

MR. FRANK WEBSTER, of the construction department of the Market Street Railway Company, of San Francisco, was tendered a banquet Sept. 3 by a number of his friends, the occasion being his recent attainment of the thirty-second degree in the A. and A. S. rite of Masonry. During the evening Mr. Webster was the recipient of a very handsome typical emblem.

SIG. GUIDO SEMENZA, chief electrical engineer of the Milan (Italy) Edison Company, arrived on the steamship "City of Rome" from Glasgow, on Sept. 4, and will make a careful study of electric lighting and tramway work in this country during the next few weeks, going west as far as St. Louis, Chicago and Minneapolis, and visiting the principal cities en route.

MR. JOHN H. SESSIONS, president of the Sessions Foundry Company, makers of the "Composite" brake shoe, died at his home at Bristol, Conn., Sept. 10. Mr. Sessions was also president of the Bristol National Bank and the Bristol Water Company, and was a director of the Bristol & Plainville Tramway Company. He is survived by a widow, two sons and a daughter.

COL. N. H. HEFT, president, secretary and chief electrician of the Meriden Electric Railroad Company, and president and purchasing agent of the Stamford Street Railroad Company, was injured a few days ago while alighting from a street car. Mr. Heft wrenched his knee and was compelled to take to his bed for a few days, but is now able to be about, and no serious results are anticipated.

MR. A. R. MOORE, president of the Escanaba Electric Street Railway Company, tendered a number of his friends a trolley ride Aug. 25. The party journeyed on one of the company's large interurban cars to Flat Rock, where supper was enjoyed and a general good time had.

MR. JOHN E. SANFORD, of the Mass. State Board of Railroad Commissioners, is said to have resigned. Mr. Sanford, who has been identified with the board since his appointment by Governor Russell, refuses either to confirm or deny the report. He has been in poor health for several months, and has been compelled to confide the greater part of the detail work of the commission to his associates, Messrs. Bishop and Goodwin.

MR. H. A. TYLER, president of the Trolley Club, composed of employees of the New London Street Railway Company, has resigned his position with the company and also as president of the club to enlist in Forty-sixth Regiment now being organized for service in the Philippines. Mr. Tyler was held in great esteem by his associates and was, upon his departure, presented with a handsome gold mounted briar wood pipe as a token of remembrance.

MR. H. B. WESTCOTT, general manager of the Cortland & Homer Traction Company, of Cortland, N. Y., has entered the theatrical field, and, together with Mr. C. W. Burrill, has incorporated the Burrill Comedy Company, of Cortland. The plans of the company are not yet fully matured, but it is stated that it is the purpose to organize a comedy troupe and travel during the coming theatrical season. Mr. Burrill is at present managing the attractions which are being given at the railway company's park.

MR. C. B. FAIRCHILD AND MR. C. B. FAIRCHILD, JR., for many years connected with the STREET RAILWAY JOURNAL, have become associated with the "Street Railway Review," the former as New York business representative and the latter in the editorial department in Chicago. The heartiest good wishes of the STREET RAILWAY JOURNAL go with the Messrs. Fairchild in their new work, the kindest and most cordial feelings having always been entertained for them, and their value of their work having been fully recognized and highly appreciated.

MR. GEORGE J. GOULD, president of the Manhattan Elevated Railway Company, of New York, returned Sept. 23 from a trip to Europe. Mr. Gould, when interviewed regarding the plans of the company, said: "Everything is progressing nicely. We have already broken ground for the power house. The third rails have been purchased and the engines ordered. I cannot say, however, when the change will be made, but I can say that everything is going ahead in that direction. The Manhattan will soon give the people rapid transit, and that in the near future."

MR. E. C. FELTON, president of the Harrisburg Traction Company, has resigned that position to take effect Oct. 1. Mr. Felton succeeded Mr. John Q. Denny as president of the company upon the consolidation of the East Harrisburg and Citizens' Street Railway Companies as Harrisburg Traction Company a few years ago, and under his most successful administration the property has increased in value and earning power to a most appreciable extent. Mr. Edward Bailey, president of the Harrisburg National Bank and Harrisburg Trust Company and a director of the traction company, has been chosen as his successor.

MR. C. J. FIELD, consulting engineer and contractor, who has been for the past year and a half identified with the American Vitrified Conduit Company as general manager, has severed his connection with that company to accept the position of vice-president and general manager of the United States Motor Vehicle Company, with offices in the Townsend Building, at Twenty-fifth Street and Broadway, New York City. Mr. Field also proposes to continue his separate business interests as a consulting engineer and contractor on central station, electric railway and underground conduit work.

MR. DANIEL A. HEGARTY has accepted and entered upon his duties as general superintendent of the Railways Company General, with offices in the Drexel Building, Philadelphia. A pleasing feature of his return to Philadelphia from Norfolk, where he was general superintendent of the Norfolk & Ocean View Railway, was an informal dinner tendered him by his former associates in the Hestonville, Mantua & Fairmount Railway, of Philadelphia, of which he was general superintendent and chief engineer. It will be remembered that on this railway the employees remained loyal to the company during the great strike on all the other roads in Philadelphia in 1897.

MR. SHIMBA KUNISAWA, C. E., chief engineer of the Japanese Government railroad system, with headquarters at Tokio, sailed from New York for Japan, Sept. 27. Mr. Kunisawa was in this country about three weeks, and his visit was for the purpose of studying American railway methods in general and the condition of maintenance of shops in particular. Mr. Kunisawa, while out West, made a minute inspection of the Chicago, Burlington & Northern shops, and also those of the Chicago & Northwestern and the Chicago, Milwaukee & St. Paul companies, and expressed himself as having been highly delighted with the instruction which he received.

MR. H. WHITLEY, vice-chairman of the Borough Tramway Committee of the Halifax (England) Corporation, and Mr. H. F. Street, borough electrical engineer, arrived in New York via steamship "Servia," on Sept. 6. It is their intention to make a quite extended trip in the United States, investigating, in the interests of their municipality, the subject of electric traction, particularly with respect to the use of polyphase currents for transmission purposes. They will first spend several days in New York and Brooklyn, and then will go to Philadelphia, Washington, Pittsburgh, Cincinnati, possibly Chicago, Buffalo, Toronto, Montreal and Boston, returning to England early in October.

HENRY B. CUTTER, president of the Cutter Company, of Philadelphia, recently returned from Europe on the "City of Rome." He expresses himself as delighted with the results of his prolonged European trip. As the I-T-E circuit breaker is already well and favorably known in Europe, it was to look over the field rather than to begin operations which took Mr. Cutter abroad. In a number of the most important recent electrical installations, for street railway services particularly, the I-T-E circuit breaker has been specified. The Cutter Company has also been specially invited to bid on the circuit-protecting apparatus for the Metropolitan underground system in Paris.

DR. W. D. EASTLAKE, of Tokyo, Japan, has arrived in New York. Dr. Eastlake is an American, but has been in touch with Japanese business and professional life for about twenty years, during ten of which he has lived in that country, and has enjoyed

peculiar facilities for becoming thoroughly acquainted with its people, speaking, as he does, the Japanese language perfectly. He is now in this country for the purpose of making arrangements with manufacturers here, by which American goods can be introduced into Japan to good advantage, and is particularly desirous of handling electric railway apparatus and material, machine tools, mining tools and supplies and electric lighting supplies.

MR. THOMAS BARRETT, assistant general superintendent of the Metropolitan Street Railway Company, of Kansas City, died Aug. 26. Mr. Barrett was sixty years of age, and had been in the employ of the company for about thirty years. He began service with the company as a hostler, and by faithful service was successively made driver, barn foreman, superintendent of car repairs and lastly assistant general superintendent. His death is greatly mourned by all his associates, and especially by Walton D. Holmes, president of the company, who, in referring to the matter, expressed himself as follows: "Mr. Barrett was like a brother to my brother, and we have worked along side of him ever since we have been in the street railway business, and have always considered him our right-hand man. Faithful, honest and capable, he has served our road as no other could have done."

MR. STEPHEN HARVEY BENNETT, of Baltimore, Md., has announced his intention of entering the field of the street railway examiner and appraiser. Mr. Bennett's first business training was received in the counting rooms of Messrs. Fisher & Shaw, bankers, of Baltimore, which firm was instrumental in placing large amounts of securities on railways and other industrial enterprises throughout many sections of the country. Showing an inclination to railway interests, Mr. Bennett was placed by this firm in the position of treasurer of the Atlanta Railway Company, of Atlanta, Ga., which position he filled until his resignation, July 1. During his office of secretary-treasurer of the Atlanta Railway Company Mr. Bennett for a time filled the offices of treasurer and auditor of the Nashville & Suburban Railway Company, but later resigned this position. It is Mr. Bennett's intention to devote his energies to the physical and financial examination of street railways and allied interests, especially where consolidation is contemplated, and to undertake the procuring of capital for the building or extension of desirable railway properties.

MR. W. D. RAY, who has recently accepted the position of general manager of the Magann Air Brake Company, is 26 years of age, and for eleven years has been engaged in the electrical business. In 1890 he entered the employ of the Cicero Water, Gas & Electric Company, Oak Park, Ill., as electrician's assistant, and from that position went with the Chicago & Northwestern Railway, first in charge of the lighting plant at the Grand Central passenger station at Chicago and of the electric and pneumatic block signals, and later as electric light inspector of the Chicago, West Chicago, Milwaukee and other towns. In 1893 he associated himself with the electrical department of the World's Columbian Exposition as trouble man and inspector. The following year he became connected with the Standard Electrical Company, of Chicago, as assistant consulting electrician, engaged in the testing and designing of dynamos, motors and transformers. From November, 1894, to July, 1897, he was employed by the Everett Railway & Lighting Company, of Everett, Wash., first as superintendent and then as general manager. Mr. Ray is also known as an inventor and writer, and is joint author of a book on the practical applications of dynamo electric machinery.

CAPT. ROBERT McCULLOCH, retiring superintendent of the National Railway system, of St. Louis, and C. Nesbitt Duffy, late secretary of the same company, were tendered a farewell banquet by the employees of the Broadway, Southwestern, Baden, Citizens', Cass Avenue, Northern Central and Union lines, Aug. 28. Among those present were: C. H. Spencer, president of the National Railway Company; W. J. Orthwein, president of the underlying companies of the National Railway Company; Christian Peper, for many years president of the Broadway line; R. D. Ellis, assistant attorney for the railway companies; F. C. Whittemore, Messrs. McCulloch, Duffy and a few others. More than 300 employees of the railway companies sat down to the banquet, which was most elaborate. When all had partaken of the banquet, C. H. Spencer was made chairman and R. D. Ellis secretary of the meeting. In a short speech Mr. Spencer set forth the object of the gathering, and added a few words complimentary to the employees. Capt. McCulloch was then called on and thanked the employees for the expression of their feeling and spoke of his regret in leaving them. A talk of pleasant nature was also made by Mr. Duffy. Secretary Ellis then read resolutions prepared by the employees conveying the good wishes of all to Capt. McCulloch and Mr. Duffy. They were printed and handsomely bound and contained the names of all the employees of the lines. Several other interesting and short speeches were also made. Mr. McCulloch and Mr. Duffy, the day following the banquet, were waited upon at their homes by the employees. Mr. Duffy was then presented with an open-face watch, with his initials, the date and "From the National Railway Boys" engraved upon the back, and Capt. McCulloch was presented with a fine piece of Dresden china, decorated with a hand-painted Scriptural scene.

MR. W. A. McGUIRE, president and manager of the McGuire Manufacturing Company, is well known in the street railway industry, so that in a Chicago number the presentation of his portrait is most appropriate. Mr. McGuire has not only been the constant guardian and builder of the financial reputation which this company enjoys, but is also to be credited largely with the success of the company in other ways, as most of the patents which this company owns are the product of his mechanical genius. He has accumulated a very comfortable fortune, and might have retired many years ago but for the pride he takes in the company bearing his name and his apparent determination to see it one of the largest and strongest concerns of its kind in the world. A portrait is also published of Mr. W. J. Cooke, vice-president of the company, who has been with it from the start, and has shared its success. He has always cared for the selling interests of the company, and is one of the most popular salesmen in the field. His pleasant smile and genial manner have gained for him the sobriquet, the "Chesterfield" of railway salesmen of the country. Father Time has changed the color of his hair to a silvery white, but his bland smile and bright eyes are as attractive to-day as they were twenty years ago. At present the company is enjoying the largest business it has ever done. Not a part of the large factory but is filled with material and machinery, and, though the works are running night and day, they still are about three months behind with a large amount of work.



W. A. MCGUIRE



W. J. COOKE

AMONG THE MANUFACTURERS

EDWARD A. MEYSENBURG has resigned as an officer of the Badt-Goltz Engineering Company, and has retired from active management of this concern. This corporation was formerly known as Meysenburg & Badt (Incorporated).

DICK, KERR & COMPANY, of London, England, have received a contract for the entire equipment of the Calcutta tram-

ways, and their representative, Mr. Rutherford, has left for India to take charge of the work of constructing the line.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY has issued its September bulletin, numbered 2728. The bulletin is illustrated and describes in general the Bullock electric power system for operating newspaper presses.

WESTINGHOUSE, CHURCH, KERR & COMPANY, are out with a neat little brochure entitled "A Bird's Eye View of Our Business." This comes in concise form, and gives descriptions of the different types of Westinghouse engines and generating sets.

THE WALWORTH MANUFACTURING COMPANY, Boston, purchased property 130 to 136 Federal Street, and after it is remodeled the company hopes to have as convenient, well-arranged and handsome salesrooms and offices as any in Boston.

THE STANDARD AIR BRAKE COMPANY, of New York City, has a new catalogue, handsomely bound, showing the latest developments in standard air brake apparatus. The company's new compound compressor and automatic motor controller are described and illustrated.

McKEE, FULLER & COMPANY, of Catasaqua, Pa., manufacturers of chilled and steel-tired car wheels for electric railways, will have an exhibit at the Chicago Convention, showing their wheels and axles. It will be under the supervision and in connection with the exhibit of Elmer P. Morris.

THE WATSON-STILLMAN COMPANY, of New York, manufacturers of hydraulic tools, and particularly of jacks and lifts, describes its latest productions in a catalogue of 54 pages. A complete line of hydraulic jacks for street railway purposes is shown, including motor lifts, jacks and replacing jacks.

W. S. LAYCOCK, of Sheffield, Eng., a prominent manufacturer of railway cars and railroad appliances, has recently published a very tasteful catalogue descriptive of the specialties supplied by him. They comprise all kinds of railway fittings, including curtains, boxes, steam and electric heaters, etc.

REAVELL & COMPANY (Ltd.), of Ipswich, Eng., report an excellent demand for their high-speed enclosed constant-thrust compound engine, and although the company has entered the electrical field within a comparatively recent time its sales show that the engines are favorably regarded by electrical engineers.

GREEN'S fuel economizer seems to be equally popular for railway power stations on both sides of the Atlantic. It is noticeable that economizers are used in most of the large stations which are being built for electric railway service, and it is stated that this make of economizer has been fitted to upwards of 200,000 steam boilers.

THE ELECTRICAL INSTALLATION COMPANY, of Chicago, has closed contract and is about to begin work on 6 miles of single track and 3 miles of double track construction for the Birmingham Railway & Electric Company, Birmingham, Ala. This is the third contract this company has had in Birmingham during the past two years.

A VERY CONVINCING little circular is that issued by the B. F. Sturtevant Company, of Boston, Mass., regarding its exhaust heads, which shows that by the utilization of centrifugal force in the operation of this head, the water is thrown outward with 1000 times the force exerted upon the steam, and is thereby absolutely separated from it.

THE STANDARD ROLLER BEARING COMPANY, whose factory has formerly been in Boston, announces that it will very shortly move to Philadelphia, where it has commenced the erection of a new factory that will be 60 ft. x 100 ft. and four stories high. The company expects to have its new factory in operation within the next sixty days.

THE NEW ENGLAND RAILROAD CONSTRUCTION COMPANY, of Worcester, has just closed a contract for the complete construction and equipment of an electric line between Templeton and Gardiner, Mass., a distance of 5½ miles. The contract embraces the construction of the road, the power station, car house and everything complete. Work begins at once.

THE R. WOODMAN MANUFACTURING & SUPPLY COMPANY, 63 Oliver Street, Boston, states that it has never been so busy as at the present time. The Woodman steel ticket punch is one of the best known articles in the electric and steam railway field, as there are but few roads in America where they are not used to some extent. The company also manufactures uniform buttons, badges, etc.

THE DE WITT "Common Sense" sand box completes this fall the sixth year of its use on street railway cars. During this time it has constantly grown in popularity and is now well known and in use on a very large number of roads in Europe and America. The claim is made for it that it will work every time and under all circumstances, that it has no complicated parts to get out of order, and that it will last as long as the car body.

THE JACKSON & SHARP COMPANY, of Wilmington, Del., were the builders of the double-deck car used on the Syracuse, Lakeside & Baldwinsville Railway, and of which a description and engraving were published in the last issue of the STREET RAILWAY JOURNAL. This company has built a number of this type of car recently; these cars have proved very satisfactory, especially for summer service where large crowds have to be handled.

THE GREEN ENGINEERING COMPANY, of Chicago, reports that it has just secured an order from the West Chicago Street Railway Company for twenty chain grates to go under 8000 h.p. Stirling boilers at the Western Avenue station. This company has also received the contract for sixteen grates for the new plant to be built by the United Railways Company, of St. Louis. These contracts are said to be the largest ever made for chain grates.

THE AMERICAN VITRIFIED CONDUIT COMPANY, of New York City, is sending out a valuable catalogue, giving illustrations and descriptions of its vitrified salt glazed underground and interior conduits. This company is prepared to take contracts for complete installation of conduit systems. It has finished, within the past few months, a number of large pieces of work of this kind, including many thousand feet in New York, Providence, New Orleans, Boston, etc.

THE WILLANS central valve engine, manufactured by Willans & Robinson, Ltd., of Rugby, England, has proved a most popular type of engine for electrical service in Europe. This company reports 16,000 h.p. in use or on orders for electric traction in the United Kingdom. Among the parties using these engines are the Liverpool corporation, who have ordered eight engines of 1200 h.p.; the Bradford and St. Helens corporations, and the City & South London Railway.

THE MONARCH TRACK CLEANER, heretofore manufactured and sold by the Monarch Stove & Manufacturing Company, of Mansfield, Ohio, will from now on be handled exclusively by the Ohio Brass Company. There are already a large number of these cleaners in use, as they universally recommend themselves, whenever investigated or tried. The Ohio Brass Company is taking steps to push actively the sale of this latest addition to its line, and it is safe to predict satisfactory results to its efforts.

AGARD'S patent vestibule sliding door for electric cars, which is manufactured and sold by James L. Howard & Company, of Hartford, Conn., seems to grow in popularity. This device is in use on all closed cars of the Hartford Street Railway Company, and has given entire satisfaction after two years of use. Mr. Crawford, the general manager of the company, states that in his opinion it satisfactorily solves the vestibule door problem. Briefly, the invention substitutes a sliding door for folding doors.

THE STILLWELL-BIERCE & SMITH-VAILE COMPANY, of Dayton, Ohio, has established a branch office at St. Louis and contiguous territory, in room 601, Burlington Building. The office is in charge of Louis Bendit, and the company will carry at this office a full line of standard sized steam pipes and automatic feed pumps and receivers, air compressors, heaters, etc. The company is enjoying an excellent business just now in the manufacture and sale of the Victor water cooling tower for condensing purposes.

THE STURTEVANT COMPANY has recently published a tasteful illustrated catalogue descriptive of its blowers and exhausters. As is well known, the company makes a specialty of this class of machinery and supplies it in every size for all conditions of work and for either electric or steam operation. The company has done considerable work in Chicago, but perhaps as good an example as any is contained in the large works of the Siemens & Halske Company, of Chicago, which uses the Sturtevant system of heating and ventilation.

THE LESCHEN, MACOMBER, WHYTE COMPANY, of Chicago, has supplied many appliances used on the local street railway lines, as well as of railways farther from home. Among the goods which this well known firm has sold to the Chicago companies are trolley wire, weather proof feed wire, rubber insulated wires and cables, magnet wire, century tape, wire rope, galvanized steel stranded curtain cord and "Beacon" bearing metal. The company is agent for the Bibber-White Company, of Boston, and handles all the goods of that prominent supply house.

J. H. HOLMES & COMPANY, of Newcastle-on-Tyne, England, have met with excellent success in the manufacture and sale of the Castle dynamos, as well as their apparatus for electric lighting, transmission of power, etc. Special attention has been paid in the design of these machines to electrical and mechanical details, which secure not only a high electrical and commercial efficiency, but also prove satisfactory from a mechanical standpoint. The machines are built in all sizes, from 11 kw. up, and for direct connection or for belting. The firm is represented by L. W. Holmes, 17 Soho Square, London.

MATHER & PLATT, of Manchester, England, are doing their proportion of the electric railway work in England, and this proportion is a very large one, as is shown by the frequent installations of machinery of these manufacturers chronicled from month to month in these columns. The corporation of Mather & Platt, Ltd., makes slow speed generators for railway and lighting purposes, direct and alternating currents, boosters and balances, electric locomotives, generators, motors and controlling apparatus for electric power distribution.

GALES COMMUTATOR COMPOUND, which is manufactured by K. McLennan & Company, of Chicago, and is employed to reduce sparking, has been heartily indorsed by the managers of a large number of railway and lighting companies, including the Aurora (Ill.) Street Railway Company, Charlottesville (Va.) City & Suburban Railway Company, Niagara Falls (Ont.) Electric Light & Power Company, and the Dover (Maine) Foxcroft Light & Heat Company. The testimony of these users indicates that the compound increases the life of both commutators and brushes.

GEORGE E. FISHER, president and treasurer of the Chase Construction Company, general contractors, Detroit, Mich., has secured the contract for his company for constructing the Toledo, Fremont & Norwalk Railway, from Toledo to Fremont, Ohio, which includes all work outside of the power house and bridges. The company will employ a force of two hundred or more men on this contract. Mr. Fisher states that his company is now completing the large municipal electric lighting plant for the city of Grand Rapids, and the construction of the Cleveland & Eastern Railway at Cleveland, Ohio.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently taken the agency for the multiplex reflector. This is something entirely new, and is attracting much attention. It is claimed to be the most powerful street railway headlight made, and is guaranteed on competitive tests to be 300 per cent stronger than any other make of reflector, plain or parabolic, on the market to-day. This headlight is corrugated in such a manner that each corrugation acts as an independent lens, producing thereby a light of the greatest intensity. They are made in all sizes and styles.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, will have a representative of its street railway department at the National Street Railway convention in Chicago this month. This department has in the past year become one of the most important branches of their business. Its growth has certainly proven phenomenal. The company, realizing that prompt shipments are a most important factor, is carrying what is probably the largest and most complete stock of street railway material in the country. The company has also gotten out a most complete and up-to-date catalogue devoted exclusively to street railway equipments.

THE WILKINSON MANUFACTURING COMPANY, of Philadelphia, whose automatic stokers have received so favorable a reception from steam users, reports that it has received orders, during the last two months, in the city of Washington for the equipment of 11,000 h.p. of stokers, and within the same space of time in the cities of Philadelphia, New York, Jersey City, Harrisburg, Wilmington, Coatesville and Camden orders for the equipment of 9150 h.p. The company states that the outlook for stokers of its make is very promising, and that it has sufficient orders to keep its works taxed to their utmost capacity, running day and night, for six months.

THE USE of telephones for car dispatching and signaling on electric railroads has increased to such an extent that the fact that the Garl Electric Company, of Akron, Ohio, makes a telephone especially for this work is of interest. This instrument is designed especially to overcome the heavy induction always found on electric lines, and, being simple in construction, is adapted for portable service. The company also makes an ingenious connecting box and pole for this service. In case a car should be disabled and away from any connecting box or hook, the telephone can be raised from the holder and carried to the nearest connection box or hook and connected from that point.

THE NAME OF T. J. WHITING & SONS, Limited, of London, is well known throughout Europe and the English colonies as manufacturers of tickets for tramways, omnibuses, etc. This firm has been established for over a quarter of a century, and numbers among its customers railway companies in every section of the world. A reference to this company's catalogue was published in a recent issue, and gives the best idea possible of the extent of the company's business. Reproductions of the tickets which the company has printed for all parts of the world, civilized and uncivilized, are given, and it would need an expert polyglot to read all the directions on the tickets reproduced.

THE H. W. JOHNS MANUFACTURING COMPANY, of New York, will exhibit at the Chicago Convention a full line of its molded mica overhead insulation, together with its "Noark" indicating fuses and car heaters. The exhibition will be in charge of its Western representatives, the Manville Covering Company, of 173 Randolph Street, Chicago, Ill. The company will also make a practical demonstration of its enclosed fuse, and intends to show something in this line far in advance of anything previously undertaken. It will have present at the convention at least six representatives from its Eastern office, and in addition to this the representation of the Manville Covering Company.

BULLOCK ELECTRIC APPARATUS continues to find favor, especially among the more exacting users. Sales reported by the company for August embrace fifty-two machines, ranging in size from 2½ kw. to 800 kw. capacity. The orders were widely distributed throughout the United States and two were from Great Britain. The latter were for the celebrated "Fraser" equipment for operating large printing presses; one 50 h.p. equipment coming from the "Free Press," of Aberdeen, Scotland, and four 50 h.p. equipments from the "Scottsman," of Edinburgh. The company has just issued Bulletin No. 2732, which will be forwarded to any one applying for it at its general office, Cincinnati, Ohio.

THE HOPPES MANUFACTURING COMPANY, of Springfield, Ohio, has just issued a new catalogue with handsomely designed cover. This cover shows an artistic arrangement of the company's vertical and horizontal separators and cuts of its live steam feed water purifier and a number of scaled pans showing their appearance as they come from the purifier when ready to clean. The interior of this catalogue shows the separators and oil eliminators, together with the live steam feed water purifiers and exhaust steam feed water heaters, but is more especially devoted to the former, together with special forms of separators and receivers. The pamphlet is well printed and will be of interest to any one who desires information in this line.

THE LOMBARD WATER WHEEL GOVERNOR COMPANY, 61 Hampshire Street, Boston, has orders booked for more than seventy water wheel governors, and has been running its works to their fullest capacity for the past year or more. By the use of the Lombard governor water power plants have been brought to as perfect regulation as the best regulated steam plants. A large number of orders have been filled for very difficult water power plants, where close regulation was an absolute necessity, and in every case the Lombard governor has met the requirements and given perfect satisfaction, in fact, there seems to be no longer any question as to the ability of this governor to properly govern the speed of a water wheel which is subject to large and sudden variation of load.

THE CROWDUS ACCUMULATOR SYNDICATE, of London, England, is meeting with great success in the manufacture of accumulators for traction purposes, especially for automobiles. The greatest care is taken in the manufacture of the plates to secure lightness and durability. The lead grids are stamped out by machinery, and are only 0.037 in. in diameter. They are then pasted with sulphate of lead and litharge, and then soldered to a back plate. In assembling the cell the plates are wrapped in an envelope of cellulose, and between each plate is placed a perforated sheet of highly absorbent material, which hardens when the fluid is put in and holds the plate permanently in position. The containing case is of ebonite, and the top is cemented on. The London factory has a capacity of 180 cells a day.

THE GREEN FUEL ECONOMIZER COMPANY reports recent sales of Green's economizers for the following plants, among others: Third Avenue Railway Company, Kingsbridge power station, New York (32,000-B. h.p.); Swift & Company, Chicago, Ill.; Dominion Cotton Mills, Montreal, P. Q. (fourteenth order); Great Northern Paper Company, Millensocket, Maine, and Madison, Maine (two orders); American Thread Company, Holyoke, Mass.; American Hard Rubber Company, College Point, N. Y. (second order); Richelieu Woolen Mills, Chembley, Canton; Worcester City Hospital, Worcester, Mass.; Knoxville Woolen Mills, Knoxville, Tenn.; Anniston Manufacturing Company, Anniston, Ala.; International Paper Company, Otis Falls, N. Y., and Nashua River Paper Company, East Pepperell, Mass. (second order).

GEORGE KISSAM, of George Kissam & Company, will attend the convention in Chicago as usual. He has only missed one in ten years, and is practically the only man in the street car advertising business who is always found at the annual meetings. Mr. Kissam states that the street car advertising business this year is in a very much improved state, and that his firm is making money for the first time since 1893. The largest branch of this firm is located in Chicago, where they control the advertising privileges of all the North and West Side cars, and have done so for over eleven years. They claim to have the largest business in street car advertising in the world, and control the advertising privileges in most all the principal cities of the United States. Their annual disbursements in this line for rentals are over $300,000.

THE WORTHINGTON PUMPING ENGINE COMPANY, of London, reports a large business in orders from electric railway stations in Great Britain and on the Continent. This company has branch offices in the principal cities of Great Britain and in Copenhagen, Calcutta, Amsterdam, Johannisburg, St. Petersburg and Sydney. It has also allied companies in Paris, Berlin, Vienna, Brussels, Buda-Pest, Milan, Naples and other cities. The company's cooling tower for condensing water, where a natural source of supply is wanting, can be operated either by fan or natural draft, and in connection with the surface or jet type of condenser, and is particularly adapted for railway stations, on account of the frequent necessity of locating such stations away from the most economical point for producing steam, in order to procure electrical efficiency.

J. R. McCARDELL & COMPANY, of Trenton, N. J., write that they will be well represented at the convention. Among other exhibits they will show one of their improved standard two-horse Trenton trolley wagons, with revolving platform and extension tower. This wagon has established a high reputation for convenience, ease of operation, durability, labor-saving qualities and general adaptability to street railway work. The company also expects to exhibit its new one-horse tower wagon, which is built on the same plan and in the same manner as the standard two-horse wagon, only much lighter. This wagon possesses all the good qualities of the standard wagon, and is adapted to all street railway requirements, except perhaps the heavier construction work, for which the Trenton standard wagon is intended. These two wagons will comprise the firm's exhibit.

AT A MEETING of the stockholders of the Erie Canal Electric Traction Company, held last month, the following directors were elected: Louis A. Von Hoffmann, of the banking house of L. Von Hoffmann & Company; William Mertens, of the banking house of L. Von Hoffmann & Company; Henry R. Ickolheimer, of Heidelbach, Ickolheimer & Company; T. C. Platt, president United States Express Company; Charleton P. Lewis, Mutual Life Insurance Company; John C. Carlisle, ex-Secretary of the Treasury; Frank H. Hawley, president of the West Indies Telegraph & Cable Company; William H. Baker, vice-president Postal Telegraph Company; George W. Balch, New York Produce Exchange, and James Virdin, Corporation Trust Company. The following officers have been elected: President, Baron Louis A. Von Hoffmann; vice-president, Frank W. Hawley; secretary, A. D. Donaldson.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has the contract for furnishing the structural steel work for three buildings for the Ottawa Carbide Company, of Ottawa, Canada. The buildings are from three to five stories high, and consist of a furnace building 80 ft. wide and 286 ft. long, a grinding room 38 ft. wide and 80 ft. long, and a breaking room 35 ft. wide and 80 ft. long, and two stories high. The floors are carried on steel beams and columns, and the flooring is steel plate. The trusses have a clear span, and the roofing is corrugated iron. The bins for the storage of material are all of plate iron. No woodwork is used anywhere in the construction of the buildings. The Berlin Iron Bridge Company is also erecting an extension for the power plant of the Hyde Park Electric Company, at Boston, Mass.; a fireproof station for the Gloucester (Mass.) Street Railway Company, and a number of bridges for the Elmira & Seneca Lake Railway Company.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that in no department of its business have the effects of the good times been felt so much as in the street railway department. A street railway department was added to the company's general supply business about a year ago, and to-day the company claims to be the largest strictly jobber of street railway supplies in the country. It has a most complete line of agencies, embracing the best known and largest manufacturers of street railway supplies. Realizing that prompt shipments are the jobbers' key-stone to success, the company carries in St. Louis stock the largest line of street railway supplies in the West, and is now reaping the benefits of its foresight. All the factories being crowded with orders, the ability to make prompt delivery from stock gives the company a great advantage over the ordinary jobber or agent. The growth of this company during the past year has certainly been phenomenal. The company has gotten out a complete line of catalogues, embracing everything pertaining to the electrical supply business. Its special street railway catalogue contains a very complete and carefully compiled line of street railway supplies. It is thoroughly up to date in every way.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, reports a large number of recent sales of electrical apparatus, among which were the following: One 25-h.p. motor to J. A. Fay & Company, Cincinnati, Ohio; one 125-kw. generator to Ottawa Street Railway Company, Ottawa, Ill.; five motors to Armour & Company, Chicago, Ill.; one 100-kw. generator to Grand Island Electric Light Company, Grand Island; one 50-kw. generator to Carlisle Electric Light Company, Carlisle, Ky.; one 35-kw. generator to Murray Electric Light Company, Murray, Ky.; one 25-kw. generator to Owingsville Electric Light Company, Owingsville, Ky.; one 80-kw. generator to Light, Heat & Power Company, New Albany, Ind.; one 25-kw. generator to Arcadia Electric Light Company, Arcadia, Ind.; two 50-kw. generators to Fargo Gas & Electric Company, Fargo, Dak.; one 25-kw. generator to Kanawha Electric Company, Montgomery, W.

Va.; one 25-kw. generator to Williamson Electric Light Company, Williamson, W. Va.

CLING-SURFACE is a name becoming pretty well known in the manufacturing world, if inquiries and sales are an indication. The Cling-Surface Manufacturing Company, of 145-151 Virginia Street, Buffalo, N. Y., reports that it has just established a branch in Johannesburg, South Africa, to meet the increased demand for Cling-Surface in that section from those who have been compelled to run their belts as tight as possible to prevent slipping. A recent letter from a prominent mechanical engineer says: "Being somewhat skeptical as to the virtue of any belt dressing, it was some time before I concluded to try Cling-Surface, and only after being driven to it, as our belts were badly over-loaded and showed signs of rapid depreciation. Your Cling-Surface was a complete revelation to me, and belts that formerly had to be run so tight as to cause a great deal of noise are now runninng slack and quiet, without the least evidence of slipping. I heartily recommend it for leather belting, for in addition to its increasing the pulling capacity of a belt, I find the belts are soft, and show a fine glossy, yet very clinging, surface."

THE UNITED STATES ELECTRIC SIGNAL COMPANY, of Newton Highlands, Mass., has lately been organized for the manufacture of automatic signals for electric railways. This signal has been thoroughly tested on some of the New England roads and is reported to be working in a very satisfactory manner. The signal operates from the trolley, is entirely automatic and is claimed to be absolutely reliable in all conditions of weather, it does not require oil and cannot burn out. Should the power be lost for a time, the signal will relight when the power is restored. There are orange and green lights at each end of block, and when a car enters turnout, one of these lights is lighted at each end of turnout. This enables the motorman to know whether the signal is working and whether he is following a car or one is coming from opposite direction. The officers of the company are: President, Charles H. Morse, superintendent Manual Training School of Cambridge, Mass.; treasurer, James H. Nickerson, president West Newton Savings Bank; secretary. F. E. Wither; manager, W. H. Rand. The factory and office are at Newton Highlands, Mass.

THE BURT MANUFACTURING COMPANY, of Akron, reports an increasing sale for the Cross oil filter, which has come to be recognized as a standard for railway power stations. With this, the oil can be used over and over again, and there is no waste, as every dollar's worth of oil is used up. The system upon which it is based is that of washing the oil as well as filtering it. The oil is first passed through a layer of waste, which collects all the heavier impurities. It then passes into a chamber filled with pure warm water, which is heated by means of a steam pipe. Very little steam is required, and if the filter is kept in a warm place it is not necessary to make any steam connection. The oil enters this chamber in a very thin film, by which every particle of the waste oil is exposed to the action of the water, which washes out all remaining impurities. It finally leaves this chamber in a finely divided state of separation, thoroughly mixed with water. From this point it passes through another stratum of filtering material, after which it is ready for use. The filters themselves are very substantially built, and are finished in a most attractive way, so that they form an ornament in any engine room. The company also supplies a gravity oil feed system for power stations, which is popular with steam users.

THE OHIO BRASS COMPANY'S materials have played an important part in the building and operation of many of the "electrics" in and about Chicago, and at least some of its products may be found on most, if not quite all of them. These goods vary in their character from such well known standards as the type D hangers, Jewell trolley slings, Spillman ears, and Globe strain insulators, used by the Chicago General, to the Emergency Hose Bridge, several of which were recently sold to the Chicago City Railway, and special bonding plugs which will be used in track bonding on the Lake Street and Northwestern elevated railroads. The Emergency Hose Bridge mentioned above is one of the most important specialties recently added to the Ohio Brass Company's line, and a description of it appeared in this year's June number of the Street Railway Journal. There are several roads whose overhead construction is made up largely, if not quite altogether, of the company's goods, that have lost their identity by consolidations, purchases, or otherwise after they were built, such as for instance, the Suburban Railroad built by Naugle-Holcomb, and the Northern Electric Railway; the latter road having used the Wood's flexible pole brackets for suspending the trolley wire. Among the regular and frequent customers besides the companies mentioned above are the Calumet Electric Street Railway, the South Side Elevated Railway, and others, whose purchases consist of the regular line of goods which are too well known, as a rule, to need further description to identify them.

THE AMERICAN ENGINEERING COMPANY, of Philadelphia, Pa., has recently completed the track and overhead work for the Newtown Electric Street Railway. The Newtown Electric Street Railway Company has leased the Newtown, Langhorne & Bristol Railway, which, in conjunction with their own line, gives a complete electric railway between Bristol, the largest city in Bucks County, and Doylestown, the county seat, a distance of 28 miles. The American Engineering Company is now rapidly completing the power house and transforming stations of this road. The company has also recently finished construction on the line of the Elmira & Seneca Lake Railway Company. This railway will connect Elmira with Watkins, and give visitors to the far famed Watkins Glen an opportunity to visit another glen reputed to be of greater scenic beauty, though not so far famed simply because of inaccessibility to it. This contract provides not only for the track and overhead work, but for an extensive power house and car barn at Millport. Still another line, which the company is building, is one between Battle Creek and Kalamazoo for the interurban line of the Michigan Traction Company. This line, with the spur to Gull Lake, makes a distance of 28 miles. The Michigan Traction Company now owns and operates the road in Battle Creek and Kalamazoo, and when the interurban line is completed, will have 50 miles of track. It is expected that cars will be running by Dec. 15. The equipment of this line, as provided by the American Engineering Company, it is claimed, will be superior to any interurban line in the State of Michigan.

Balance Sheet System of Accounts

The Account, Audit & Assurance Company, Limited, has worked out the details of a complete "balance sheet system of accounts" for use by street railway corporations, manufacturing establishments and business enterprises in general, which should be adopted by every corporation of this character, for by its means it is possible to always obtain a going profit and loss statement and balance sheet without the necessity of writing up the books especially to produce it. It is a simple system, based on scientific principles, and saves labor rather than makes it.

The company undertakes the reorganization of corporation accounting systems from the foundation up, and furnishes complete "specifications" with a chart of accounts showing at a glance the proper distribution to be made of any particular charge, and its relationship to the entire scheme of accounting. This is in itself a particularly interesting and important branch of the "installation" and a great convenience to bookkeepers.

The Account, Audit and Assurance Company has just reorganized the books of a number of street railway companies, whose managers are most enthusiastic over the results obtained therefrom, and say that they would not go back to their old system under any circumstances.

The Account, Audit & Assurance Company has just reorganmake expert examinations and periodic audit of books, and its reports are entitled to great weight as being prepared by accountants of long experience who are thorough masters of their business.

Trade Catalogues

Vitrified Conduits. Published by the American Vitrified Conduit Company. Illustrated. 54 pages.

Standard Air Brakes. Published by the Standard Air Brake Company, of New York City. Illustrated.

Hydraulic Jacks. Published by The Watson-Stillman Company, of New York City. Illustrated. 54 pages.

Making Records. Published by the Joseph Dixon Crucible Company, Jersey City, N. J. 30 pages. Illustrated.

Westinghouse Engines. Published by Westinghouse, Church, Kerr & Company, of Pittsburgh. Illustrated. 20 pages.

Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, NOVEMBER, 1899. No. 11.

Proceedings of the Eighteenth Annual Convention

OF THE

AMERICAN STREET RAILWAY ASSOCIATION

HELD AT

Chicago, Ill., October 17-20, 1899

The eighteenth annual meeting of the American Street Railway Association was held at Tattersall's, Sixteenth and Dearborn Streets, Chicago, Ill., on Oct. 17-20, 1899.

President Charles S. Sergeant, of Boston, called the meeting to order at 11:20 A. M. on Tuesday, and introduced R. S. Taylor, City Attorney of Chicago, who, in behalf of the Mayor, extended the freedom of the city to the delegates in a short speech, in which he referred to the improvements which have been made in motive powers for street railways during the past ten years, and to the complex problems to be solved by street railway managers.

President Sergeant replied to Mr. Taylor's address in an appropriate manner, saying that he presumed that the association had never before had the freedom of so large a territory extended to it, and that he sincerely trusted that the members would not abuse the privileges accorded them.

The President: The next order of business is the calling of the roll. If it is the pleasure of the association, instead of taking time to call the roll, the official registration of the secretary will be deemed the calling of the roll. That has been the custom at the meetings for some time past, and will save us a great deal of time. I would inform the association that the executive committee has passed a vote that it considers that any American elevated railway company is eligible to membership in this association. We consider that the delegate of every member is a missionary at this meeting to bring in some other company, and the invitation is cordially extended at this time to all companies not members to join this association. We believe it will be for their good and ours, and we hope if there are any persons here representing companies not members of the association they will send in their application to the secretary.

The following companies then joined the association:

Pueblo Traction & Electric Company, Pueblo, Col.

Venice, Madison & Granite City Railway Company, St. Louis, Mo.

Atchison Railway, Light & Power Company, Atchison, Kan.

President Sergeant: The address of the president is next in order.

ADDRESS OF THE PRESIDENT

The American Street Railway Association—

Gentlemen: We are to-day assembled for the eighteenth annual gathering of our association, and for the second time we meet in this great and prosperous city.

I feel very deeply the honor which makes it my duty and pleasure to welcome you to Chicago in behalf of the street railway men of this city, whose generous exertions have provided us with all the essential elements for a profitable and enjoyable meeting.

What remains to be done lies in your own hands, and I may be permitted to urge upon you the desirability of a full attendance upon the business meetings, and a free and ample discussion of the papers which will be presented. In order that the time may be sufficient for this purpose, your executive committee has purposely restricted the papers to a smaller number than usual, and earnestly solicits your co-operation in giving them full audience and ample discussion.

As will be seen by the report which is to be submitted, the financial condition of your association is good and improving from year to year, for which happy condition we should not forget we are indebted to the efficient efforts of your officers in prior years when the bank balance was not so readily visible; nor should the generous support of our exhibitions by our friends, the supply men, escape our notice.

The devotion of one day of your convention to the especial purpose of visiting the exhibits, which has been arranged by your executive committee, will be availed of it is hoped, by every delegate, to the mutual profit of all.

Those gentlemen who met here in Chicago in 1883, many of whom are, I trust, present to-day, could have had little conception of the changes in their business which were to occur before the end of this century. At that time there were in Chicago street railways operating about 153 miles of single track. At the present time the mileage of the surface street railways of this city is about 736 miles, of the Chicago interurban street railways about 261 miles, and of the elevated street railroads about 100 miles, either operated or under construction, making an increase since your last meeting here of 944 miles of track.

This remarkable extension of street railways, their equipment with mechanical motive power, the unique union "loop" system, and the successful application of electric power in the elevated railway service, are not only a wonderful testimonial to the courage, energy and capacity of their projectors, but they have made Chicago a street railway Mecca to which we all may come to observe and learn. We are, therefore, to be greatly congratulated upon the advantages afforded us by the selection of this city for our convention.

The year which has passed since we met has presented some unusual features which are worthy of our attention. The tendency toward consolidation of small or competing roads into larger homogeneous systems has been manifested by many examples. With the introduction of electric motive power the old time horse railway company operating a few miles of track on two or three city streets has disappeared, and its larger successor has found necessary such changes in administration, such extensions of its system and service, that the advantages of combination with rivals have become more and more manifest. The street railway which formerly gave a short distance urban service, has found itself extended far into the country; the same car which disputes the passage of a busy city street with a truculent teamster, may an hour later be flushing partridges and grouse along the rural highway, stopping to leave the tired artisan at his country home, and bringing a healthful excursion within reach of the humblest family—thus the trolley car is rapidly filling a long felt want which was neither

within the power nor the disposition of the great steam roads to supply. All this means changed conditions with new responsibilities and emphasizes the need of consolidation.

To successfully amalgamate such properties and organize and operate them with due economy and a just regard for the needs of the communities to be served, require of the operating officials a high degree of experience and skill. The new problems to be met offer better positions to which those who are ambitous may aspire, and the wonderful rapidity with which this situation has been developed will be a lasting monument to the officials of our American street railways. The advantages of this larger growth are many, and perhaps not the least is a growing respect for the value and importance of the street railway industry, which we may all hope will ere long be recognized by just laws, which shall deal fairly and equitably with the relations of the street railways to the municipalities, and give to capital invested in urban and suburban transportation security and a fair return upon the investment.

Another of the notable events of the year has been the failure of a striking attempt at municipal ownership, with which we are all familiar.

It is greatly to be regretted that the year has been signalized by several very serious strikes and attempted boycotts. With the consolidation of systems the question of labor assumes a greater importance. The paralysis of all the transportation of a large city is a grave public calamity to be prevented by all reasonable means in the power of the officers and men of the transportation companies, and by the municipal authorities. The larger the system of any corporation is, the more necessary it is that its management shall firmly and wisely conduct its affairs, and the more impossible that the responsibilities imposed upon the management should be delegated to others. Does it not, therefore, devolve upon us who are charged with such responsibilities, to take the greatest care that our representatives before the public, the employees, shall always receive such liberal and just treatment at the hands of all our officials that they may feel their interests and ours to be identical, and may loyally work with us for the good service of the public and our corporations? Care in the selection and instruction of employees may, therefore, well engage our constant attention. We are all merchants in that we have transportation to sell and must present it in an attractive manner if we wish to retain our customers.

The good will of the community which it serves, seems to be an essential element of success with any public transportation company, and the best means to obtain that good will should receive our careful consideration. In this direction lies, I believe, a field of work for our association and for each and every one of its members, which may be far more fruitful for good than our technical papers or our exhibits of apparatus.

We are all aware of the wide difference of opinion which exists in the community as to the proper relation of street railways to the public, the service they should render and the burdens they should bear, and last, but not least, the returns they should expect upon capital. In the press and in educational and social reform institutions, much prejudiced opinion and misinformation is promulgated calculated to injure public service corporations, and in so injuring them, to deprive them of much of their ability to adequately serve the public. Is it not our duty, each and all, in our own communities and wherever else opportunity offers, to take steps to remedy this state of affairs? Let us seize every opportunity to refute these current fallacies, meet the self-styled "economist" on his own ground and show him that his "quasi-public octopus" is the greatest public benefactor and social reformer the world has ever seen!

Fair minded men will generally listen to both sides of any question, and the ignorance of even those who should be well informed as to our industry, is so great that mission work to disseminate truth is imperatively demanded.

I believe that work of this character has already been undertaken by one of our friends of the Chicago daily press, and that in so doing he has set a worthy example which we may beneficially follow.

One of the saddest events of the year was the sudden death, in April last, of our lamented friend M. K. Bowen, president of the Chicago City Railway Company. Beloved by all who knew him, ever ready to spare his valuable time for the aid and information of others who sought to learn from his experience, he was an honor not only to the corporation he served so well, but to the profession which will miss him so sadly. Ever faithfully interested in your association, his untimely death brings a feeling of deep loss to us all.

I venture to remind you of the work which our friends of the Accountants' Association have undertaken and are accomplishing. The importance of accurate and uniform accounts to the success of any railroad can hardly be overestimated. A thorough knowledge of accounts and of finance are essential qualifications for the administration of large properties. The work so far accomplished by their association, and their further deliberations, merit your earnest support, which will not only be beneficial to them but to each and all of the members of our association.

I wish here to express my appreciation of the cordial support and valuable work of your efficient secretary and executive committee. That our association may always be so fortunate is my earnest wish.

In conclusion, may I once more express my sincere appreciation of the honor which you conferred upon me by electing me to preside over this meeting, and bespeak your patience with my shortcomings. (Applause.)

The President: The next business in order is the report of the executive committee.

The Secretary: The report of the executive committee, as in past years, will consist of the reading of the minutes of the several meetings held during the year, which will show what has been done by your committee.

ABSTRACT OF MINUTES OF EXECUTIVE COMMITTEE MEETINGS

The first meeting of the executive committee was held at the Auditorium Annex, Feb. 6 and 7. There were present Messrs. Sergeant, Holmes, Lang, Yuille, Jones, Beggs, McCormack and Penington. The motion was made and carried that all members in arrears for dues for more than two years be served by the secretary with a written notice that if these back dues are not paid by Sept. 1, 1899, the executive committee will recommend to the association that such members be expelled in accordance with the provisions of Article XIX of the by-laws. The renewal of the treasurer's bond, issued by the American Surety Company, of New York, in the amount of $5,000, renewed to Feb. 1, 1900, was presented to the committee by that officer, and placed in the possession of the president. The original bond of said company, dated Feb. 1, 1898, which had been in the possession of President Lang was delivered to President Sergeant. The salary of the secretary-treasurer was continued at $1,500 per annum, as in the past years. The committee visited Tattersall's and approved the hall for exhibit and convention purposes.

The second meeting of the executive committee was held at the Auditorium Annex, Oct. 16 and 17. There were present Messrs. Sergeant, Moore, Woodruff, Lang, Jones, Beggs, McCormack and Penington. It was moved and seconded that the secretary write to all street railway companies eligible to membership which are not members of the association, inviting them to become members, in the belief that it will be to the mutual benefit of all concerned for them to belong to the association; also that in the sense of the executive committee any American elevated railway company is eligible for membership. The auditing committee, consisting of Messrs. Lang and Beggs, then rendered a report that they had examined the accounts of the treasurer and had found same correct. The report was accepted and the committee discharged.

Mr. Lang moved that inasmuch as the various technical papers, especially the street railway periodicals, devote considerable space each month to publishing legal decisions relating to street railways, that the publication of street railway decisions by the association be dispensed with. Motion carried.

President Sergeant read a letter from John T. Burnett, chairman of the special committee on the carrying of United States mail on street railways, in which he stated that the conditions during the year had not been opportune for effective work, and he believed that the committee should be continued for another year and given further time for action; or, if preferred, a new committee should be appointed. Mr. Lang moved that the executive committee recommend to the association that the committee on the carrying of United States mail on street railways be continued for another year. Motion carried.

Mr. Woodruff moved that the executive committee recommend to the convention the adoption of the following rules:

RULES OF THE CONVENTION

1. No member will be recognized by the president unless he shall announce distinctly his name and address.

2. Speeches will be limited to ten minutes unless the time shall be extended by the convention.

3. Members who desire to offer resolutions or other matters to be considered by the convention, are requested to submit them in writing, over their signatures, to the secretary.

Motion carried.

The minutes were approved and filed.

The President: We will now listen to the report of the secretary and treasurer.

REPORT OF THE SECRETARY AND TREASURER

Cash in bank, Aug. 25, 1898		$3,656.28
Receipts to Oct. 11, 1899		
Membership fees	$450.00	
Annual dues	3,930.67	
Space, Exhibit Hall, 1898	3,137.70	
Space, Exhibit Hall, 1899	132.50	7,650.87
		$11,307.15
Expenses to Oct. 11, 1899		
Printing and stationery	$1,649.33	
Postage	181.45	
Salaries	1,500.00	
Executive committee, 1899	383.12	
Miscellaneous expenses	25.00	
Convention, 1898	1,646.88	
Convention, 1899	262.50	5,648.28
Cash in bank, Oct. 11, 1899		5,658.87
		$11,307.15

Membership

Aug. 25, 1898	173
New members to Oct. 11, 1899	7
	180
Withdrawn	8
Membership, Oct. 11, 1899	172

NEW MEMBERS

Aurora, Ill.—Aurora Street Railway Company.
Bridgeton, N. J.—Bridgeton & Millville Traction Company.
Chicago, Ill.—Chicago Electric Traction Company.
Detroit, Mich.—Detroit & Pontiac Street Railway Company.
Elgin, Ill.—Elgin City, Carpenterville & Aurora Railway Company.
Joliet, Ill.—Joliet Railway Company.
Montreal, Can.—Montreal Street Railway Company.
Oakland, Cal.—Oakland Transit Company.
Pasadena, Cal.—Los Angeles & Pasadena Electric Railway Company.
Peoria, Ill.—Peoria & Pekin Terminal Railway Company.
Schenectady, N. Y.—Schenectady Railway Company.
Sioux City, Ia.—Sioux City Traction Company.

WITHDRAWN

Brooklyn, N. Y.—Atlantic Avenue Railroad Company.
Battle Creek, Mich.—Citizens Railway Company.
Detroit, Mich.—Fort Wayne & Belle Isle Railway Company.
New York City.—Second Avenue Railroad Company.
New Haven, Conn.—New Haven Street Railway Company.
Newark, N. J.—Newark & South Orange Railway Company.
Sioux City, Ia.—Sioux City Traction Company.
St. Louis, Mo.—People's Railway Company.

DUES UNPAID

Derby, Conn.—Derby Street Railway Company	$25
Girardville, Pa.—Schuylkill Traction Company	25
Great Falls, Mon.—Great Falls Street Railway Company	50
Lansing, Mich.—Lansing City Electric Railway Company	25
Lock Haven, Pa.—Lock Haven Traction Company	50
Newburyport, Mass.—Newburybort & Amesbury Street Railway Company	75
Oil City, Pa.—Oil City Street Railway Company	50
Portsmouth, Va.—Portsmouth Street Railway Company	25
Steelton, Pa.—Middletown, Highspire & Steelton Railway Company	75
St. Joseph, Mo.—St. Joseph Railway, Light, Heat & Power Company	25
Tampa, Fla.—Consumers' Electric Light, Street & Railroad Company	25
West Superior, Wis.—Superior Rapid Transit Railway Company	75
	$525

1898 CONVENTION SPACE UNPAID

F. H. Newcomb, Brooklyn, N. Y.	$10

DEATHS DURING THE YEAR

M. K. Bowen, president Chicago City Railway Company, Chicago, Ill., April 9, 1899.

William Penn Cooper, superintendent, Thirteenth & Fifteenth Street lines, Union Traction Company, Philadelphia, Pa., Feb. 23, 1899.

John H. Callahan, secretary, United Traction Company, Pittsburgh, Pa., Feb. 13, 1899.

DeWitt C. Cregier, ex-superintendent, Chicago, West Division Railway Company, Chicago, Ill., Nov. 9, 1898.

William E. Hale, treasurer, Toledo Traction Company, Toledo, Ohio, Nov. 16, 1898.

Joseph S. Lawrence, president, Charleston Consolidated Railway, Gas & Electric Company, Charleston, S. C., Aug. 5, 1899.

Charles F. Orthwein, vice-president Southern Electric Railroad Company, St. Louis, Mo., Dec. 28, 1898.

Austin Ely Smith, treasurer and general manager Springfield Street Railway Company, Springfield, Mass., Aug. 8, 1899.

Sylvanus M. Thomas, president and treasurer, Taunton Street Railway Company, Taunton, Mass., Nov. 20, 1898.

George Henry Wheeler, ex-president, Chicago City Railway Company, Chicago, Ill., Aug. 11, 1899.

Mr. Wyman, New Orleans: I move that the report be accepted. Carried.

The President: There is at least one committee report, which will be presented at a later session. We now have the pleasure before us of listening to a paper by the Hon. Chas. T. Yerkes, entitled "Investments in Street Railways: How Can They Be Made Secure and Remunerative?" [This paper appears elsewhere in this issue.]

Mr. McLean, Toledo: I move that the thanks of the association be extended to Mr. Yerkes for his able and interesting paper, and that it be entered in full on the minutes of this meeting.

The motion was unanimously carried.

The President: Personally I wish to thank Mr. Yerkes also for the very able paper he has given us and for explaining his methods of getting at the real essence of the whole financial situation of the operation of street railways, based upon his experience, as they have been developed in this paper. I am sure it will be a most valuable lesson to us all. The paper is now open for discussion. I will call upon C. D. Wyman, of New Orleans, to open the discussion.

Mr. Wyman, New Orleans: I think that by the vote you have passed, in which I most heartily join, we have expressed our sentiments touching this paper most sincerely; I felt when I saw such a topic had been assigned by the committee having that matter in charge for presentation at this time, that it was a topic which was of the greatest importance, and which we might congratulate ourselves would be presented at this meeting, but especially did I join with you in that pleasure which I know you all experienced when it was announced that Mr. Yerkes would read a paper upon that topic—a gentleman who has been so thorough a student of street railway enterprise, both from the financial and operating side. It seems to me also a work of supererogation on my part to attempt to add anything to what he has said upon this subject. But I will venture to say a word or two upon some lines which may possibly touch us as managers in our relation to our stockholders, our investors, that we have all duly considered, and yet which might be proper to suggest in connection with the lines of thought that Mr. Yerkes has presented.

Of the importance of sustaining and preserving the confidence and the faith of investors in the enterprises in which we are engaged there can be no question. When it is remembered that one-third of the invested wealth in civilized nations is to-day placed in steam and street railroads, and not an inconsiderable portion of that investment is in the street railroads, that we should secure and hold the confidence of our investors and that we should make their investments profitable is very evident. The great search which now is manifest on the part of capitalists to put their money into street railroad enterprises is one which should be met by a corresponding effort on our part to make everything plain, clear and distinct to them in regard to such

enterprise. In choosing a board of directors from among our stockholders it is always customary, of course, to select men not only of financial responsibility in a community, but we always regard it as necessary and proper to select men of high probity of reputation and of position. And if upon the officials of the company, the managers and the directorate, there is made emphatic in the eyes of the public this feeling of responsibility to the public and also the equal responsibility to their investors and the capitalists, the impression is wise and beneficial, and tends, moreover, to the extension and expansion of our business; for I take it in this respect, at least, we are all expansionists.

I remember reading in the paper that a distinguished orator here in Chicago, upon the occasion of a great gathering recently that was discussing trusts, said that in his opinion any danger on the part of aggregated capital might be warded off if there was a sufficient amount of publicity given. There is one thing that I respectfully submit to you in this matter, as my belief along this line, and that is that we should be frank, free and open with our investors; that we tell by means of circulars, of statements, of various methods of publication, of our operations and results, and state the truth, the exact truth as near as we can ascertain it, to all those interested in our respective companies, whether they be interested to a large or small extent.

While it is possibly true that complete disclosure at all times of the policy of the company might thwart it unjustly and unreasonably, I still do hold to this idea, and I am very glad to see, by publications made recently, much more so than a few years ago, that the results of our work are being set forth constantly and freely, and I believe that the more this is done in a proper and complete manner the more we shall secure and retain the confidence of our investors and secure likewise their further investment with us.

We often have what are known as "panics," a sort of neuralgia that pervades the financial market, and the usual reason given to us (we, perhaps, are not so thoroughly skilled in such matters) is that it springs from a want of confidence, that actual values are not disturbed, speculative values are, but that it results from a want of confidence, a fear, a distress, an uncertainty as to what is going on. Credits are withdrawn.

We may to some extent ward off any such feeling, any disquietude on the part of our investors, by letting them know the facts so far as we are able to do it, and give them frankly and freely our judgment as to our present condition, and our anticipations of the future with reference to the enterprises with which we are connected. I also believe we should adopt, so far as possible, a plain, simple and thoroughly understandable method of bookkeeping, and I am therefore most heartily in accord with the Accountants' Association now in session, who are endeavoring to do precisely that which I am endeavoring to describe. The average stockholder oftentimes becomes very much muddled when he attempts to study out the question of what shall be charged to operating expenses and what to permanent betterments, and, therefore, to invested capital. So far as it is possible, such a system of bookkeeping and recording of expenses should be adopted as will make everything clear and thoroughly comprehensible to his mind. I would also suggest in this connection the question of depreciation and the providing for same. I am exceedingly glad to see that some of the railroads, and notably the Milwaukee Street Railway Company—presided over by so able a manager as Mr. Beggs—have taken up this question of depreciation very carefully, very particularly, and have taken into account the depreciation of the different mechanical parts entering into the physical equipments of the roads. They are setting aside annually, as I understand it, a certain amount of money from their receipts to make good that depreciation.

Many electric railroads, or for that matter, cable railroads, recently converted from horse lines, are liable to lose sight of this fact for the first few years of their operation. Their receipts naturally increase and their expenses may be at a very low ebb, by virtue of the fact that everything they have is new and the era of repairs has not set in. It seems to me, therefore, that it is unsafe from the results of that particular year, or some other year, to predicate what the earning power of the company is going to be, or to tell stockholders that these results may be always expected. While it is always to be hoped, of course, that the increase of receipts will take care of the repairs and depreciations, it is, nevertheless, desirable if we can make certain and absolute that point by studying out what this depreciation is, what this life of the equipment is going to be, and we are at least on the safe side if we begin to provide for it, and tell our investors that that is what we are doing from the initial roll of the first wheel on our line. I think this subject is very important. The average net receipts for the years as they pass should be made up on such basis, and in that statement of average net receipts should come a careful estimate of the amount of money necessary to replace the rolling stock, power-house and miscellaneous equipment, after its life shall have been exhausted, and then a certain amount should be set aside; it may be very certainly fixed,

It is now some years since electricity, or that form of motive power which the major portions of the roads are now using, has been in our hands, and it is therefore by no means a difficult matter to come within a very fair average of the life of these different mechanical appliances and devices, and the material which we use in our different operations. Some time, possibly, we may be put under pressure to hasten matters, but I think a conscientious, firm, truthful, frank and honest management, while it may be criticised as being too conservative, had better err upon that side rather than the other. (Applause.)

Mr. Beggs, of Milwaukee: I feel very deeply interested in this subject that has been so ably presented here by a gentleman who has spent almost a lifetime in the ownership and direction of street railway affairs, and I feel so deeply interested in it because I am in a condition similar to that stated by Mr. Yerkes. I am charged with the responsibility of managing what is becoming one of the larger street railway systems of the country, but I am more than that, and have, therefore, given to this matter the most close and careful thought, because I can say, with Mr. Yerkes, that all I have in the world is in street railway property.

I think there is a side to this question that has not been touched upon in Mr. Yerkes' paper, even so thoroughly as he has discussed it, or in Mr. Wyman's analysis of it, and I desire to throw out that thought here. It is one which, as my friend, Mr. Wyman, has suggested, the Milwaukee company has taken hold of. I want to know that when I have been laid to rest, those to whom I may leave the results of a life of hard work will have some protection for the payment of these securities when these short-term franchises have ceased to exist. Taking the property of which I am now speaking, the franchises have a little over twenty years to run, and yet we are discussing the question now, as they are in some other sections of the country. We are trying in advance to make calculations as to how much we are justified in putting into that property and how long we have in which to get a return from it. I do not know that it is being done so methodically by other companies—it may be. We have calculated, and I believe you will recognize that this is a proper charge against earnings,

that you have a right to set aside a sum for this purpose before the public can demand that you shall give greater accommodation for the carrying of a passenger 12 miles to 15 miles, to which Mr. Yerkes has alluded, or that the fare shall be reduced. We are setting aside a certain amount for this purpose, to be paid to those who may succeed us in our investment in these properties, and so that, after the twenty years expire, they will not simply have turned over to them, out of which to recoup their investment, a pile of junk on the streets, that the city wants to return in order that it may make a better dicker with some one else. I feel that we have a good investment in the property if properly run. When a road is new and the equipment requires very few repairs it is not usual to look forward to the time when 45-lb. rails must be taken out and replaced with 80-lb. or 90-lb. rails, nor to the time when we shall be taking off the single-truck cars, the cost of which is $2,900 each, and replacing them with cars costing almost four times as much. The thought which I wish particularly to present here is that we must make some provision for the time that these bonds of ours will mature. In the case of the Milwaukee property, this does not occur until two years after the expiration of the franchise.

Now, as to the other point suggested, the security. Because I do not want to have anything to do with a thing that I cannot put my own means in, I want to know what provision has ben made to pay these bonds. Is there any sinking fund being set aside by your companies to take care of these various investments when they shall mature? Gentlemen, you must make proper provision for your properties by looking forward a very few years, when they will have to be thoroughly reconstructed from the ground up. I estimate that we replace 10 miles of track every year, and that is not at all conservative, because we have about 150 miles of track in the city limits, and I estimate that it will last fifteen years, which no track has done thus far. We must, therefore, put down 10 miles per annum to make it good. We estimate our rolling stock in the same way. It is a wonderful thing to tell, not only to the specialist, but to any business man or to any court, and it was very influential in the argument where the city tried to make us give 4-cent fares, that with proper maintenance of our system we could not do it. If we had taken the figures as they appeared on their face, our earnings would have seemed to be sufficient to warrant a reduction in fare, but they were fictitious, they did not represent our normal repair condition as it was. I desire, gentlemen, to impress upon you the necessity, in order to make these securities safe, of having the public take them as they do our waterworks and gas stocks, in nearly all of which the charters are perpetual. The longer our franchises have to run the more we can afford to spend upon the betterment of our systems and the greater the facilities we can give. We are merely merchants, as Mr. Yerkes stated, in selling transportation, and we must make a practice of "provoking the public to ride." It seems necessary in order to give security to these investments to make some provision for the bonds when our franchises have expired, and when we cannot earn the interest on them, to say nothing of paying the principal.

The President: We should like to hear from Mr. H. H. Vreeland, of New York, on this subject.

Mr. Vreeland: I had hoped that our president could have waited until a little later before calling upon me, because it is placing me in rather an embarrassing position, calling upon a boy to talk in the presence of a lot of men. I am but a child in street railroad work, and it seems that anything that I might say in the way of analysis of the very valuable paper of my friend, Mr. Yerkes, would be criticising the pioneer and the patriarch in street railroad work. I have learned since my connection with the industry that of the few men who started their life's work in connection with street railway interests, who have invested their money as they made it in the interests which they had created, who have followed it up as a life work until it reached a success far beyond what was considered possible for men to attain in any line or calling years ago, Mr. Yerkes is really the pioneer in that direction.

There is a thought in connection with Mr. Yerkes' paper that occurred to me when he suggested the question of management, the consideration not only of the average revenues, but the average of expenditures; that is one of the very strong points that appeals to the confidence of investors and the general public in properties. The great steam railroads of this country, with which the greater part of my life has been spent—you have only to mention the Pennsylvania, the New York Central, the New York, New Haven & Hartford and roads of that class to know what I mean—have created a confidence in the permanency of their managements. Secure the proper man to manage the property. This is really more important in street than in steam railroading, from the fact that in the steam road the directors do direct. There is not very much done in street railways in that direction. The manager is elected and put to work and allowed to run the property. He does not get much help, and he has to be a man who can meet the local municipal conditions, the State conditions and the general conditions as affecting the properties so far as legislative and municipal affairs are concerned. He has to be a man who can take care of the financial part of the operating side, and he has to do it with very little assistance.

The next thought that occurred to me was what my friend, Mr. Wyman, suggests, and it is a very important one—the question of publicity. Coming out of the school where we are taught—were taught for years—not to submit a report to your directors or president without analyzing it thoroughly, not simply showing that their train tonnage increased so much, mileage increased so much, revenue decreased so much, but went to work and analyzed it, and the same with reference to passengers—coming from that school then, I was surprised to find how very little of that there was connected with the street railroad system. In many cases, in the early days, there were good reasons for this, because usually two or three men ran the railroad and for years would act in the same manner as they would with a country store, and divided the money in the drawer among themselves. But the effect of consolidation and merging of the railroad interest in this country, both of steam and of street railroads, where 946 properties have been consolidated within the last ten years, irrespective of what may be termed trusts or monopolies, have changed this. The consolidations have reached a point where, by reason of recapitalization and reissuing of bonds necessary, our securities have come into the hands of the investing public, and the managers are the care-takers of the property, not of the few, but of the many. But it is necessary to let people know what they are buying and what values they are getting to determine whether it shall be made into a fund or be a different proposition. The number of the stockholders in the large corporations, I am glad to say, is increasing very rapidly in the different properties with which I am connected. The increase in the average number of stockholders has been very large. In the Metropolitan Street Railway Company the increase has been over 150 per cent in the last ten or fifteen years, both in the increase of capitalization and the bringing in of new investors. At the present dividend we had 130 more stockholders than we had at the last dividend three months ago; not one of them held over 100 shares of stock, and they are residents of New York City. That is one of the greatest

elements of strength in the handling of this property where we have to meet with the municipal and State question—a common interest with citizens in our properties—are located in the properties themselves. It assists and helps out with the question, gains friends for the property and assists very materially in the management.

With the question of twenty-year franchises and twenty-five-year franchises, I am glad to say that many years ago my predecessors were granted permanent franchises. Lately (though after we had secured such permanent franchises as are necessary for the handling of the business for the territory where we operate), the State Legislature decided to limit all future franchises to twenty-five years, so that it is not a question for me, as manager of the property, seriously to consider, but it is a very serious question for the other fellows.

There is one further point that Mr. Yerkes suggested, and that is the labor question. It is the life of the street railroad. All other matters connected with the property are insignificant. The financial side, the transportation side, except as represented by labor, are insignificant as compared with the great problem of handling labor. In the large consolidations there are, say fifteen or twenty different lines in which the employees have been handled under the theory and ideas of as many different managers, and you see how difficult it is to bring that body together, to try to get them responsible to one man and responsive to one method of management. It is a thing that requires a great deal of energy and ability, but it is a thing which, if once accomplished, gives the public to understand that the manager is managing the labor problem and not the agitator. And if you can get that confidence you must adopt the same policy as the agitator and take the platform as he does when he talks in his interests, and make up your mind that it is just as important for the manager to go on that platform and talk to them in his interests; that is one of the greatest elements of strength in the street railway question in my mind. I feel that it is one of the things to do in consolidating properties, and that the success that has come to our property is largely attributable to this. The success of the investment is in the confidence of the stockholders and the general public that no crisis is going to confront the property this year or next, that may not only wipe out the dividend, but mean the elimination of the entire earning capacity for that period and the disturbance of all the smooth working conditions that are necessary at all times.

Mr. McLean, Toledo: I feel amply repaid for attending this convention and listening to the discussion already had upon the very able paper of Mr. Yerkes, and without taking up the time of the convention, I think it proper to say that the paper itself and the discussion had upon it open up a train of thought which we can carry home with us, and which will inure to the benefit of the properties with which we are all identified. (Applause.)

Mr. Foster, Lynn: I feel entirely unequal to expressing to you my opinion upon this subject, although I have listened with a great deal of interest to the very able paper read before the members of the association by Mr. Yerkes, and I have also been interested in the very able discussion of the gentlemen who have preceded me. I agree with them that it is a subject of very great importance; but it appears to me to be a subject of far more importance to those operating street railways in the Western countries than it may be possibly in Massachusetts. In Massachusetts we have a Board of Railroad Commissioners, who have supervision of the movements of the street railways. Our tenure of franchise is entirely different, as I understand it, from what it is in this section of the country. There a franchise is granted to a corporation without limitation. To be sure, it is subject to revocation by the local boards, approved by the railroad commissioners. Of course, it would seem absurd on the part of the Board of Railroad Commissioners to revoke a charter on which they had approved the issuing of securities. Their approval is set upon the securities as a seal, and they have the power of limitation on the amount of securities which are issued, or may be issued. I understand that not to be the case in the Western States. It would seem that you are justified in seeking some better protection than what you now enjoy. I do not say, gentlemen, that the laws of the State of Massachusetts are superior for the operation of street railways than those of any other States, but I do feel that the investors are protected. It is frequently remarked by those offering securities of the home companies in Massachusetts that it is a dividend paying stock and it is free from taxation, making it a very desirable investment. A person holding street railway stock in any of the home companies, I believe to have a security which will justify any one in investing in it on account of its permanence. To be sure, we are subject to the caprice and whims of the local authorities to a certain extent, but that is limited by reason of our right of appeal to the Board of Railroad Commissioners.

Mr. Yerkes, Chicago: May I be permitted to ask the gentleman a question on one point he made? I understood from him that the grants of street railroads are liable to revocation at the instance of the local authorities, confirmed by the commissioner. Is it not a fact—and this I merely ask for information—that the courts have decided that these revocations cannot be put into effect unless it can be shown that the roads are not needed by the people? That was the point I wanted to make. According to your argument, Mr. Foster, it would seem as though at any time the municipal authorities and the commissioners could get their heads together, and could compel all the tracks in any town in Massachusetts to be taken up.

Mr. Foster: They would have to show that public necessity and convenience required the removal of the tracks; otherwise they could not do it.

Mr. Yerkes: It would be a pretty difficult thing to get the tracks up after the people once became accustomed to the use of the cars.

Mr. Foster: I do not know of its ever having taken place, except in one instance. I think there was a leased road where they undertook a revocation of the location; it was revoked and another was substituted for it. It was not a complete revocation.

The President: We do not want to hear from one section of the country alone. I may, perhaps, recognize the face of some gentleman because he lives in New England; I think we want to hear from all parts of the country. The South is represented here, and I believe we would be glad to hear from F. G. Jones, of Memphis, and other gentleman from the South.

Mr. Jones, Memphis: I think everything has been said that would be of any benefit, so far as my ideas go. We certainly have gathered very considerable information for us all in the line of making investments productive to people looking for that sort of securities. I do not believe it will be possible for me to add anything that would be interesting on the subject. We have certainly gathered some points and ideas that are new to us on the line of these short franchises, from our friend from New York, who gives us a pretty good idea that some of the larger companies there have gone in and succeeded in getting perpetual franchises. These arguments are going to help us in our territory when we come to ask for further extensions, and that, among other things, has been very gratifying to me. (Applause.)

The President: I see in the rear of the room a gentleman from whom we ought to hear, N. H. Heft, of Meriden, Conn. I am sure he has had a large experience in steam railroads, and possibly he can give us some idea on this question.

Mr. Heft, Meriden: While my time has been given to the building of electric railroads, I have not been required to direct any of my energies toward raising the money to pay for them. Our board of directors has done that. I have simply directed my energies to seeing how I could best spend the money to make the investment more desirable, and while I believe it is necessary to sustain harmonious relations with municipalities and with the State Legislatures, and with the public in general, I believe that the greatest benefits will come to the street railroad through mechanical and electrical engineers in improving the present equipment of the road. I believe that sufficient attention has not been paid to this matter, and in a great many instances we have run mad on the question of rails and the question of car equipments. In going over the questions of weights to-day I was horrified to find that for every paying passenger hauled with the modern street railway equipment we were drawing 721 lbs. of dead weight, exceeded by the steam railroads only to the extent of 137 lbs. with their standard steam railroad equipment. I think it behooves all street railroad managers to turn their attention to the question of equipment, to see if they cannot get rid of some of this weight. We expect to operate within the next two months a car whose weight, including the entire equipment, will not exceed 227 lbs. per passenger.

I have been very much gratified in listening to the paper of Mr. Yerkes, and also much interested in what our friend Mr. Wyman has said. He is always good, and I have also listened with a great deal of pleasure to our friend Vreeland, of New York.

The convention then adjourned until 10 o'clock Wednesday morning.

WEDNESDAY'S SESSION

President Sergeant called the meeting to order at 10:10 A. M.

Secretary Penington then read an invitation to the delegates from the Siemens & Halske Company to visit its plant. The secretary also announced that the excursion to the drainage canal would take place in the afternoon, and that the special train would leave the Dearborn Street station at 1:30 o'clock. The secretary also stated that as there was nothing on the programme for the evening, it had been arranged that the ladies should meet and go to the exhibition hall in a body to view the exhibits.

The President: The first paper upon our programme for to-day is a paper entitled "Maintenance of Car Equipment," by J. H. Vander Veer, superintendent of motive equipment, Brooklyn Heights Railroad Company, Brooklyn, N.Y. [This paper is published elsewhere in this issue.]

The President: The thanks of the association are due to Mr. Vander Veer for his able paper. I trust that it will be very fully discussed by all the practical and unpractical men who are here, but I do not think there are many unpractical ones. I desire to call on some one to open this discussion, and I will ask E. G. Connette, of Nashville, Tenn., to do so.

Mr. Connette, of Nashville: My primary education in the railway business, having been with steam railroad systems, has probably diverted my mind in a different direction from the opinions of some street railway people in regard to the inspection and maintenance of street car equipments. You all know that after a locomotive makes one trip, perhaps, of 100 miles or 150 miles, possibly 200 miles, it enters the round-house and is inspected, cleaned and all necessary repairs are made before it makes its next trip. So on the line with which I am connected. I adopted the method that when a car comes in from its work at night, having run perhaps 100 miles to 150 miles, it is first cleaned, then inspected. All the parts of the motor, including the wire connections, the brush contacts, and all the parts of the truck, are properly inspected, loose parts tightened up and all minor repairs made to the car, and it is prepared then for its journey on the following day. My experience with that method for perhaps ten years justifies me in saying that it has been entirely satisfactory. It is argued by some that daylight inspection is better, because the men have a better opportunity to see what they are doing, and feel more like working in the daylight than they do at night. That is true to a certain extent, but with a limited car equipment, and, perhaps, with the car-houses located in such a manner that it would be inconvenient to have the cars run in during the day from time to time to have the inspection, cleaning and repairs made, it becomes necessary with some companies to do the work at night. To a large extent this is the case with the system in Nashville, but, as I stated, the system of cleaning, inspecting and making minor repairs at night has been very satisfactory. If a car goes out in the morning and something occurs to disable it and it is brought into the shed, and it is found that the defect was caused by a lack of inspection, proper action, of course, is taken. That is an incentive to the night inspectors to do their work properly, because if they do not do it, results will tell. The general overhauling is done by the regular repair force by daylight, and we make it a rule to have the motors generally overhauled perhaps once in six months. About two years ago we had a very large exposition in Nashville, the Centennial Exposition, in commemoration of the one hundredth anniversary of the admission of Tennessee into the Union. During that period we hauled a very large number of people, using trail cars behind every motor car, with a headway of from one minute to 1½ minutes regularly, and during the six months of the Exposition there were but six motors disabled. I think that record will justify me in stating that the application of steam railway methods to street railway service has been entirely satisfactory to our company.

W. E. Harrington, of Camden, N. J.: I represent the Camden road, on which we operate at this time about forty-three cars, and do the bulk of our inspection and minor repairs at night. We do the general repairs, the carpenter work and painting work on the piece-work system, which has proven very satisfactory to us. One of the difficulties in adopting the piece-work system was in establishing prices for the work, not having any precedent, and we struck upon a method of covering possible mistakes in prices by limiting the amount of bonus that we would give in this way: If we set a contract price for a piece of work, say $5, and the work was actually done for $2, that would make a profit of $3, which would be entirely disproportionate; so we settled on a limitation of 20 per cent of the actual cost. If the work cost $2 and the contract price is $5, the actual bonus would be 40 cents; whereas. if the cost exceeded $5, the loss would not exceed 20 per cent of the actual cost price. That seemed to satisfy the shop-men, and enabled us to settle quickly this question, and it has been very satisfactory in its operation. We followed this same practice in our construction work, as well as the repair work, and in every respect it has been very satisfactory.

The matter of car cleaning and washing with us is a very serious matter, on account of the great amount of dirt and dust which we have in the territory through which our cars run. We do our car washing at night, and do that also on

the piece-work system. We are washing 18-ft. bodies for 15 cents a car, sweeping them out, dusting them and washing them thoroughly, and double-truck cars for 22 cents. The cost formerly was 40 cents to 60 cents for the same cars. We have got the cost down to these very low figures, and the work is being satisfactorily done. A point upon which I would like to get information is what is the general experience of the members in reference to the number of cars that are housed for repairs, taking the percentage of cars housed for repairs in proportion to the total number in operation. On our road the average is 10 per cent of the number of cars in operation, which are sent to the shops for repairs. I think this point should be brought out thoroughly, as it is a guide to know how many equipments to provide, and I think it is a point which should be generally discussed.

Mr. Vander Veer: In regard to the allowance of 10 per cent as the number of cars housed for repairs, we find on the system in Brooklyn that on some lines it will average 10 per cent, but on others it will go as low as 4 per cent, depending a great deal on the service and the equipment we have at the particular depot. I think 10 per cent of the total number of cars is an extreme limit.

Mr. Harrington: What effect would the question of having single-motor equipments and double-motor equipments on any ordinary road have on that percentage? We are running single-motor equipments, and I know that our depreciation is relatively high on our armatures and motor parts, and I ascribe a great deal of the percentage stated to be due to that fact. What is your experience in that matter?

Mr. Vander Veer: I have fortunately had nothing to do with single-motor equipments during the last few years, but my recollection is that it is much higher than the percentage stated. It will run higher than 10 per cent for single-motor equipments. Of course, the miles run per day and the style of motor will have a great deal to do with the question.

E. C. Foster, of Lynn: I would ask the gentleman if he considers there is any economy in operating a single-motor on an ordinary car? As I understand the situation now, this gentleman has been speaking of disabled cars which are lying in the car-house during a part of the day, and this disability, as I understand it, is due to defective apparatus. He says that 10 per cent of the cars are in the house all of the time. It seems to me if that is a fact we should go into the subject further, and ascertain if there is any profit in running single-motor cars. I would say for the benefit of the association that our experience on a suburban and interurban road is that we have not found it profitable to operate single-motor cars, probably on account of the increased expenses incurred in the maintenance of them as compared with the double-motor cars. This past season we have been operating one ten-bench open car with a pair of G. E.-57 motors, each having a capacity of 52 h.p., making the two motors 104 h.p. That, you will recognize, is an excessive amount of power to operate a ten-bench, single-truck car. But the results, so far as repairs have been concerned, have been very satisfactory, no repairs being required on that car during the entire summer. We have not even worn out one pair of brushes, although the car has made about 120 miles a day. I believe it has been customary in the past to operate a motor of small capacity, and by reason of that small capacity the expenses of maintenance have been increased very materially. There is only one other matter I would refer to, and that is if the gentleman has any figures as to the cost of painting or varnishing the cars, cleaning up and touching up the cars, I would like to get the figures for the labor.

Mr. Harrington: In reference to the first matter, the greater depreciation in using single-motor equipments, we have been using single-motor equipments practically up to date, with the exception of a few double-truck cars recently purchased. About one year ago we equipped one 18-ft. body with double equipments, and where we averaged a car in the house, say once in every ten days, with the single-motor equipment, that car has only been in the house three times in a year, and that for only petty repairs. On the strength of the record of that car, our board of directors has concluded to order double equipment for twelve of our cars as a starter. Our armature depreciation has been, in my judgment, tremendous and altogether out of reason. On a forty-car road we have one armature man busy all the time doing nothing else but looking after the armatures, and I think we will be able to put him on some other work in conjunction with the armature work as soon as we have more of these double equipments. Just the exact cost of depreciation on single equipments it is difficult to say, but we are sure we will cut it down with the double equipment.

In reference to the cost of painting, while I have not definite figures in my mind, I can give you a general run of the work. The contract price for taking the car into the house, burning the paint off, painting and varnishing the car on the outside throughout, and varnishing the inside, is $20. For ordinary touching up and varnishing outside, with paint already on, and one coat of varnish on the inside, the contract price for an 18-ft. car is $6. The cost of material is approximately the same as the labor.

Mr. Foster: Do you do the work by the week or by the hour?

Mr. Harrington: We pay the painters $2.50 and carpenters $2 a day for that class of work.

Mr. Reed, of Salt Lake City: How many coats of varnish do you contract to receive when the cars are revarnished?

Mr. Harrington: Our contract covers putting on the first coat and the rough stuff, rubbing down, putting on the second coat and rubbing that down, and putting on three coats of varnish afterward. There are really five distinct steps in the operation.

Mr. Connette: There is one element of saving in running single motors where they can be conveniently run, and that is in regard to the power used. In Nashville, Tenn., there is very little level ground; it is up hill and down hill everywhere. I tried an experiment in the running of a single motor, and found by test that it used about 35 per cent less power than with double equipments, but we could not use the single motor for lack of traction. Most of our roads have no loops at the end, and consequently the ends of the car are reversed, and when the motor was in front there were many places where it was quite difficult to get up with a single motor, on account of the lack of traction. When the motor was on the rear axle, of course that difficulty was not so great, but there is a saving in power by the use of a single motor. It strikes me that where single motors are used that fact would, to a large extent, limit the capacity of the car, or the size of the car, in proportion to the power of the motor used.

In Louisville, Ky., where they operate possibly 200 or 300 cars, it has been my observation that nearly all of them are run with one motor only. One S. R. G. motor is employed, but their cars are small, most of them having been old horse cars converted into electric cars, and the city being comparatively level, I understand they operate very satisfactorily.

Mr. Douglass, of Cleveland: It seems to me that this question of single and double-motor truck cars depends a good deal on the condition of the track. I represent the

"Big Consolidated" road of Cleveland, where we recently have had a little disturbance, and we have some bad track, as do most other cities. We have some old Johnson rail on chairs, and all that kind of thing, and have recently purchased 150 double-truck cars, modern cars in every respect. One motive in getting these cars was to keep up with the times and handle our people in the best way. Another reason was that we have some bad track, and by putting the double-truck cars on this track the cars would run smoothly over the track, which was almost impossible with the single-truck cars. The relative advantages of single and double-truck cars is a question of track to a great extent. I think single-truck cars of from 18 ft. to 24 ft. in length can be operated more easily and simply than double-truck cars, and I do not think we should discard the use of such cars if our track is in good condition. It strikes me that the question of the track is largely a factor in this matter.

When I went to the "Big Consolidated" Road on May 1, I found that contracts for the painting of the cars were in force there, and they were unsatisfactory. The company was paying 25 per cent more for painting, touching up, burning off and varnishing, as the different requirements called for, than it actually costs now by days' work, and we are getting fully as good work. Under the contract system, the men painted the window glass and daubed things generally. We get much more satisfactory work by the day, and I think we save 25 per cent. That will apply to painting and varnishing.

We have a contract for making armature coils and doing similar kinds of work, which is extremely satisfactorily. We have that contract still in force, and that is the only contract work we do. I have not seen fit to change that method of caring for this work.

Now, about trolley wheels. When I went to the Brooklyn Heights Road about five years ago, Mr. Vander Veer was there, but I did not have the pleasure of making his acquaintance. They were manufacturing their trolley wheels out of zinc, brass and copper. I have often wondered since why we did not put in a brass foundry to make the trolley wheels. We are buying castings in the rough, and turning them down half way and putting in the bushings. I wonder why we do not make these castings ourselves and scrap our old copper and brass at 15 cents a pound before paying such large prices for new wheels. I believe, however, that the Brooklyn Heights Company has discontinued that practice. I would be glad to hear Mr. Vander Veer's experience on that line.

Mr. Vander Veer: With regard to the brass foundry, while it commends itself to a large road, our experience was that our men made things out of brass that should have been made out of iron, and we shut down the foundry for a while. We started it up again a short time ago.

Mr. Douglass: Is it not economy to make your own wheels on a road of your size?

Mr. Vander Veer: Yes; it is profitable.

Mr. Douglass: A saving of 25 per cent to 30 per cent?

Mr. Vander Veer: Yes, fully that; but there is always a tendency to drift off into other things.

Mr. Douglass: I am surprised that more of us do not make our trolley wheels.

Mr. Beggs, of Milwaukee: The question of Mr. Douglass brings out many other points as to the cost of operating a road, and the question whether roads could profitably manufacture trolley wheels, like many other things in use on the road, would depend on what they are compelled to pay for them. I have a contract for trolley wheels at the present time, made according to a formula which on our lines seems to be the most advantageous, as to the proper degree of hardness of trolley wheels to give best results without wearing the wire, as we consider it preferable to wear the wheel, at 23 cents per pound; we have also a contract for converting the worn-out trolley wheels into new ones. I do not believe that any road can afford to put in a brass foundry and make its own trolley wheels if it can buy them at that price. We can get 16 cents for the old wheels.

Mr. Douglass: Is the price quoted the rough casting?

Mr. Beggs: That is the finished wheel; a wheel 5 ins. in diameter, which is somewhat larger than the wheels on many other lines. We believe in large wheels, because they run at less speed. Our trolley wheels weigh approximately nearly 3½ lbs. finished, and including the bushing, and I do not believe there is any road that can maintain a brass foundry profitably when it can buy wheels at that price. The argument so often made by municipalities that they can operate street railways and electric light plants and other public utilities at less than we, who are in the business, can, applies here. Many times the special foundries in connection with your road are not charged off where they should be charged; that has often been the case with the brass foundries and other appliances run in connection with a road, nothing is charged off for superintendence, for percentage of capital represented, and everything of that kind. When it touches that particular point I do not believe that any road which is in a position to make a proper contract for trolley wheels can begin to make them as advantageously as some manufacturer who has other things to make in connection with the trolley wheels. It depends very largely upon the contract price which the road is able to make for trolley wheels. In view of the increase in cost of material during the last twelve or fifteen months, I am paying now about 30 per cent more for trolley wheels than under a contract made eighteen months ago. In order to get a satisfactory price I made a contract for 5000 wheels to be delivered to us at the convenience of the shop turning them out, made according to our formula and pattern, and they can turn them out in between times in their shop. I know that I could not run a brass foundry and begin to turn these wheels out for what they cost us to-day under a 5000-wheel contract.

I would like to throw out a suggestion here, Mr. President, in connection with this matter of motors, particularly as my friend Douglass has just made a contract for a large number of double-truck cars. I would like to give him the benefit of our experience at Milwaukee in connection with the number of motors. I do not believe any road can judiciously run single motors. I have not believed so for the past ten years. The 35 per cent of power saved, which has been referred to here, I think is threefold paid for in greater cost of repairs to single motors and other portions of the car. I think the cheapest thing virtually that we put on an electric railroad is the power that moves the car; it costs less than almost anything else going into the car. Three and a half years ago we adopted a standard car on our lines—a double-truck car. We have steadily advanced upon that plan and improved that equipment, until we put on twenty-five cars this year, and we will put on about thirty-five new cars annually in order to keep up our equipment. They are double-truck cars and are standard. For three years we contented ourselves with two motors on these cars. We put on twenty-five cars this year, and have contracted now for thirty to be delivered in April next, on which we shall put four motors, a motor on each axle, as an element of economy and greater facility and to give the public good service. The traction is much better, and we can speed up a car more quickly, and when you take a city where you stop every block, every 200 ft. or 300 ft., it is an important item if you can

save a few seconds in making these stops, and in getting the cars in motion. You thereby advance the convenience of the public and reduce the number of cars necessary to make up a schedule on any given line. For that reason we have incurred considerable expense in the improvement of these cars. We put on ten cars eighteen months ago, each car having four motors, and we find that it costs less for the maintenance of a car with four motors than for the maintenance of a car with two motors. The actual cost of maintaining the equipment under the car is reduced, and the number of cars in the shop averages only 2 per cent—we seldom have to pull one of these cars into the shop. The motors are not overworked, we can get the car up to speed within a very few seconds, and if a car gets behind its time it has the reserve power to enable it to make speed, which is an important element in the economical running of a street railway. If you can take five minutes out in the length of a run it is a great saving. For instance, we run pretty long lines, few of them less than 7 miles or 8 miles from terminal to terminal. We make 200 stops possibly in that distance, and a second or two saved in each stop, in getting up speed on the car, means a considerable amount in the number of cars necessary to equip and maintain the schedule. We have experimented on this subject very carefully. We know, of course, on our four-motor equipment—speaking off-hand, without figures—it possibly requires 30 per cent more power than to run two-motor equipments to pull the same car, but we are moving at higher speeds, saving money in other matters, and giving much more satisfactory service to the public, and we are saving wear and tear on the equipment. The cheapest thing we have on the road is power.

Mr. Foster: What type of motor do you use?

Mr. Beggs: We adopted as standard the G. E.-1000 motor. We put one motor on each axle. We have several grades, none very severe, but we have no trouble from slippery rails or frost in winter, and with our four-motor equipment we never think whether the car is going to get over the line.

The number of flat wheels has been greatly reduced, and in every way the cost of maintenance on a four-motor equipment is 25 per cent less than on a two-motor equipment. One of the reasons for our adopting the four-motor equipment is that we can give better service to the public, make more regular time, and haul larger loads. Our cars are very heavy—almost as heavy as the cars on a steam railroad. Our cars have twenty-two double seats and seat forty-four passengers. We frequently have over 100 passengers on these cars on account of there being wide platforms, the car being 41 ft. over all. That is the car we have adopted as standard after experimenting for three years, both as to the amount of power consumed and the wear and tear on the cars and rails, and, while we are running more motors on our lines, I do not think the number of men in the armature department is one-half what it was three years ago.

Mr. Connette: I do not mean to advocate a single-motor equipment, but I do say this: that with small cars, where the streets are comparatively level and where the power of the motor is in proportion to the size of the car, single-motor equipments can be operated for less expense than double. I know by actual meter tests that an 18-ft. closed car body, with single truck and two motors, requires about 150 kw. hours per day, of 125 miles to 140 miles. The cost of power, of course, varies, but a fair average is one cent per kilowatt hour. Therefore, if you use 150 kw. hours per day for each car and save 33 1-3 per cent, the saving of power would be 50 cents per car per day, and where thirty cars are run it means $15 a day for power. From the experience I have had in maintenance I consider that it will not cost as much to maintain one motor, even with a little extra service, than it does to maintain two motors. We think that two motors, involving as they do, four fields and two armatures, with all the incidental connections, must cost more to maintain than one motor, even with extra service; but where in larger cities you have larger cars and higher speeds and heavier travel, then perhaps our judgment would change in favor of the double motors, because more effective and satisfactory service can be obtained with two motors on a car than with one, but so far as the element of expense is concerned, I believe it is more economical to operate one motor than two motors, where it can be done, and I believe that it is limited to the smaller places and to places where the streets are comparatively level.

Mr. Foster: I would ask Mr. Beggs one question, and that is the average speed made by the four-motor equipment cars, and also if he uses power brakes, and if so, what kind?

Mr. Beggs: We do not use power brakes on our city equipments. In fact, where we run local service with interurban cars equipped with air brakes we shut them off in the local service. We try to maintain a speed of 8½ miles over the whole system. Speed is certainly an important element to take into consideration, as stated by Mr. Connette. We maintain one of the longest headways of any city in the United States for a thickly populated city, and one of the elements is the large cars and the great regularity maintained in the time table, which in the city traffic is kept up as closely as on steam roads. Even on our lines where we stop every 300 ft. or 400 ft., we maintain an average of 8½ miles an hour, and on some lines 9 miles an hour and over. No car makes less than 160 miles to 170 miles daily, and on our interurban lines we make as high as 380 miles a day to a car, day in and day out.

Mr. Foster: What type of motor is used? Is it a different type?

Mr. Beggs: The same motor exactly. We have to take the conditions into consideration, as Mr. Connette says. We have a considerable number of interurban lines spreading out like the spokes of a wheel, and we are trying to standardize the equipment so that if we need to send cars out on any line they have the element of speed connected with them. These cars are equipped with the ratchet brake. On our high-speed interurban lines we make a day nineteen trips of 20 miles each with two cars, and have done it for eighteen months. On these lines we have air brakes and arc lights, which are absolutely indispensable to a high-speed interurban line.

Mr. Foster: What is the maximum rate of speed on the interurban line?

Mr. Beggs: I should say that on certain portions we reach a speed of nearly 50 miles an hour. The line runs between the city of Milwaukee and the city of Waukesha, and for 6 miles or seven miles within the city limits we provide local service. On our city lines we have high-ratio gear.

Mr. Foster: Is the road on a public highway or private right-of-way?

Mr. Beggs: The particular line to which I referred is on private right-of-way. We have one interurban line 35 miles in length on a public highway. We do not get that speed on that line, but hope to reconstruct it so as to be able to do so.

Mr. Lang, of Toledo: I want to touch upon two subjects that seem to be most directly before the convention this morning, and the first is with reference to the maintenance of a brass foundry. In Toledo we are operating a street railway and an electric light plant combined, and we maintain a brass foundry, and I take it that that is an in-

dorsement, at least from our point of view, of the wisdom of maintaining a brass foundry, that is, assuming that we are giving proper attention to the item of expense. We pay our brass foundry man $1.75 a day, and he is a good man. He spends his entire time in the brass foundry, and he takes every scrap of brass that we have and works it into every available place on the car, in the lighting plant and about the power-house where brass is used, and we are satisfied beyond any doubt that it is a most economical way to operate this part of a railroad. We cast our own trolley wheels. As I say, every brass fixture appertaining to the car is manufactured from our own furnace.

With respect to the double-car equipment, it depends, I think, very largely upon local grade conditions. We are operating two motors on each car, our standard being the No. 3 Westinghouse motor. We have a few G. E.-800 motors. A suggestion that I desire to make that may be of value to some of you is the fact that we have just entered upon a method of splicing two 16-ft. car bodies together. It has been a serious question with us what to do with four-wheel cars that have been in operation from eight to ten years, and following the same line of procedure that was adopted at Columbus about three years ago, we have just taken two 16-ft. car bodies and spliced them together and put them on double trucks. We have placed these cars upon one of our longest lines, where we have been maintaining a nine-minute headway for some two or three years, and found a necessity for increasing the accommodation. To avoid the necessity of running more cars we concluded to put these double truck cars upon that line, and have had them in service about sixty or ninety days. They look exactly like new cars. An expert could tell the difference, but the people who ride in them say: "What a magnificent car this is." They are pleased beyond measure with the new cars, and we think by that means that we are still going to maintain our nine-minute headway without complaint, because the cars seat more passengers and their speed is just as high as a 16-ft. car. It was argued that we would not be able to maintain our speed using two 25-h.p. motors, but in our city, where we have few grades, we find that we can maintain our speed just the same with our double-truck car as we did with our single 16-ft. car. As you can see, the former can earn a great deal more money. I think that where the situation of roads is similar to our own it will be found of great advantage to take some of these short cars that are nearly ready for retirement, and by putting in new sills and bracing them up properly, to utilize them for a long time.

Mr. Foster: Can you give us an idea of what it costs to reconstruct the two cars into one?

Mr. Lang: It costs in the neighborhood of $300 for labor and material entering into the reconstruction of the car body. The car has longitudinal seats.

Mr. Dimmock, of Council Bluffs: Our company took some 16-ft. car bodies that had been in service for between six and seven years, spliced them together and made a number of cars measuring 42 ft. over all, including vestibules. We have run them for five years, and, outside of painting, they have required no repairs to speak of since the day they were rebuilt. I think the splicing of these cars cost us in the neighborhood of $300 or $400; I have forgotten the exact amount. We find that the double-truck car is better for the service. It was claimed that we could not keep up our schedule on the same headway, after splicing these cars, and especially so after putting gates on them. We equipped these cars with gates, which are operated with a lever controlled by the motorman, and we find that the power consumed is somewhat greater than it was before the gates were put on, on account of the additional number of complete stops required to be made. Nevertheless, the car is giving better service and running on the same time-card as that of the 16-ft. car. The speed of the car in many places is as high as 30 miles an hour, and the repairs are not more than they are on another line, where 16-ft. cars only are used.

Mr. Beggs: I would like to ask whether the cost of splicing the two 16-ft. car bodies referred to includes the trucks?

Mr. Lang: No, sir.

Mr. Beggs: What kind of trucks do you put under them?

Mr. Dimmock: Double trucks.

Mr. Beggs: That is an important question, because we have canvassed that matter thoroughly, and finally determined that it is not economical to splice our old car bodies, for the reason that by the time the trucks are under the car, the cost of the car is fully half the cost of the best car that can be built, and after spending this money you still have an old car. As Mr. Lang has said local conditions have a great deal to do with the question. For instance, this summer, in our city on the lake, we had very little warm weather to require people to take pleasure rides in open cars. We ultimately intend to dispense with the open cars and get the equipment down to standard equipment to be run twelve months in the year. To-day we put cross-seats in our cars, and this requires greater width than with the longitudinal seats. Our cars are 8 ft. 6 ins. wide, giving two cross-seats with a good aisle, and about 33-in. cushions on the seat. We made a careful estimate of the cost of reconstructing the old car bodies, and we found that it would be one-half the cost of the most modern car, with 7-in. sills, and we did not consider it a matter of economy. We do not want any longitudinal seats on our line. Our patrons prefer our standard car, and with the window sash down it is virtually an open car for all intents and purposes. Our cars are ready to run any day during the year. The amount of money spent in splicing these car bodies does not begin to include all the expenses involved, and then you have nothing but second-hand equipment. I think you will all admit that when you take an old car body built for the lighter traffic of ten years ago, and endeavor to reconstruct that car, that it will only be a short time before the car begins to creak again at the joints.

Mr. Dimmock: We have run our cars five years without repairs, but in order to make our car as good as we thought it ought to be, we had a steel frame put around the bottom of it, with truss rods, which caused the car to stand all the racket of bad track, etc. I will admit one point, however, that if we were buying new cars we would prefer them lighter and with cross-seats. We have also spliced our 16-ft. open cars, and the difference in the two cars is that the closed car seats forty-four persons, while the open car seats seventy-five. Another feature was the track centers. Our track centers will not permit of a wide car, and this fact aided us in making a decision to splice the old cars. If the track centers had been wider we might have considered the purchase of new cars. We feel we are money in pocket by the splicing of the old cars, under the circumstances which exist in our city.

Mr. Foster: What is the depth of the flange on your wheels, Mr. Beggs?

Mr. Beggs: I think 1⅛ ins.

Mr. Foster: Do you run them over a girder rail or a T rail?

Mr. Beggs: Our standard road-bed construction is a T rail with granite headers and stretchers. We form a groove out of the granite, and if you came to the city of Milwaukee you would see the same effect as with a grooved rail without the gnawing. In the city limits every

foot of track is put down so as to admit paving in any way that the city wishes to do it. We use 6-in. T rail weighing 70 lbs. to the yard.

The President: Gentlemen, this is straying a little from the matter immediately before us, and encroaching on the subject of a future paper. This paper is on the subject of car equipment. I think we should be glad to continue the discussion of the subject directly in hand.

Mr. Dimmock: Before we get entirely away from the question of trolley wheels, I would ask if any of the gentlemen present has kept the mileage on the trolley wheels?

Mr. Beggs: We get about 8000 miles or 9000 miles from our trolley wheels. I know of roads that get as high as 17,000 miles. Our policy is to prefer to wear the wheel. Our wheel is made up of a composition of 86 per cent of copper, 8 per cent or 9 per cent of tin and 4 per cent or 5 per cent of zinc, and we get a composition which wears the wheel rather than the trolley wire. Our trolley wire is No. 0000 over our entire system. We get about 9000 miles from our trolley wheels, and do not want any more. It costs less to wear a trolley wheel than it does to wear a trolley wire. The cost of putting up the wire is as great as the wire itself. I know there are some certain roads that make a boast of the number of miles they get out of a trolley wheel. They used a steel wheel in Milwaukee three years ago and were grinding the trolley wire constantly.

The President: Is there any further discussion upon this subject? If not, I think we should proceed to the subject of "The Modern Street Railway Shop: Its Design, Machinery and Shop Practice." It is a subject that I am sure everyone here is anxious to talk about, and, in the unavoidable absence of Mr. Kilgour, who, we expected, would speak on this subject, I am in hopes that it may be started by Mr. Knox.

Mr. Knox, Chicago: I was only notified a couple of days ago that I was expected to participate in this discussion, and I have not given the matter any special thought. I was hoping a paper would be presented to the convention. I consider it one of the most important problems we have, where there are perhaps greater leaks than in the other things we talk more about. I have not been able to give the subject proper consideration, however, and must beg you to excuse me from going into it with greater detail.

The President: I hope we shall hear from some other gentlemen on this subject. If there is to be no discussion on this subject the Chair will announce the committee of five to make nominations for officers for the ensuing year and determine upon a location for the next meeting. I appoint for this committee H. C. Moore, Trenton, N. J.; E. C. Foster, Lynn, Mass.; E. G. Connette, Nashville, Tenn.; Robert McCulloch, Chicago, Ill., and A. E. Lang, of Toledo, Ohio. Invitations to the association to hold its next convention in any city should be presented to this committee, and any argument or inducement held out by any city should be laid before them. This does not, of course, in any way preclude the presentation of any argument at the time of the committee's report.

Secretary Penington then announced that luncheon would be served on the special train taking the delegates to the drainage canal. The meeting then adjourned.

THURSDAY'S SESSION

The president called the meeting to order at 10:35 A. M.

The secretary read a telegram from H. M Watson, of Buffalo, N. Y., regretting his inability to be in attendance at the meeting, owing to business engagements. The secretary also read an invitation from the Westinghouse Electric & Manufacturing Company to visit the power-house of the South Side Elevated Railroad, the privilege to do so having been granted by the railway company. A special train was arranged for to leave the office of the South Side Elevated Railroad Company at 2:30 P. M. on Friday. The secretary also announced that the delegates were requested to be in readiness at the Auditorium Annex at 1:45 P. M., to start on a tally-ho ride.

The President: The first paper to be read this morning has been prepared by Edward Butts, of the Metropolitan Street Railway Company, of Kansas City, Mo., and the title of the paper is: "The Construction and Maintenance of Street Railway Track."

Mr. Butts: The paper I am to read has been prepared on the basis of our investigations in Kansas City for the past five years. It is our conclusion that the track construction described in the paper is that best fitted for the conditions presented. [Mr. Butts then read the paper, which is published elsewhere.]

Mr. Foster, of Lynn: I have listened with a great deal of interest to the paper on the "Construction and Maintenance of Street Railway Tracks," so ably presented by Mr. Butts. It seems to me that he has covered the ground pretty well for drawing up specifications for the building of a first-class girder-rail track. I did not notice that he touched upon the construction of T-rail track. It is necessary to construct the tracks of our roads differently, according to the different localities. The city roads in all of the cities with which I am familiar require a much superior track than the roads located in suburban towns. I notice a reference in the paper to the girder rail being laid on blocks, the rail spiked to blocks and then surrounding that with concrete. I should say from my observation that there might possibly be a better method than that. I trust the gentleman will pardon me for so expressing myself, but it seems to me that it would be better policy, in laying girder rail on concrete, to omit the introduction of any wood, because with the passage of time this wood must decay, and when it does decay it will weaken the structure.

Mr. Holmes, of Kansas City: Mr. Butts should have explained that these blocks are used only for the purpose of alignment, and not to support the rail.

Mr. Foster: I did not so understand it; I understood the blocks were put in there for the purpose of maintaining the track. As I understand it now, they are put in there temporarily, simply to surface the track, and there is no use of going further on that line. I should think, however, that the concrete base under the rail was superior to any other method.

The subject of cross-ties is one which we meet in almost every section of the Eastern country, as over 90 per cent of the roads there are using cross-ties. The kind of a tie and the dimensions of the tie are two points in which I am interested. Some roads use a 5-in. x 7-in. tie, 6 ft. 6 ins. in length, placing them from 24 ins. to 30 ins. on centers. On a T rail, where you are going to operate at a high rate of speed, as many of the electric roads now anticipate doing, and many, in fact, are doing at the present time, it seems to me that we should use a tie of about the same dimensions as the ties used on steam railroads. We are at present constructing 5 miles of double track with the T rail. The ties are 6 ins. deep, 8 ft. long, and run up to 10 ins. in width, being practically a steam railroad tie. We are laying on this tie a 70-lb. American civil engineers' section of T rail, and are using one of the improved joints. In the construction of this track, which will be used by cars running 25 miles or more an hour, we believe we should adopt as near as possible the steam railroad construction. On some of the smaller and less important lines I do not think it is necessary to have so heavy a rail, although I am thoroughly of the opinion that money invested in a heavy rail and a very heavy cross-tie and a

track of the best construction possible is money wisely invested.

All our girder rails are laid on cross-ties 5 ins. x 6 ins. x 7 ft. in length. Some roads are using a tie 7 ft. long, and others use a tie 6½ ft. long. I think that in some cases a tie 6½ ft. in length is not sufficient. Where the street is concreted you get but a small bearing on the outside of the rail, and it seems to me that an additional 3 ins. on the outside of the rail, if you use a tie 7 ft. long, is very important. It adds very materially to the strength of the track and keeps it in surface and alignment. This subject is one that we might talk about for a long time, relating our experiences and giving our opinions. It is possible for a man to get up and tell theoretically what kind of a track should be built, but he must take into consideration the financial condition of the road to be operated. All of these things enter into the construction of the track—the question of how much money can be put into it. We all agree, I believe, that the first construction should be of the best, provided the finances admit of it.

The question of maintenance is also important, as important, perhaps, as construction, and with many it is a problem as to how best to repair an old track. We all remember very well that in the old horse-car days we used to operate over a rail weighing only 20 lbs. to the yard, spiked to a stringer and underneath that stringer was a little tie about 4 ins. x 5 ins. We then went from that rail up to the 25-lb. rail, the 40-lb., 45-lb. and 50-lb. rail, and then to the 60-lb. rail; all of these weights were made in a tram rail and about as many in the T rail. Then we commenced with the girder rail of 40 lbs., then 45 lbs., 50 lbs., 70 lbs., and now on most roads, where it is necessary to lay the girder rail, a 9-in. 90-lb. rail is being used. It is with these lighter rails to which I have referred that the problem comes in. We have some 45-lb. girder rail made in 1890, mounted in steel chairs on small ties, 4 ins. x 5 ins. x 6½ ft. in length, 3 ft. on centers, and that was thought to be a modern construction at that time. The road to which I refer is 6 miles in length, and was acquired by our company by purchase. The people who built it made a pretty thorough investigation at the time it was constructed, and thought they had secured the ideal construction for a road for electric operation. Time has shown that they were in error. Now the problem with us is how to utilize that rail to the best advantage. The lips of the steel chairs have become worn to such an extent that they do not hold the rail securely. We do not believe it wise to purchase new steel chairs, so we have been substituting the old-fashioned stringer for the chairs, knowing that we can obtain from six to seven years' life in the stringer, and thereby get six or seven years out of the rail. The head of the rail is worn but very little. I believe this plan to be economical under some conditions where the traffic is light. Of course, where the traffic requires a fifteen-minute service, and from that down to ten, twenty or thirty cars a minute, or as many as can be run on the track, of course the latest and most modern type of track construction is necessary.

Caring for the T rail is another subject for consideration. While a 35-lb. T rail may answer the purpose—some steam railroads are operating over a 35-lb. T rail—I believe it will not do so successfully on a cross-tie. It is very difficult to hold the joints even with any of the improved joint-plates, and there are some very excellent plates on the market.

The method of cast welding is another solution. I suppose this might be applied to some of the old track, and, in fact, it has been, but I have questioned the wisdom of applying it to the 26-lb. rail. Many of the rails laid on the roads in 1890, 1891 and 1892 were very soft and wore out very quickly. The trouble seemed to be due to a defect in the formula for mixing the metal and rolling the rails at that time. That, of course we realize, has been very materially improved, so that to-day we have a very high carbon rail. I believe that on many of these smaller roads this light rail can be used, perhaps, successfully and profitably, until the finances of the road will permit it to introduce a more modern and better construction. To my mind, the local conditions and the ability of the company to make the outlay are important factors in determining what is best for the property.

Mr. Hawken, of Camden, Maine: In New England the question of the railroad tie is a very important one. We have used what we call a hackmatack tie. We also use the cedar tie, the oak tie and the chestnut tie, and I would ask Mr. Foster what kind of a tie he has found to last longest and to give the best results?

Mr. Foster: In reply to the gentleman I would say that our experience has been that the chestnut tie gives the best results. We use many of the soft woods, such as cedar and hackmatack, but think that the best results have been obtained from the use of a chestnut tie.

Mr. Keegan, of Toronto: It seems to me this discussion raises a very important question as to the advisability of rigid construction on lines where there is heavy traffic. I have had occasion to construct some lines upon a concrete foundation where the traffic has not been excessively heavy. The results so far have been very favorable indeed, but it would be very interesting to learn from some cities, where they have adopted this rigid method of construction, whether any observations have been taken to determine if there is any yielding in the rail. I have had observations taken on other lines, and find that the give in the rail is very considerable. Of course, where there is a heavy travel this method of rigid construction has been adopted, but it is a question if it does not affect the rolling stock; and I should like to ask Mr. Butts if he has made any observations to determine whether there has been any give in the rail when heavy loads pass over it; also the style of cast-welded joint he has adopted? I take it that it is what is generally known as the Falk joint. I should also like to ask if any provision was made for contraction and expansion of the rails. I know that some companies do not make any such provision, but I understand that in some places a great many broken joints have been the result. I would also inquire what provision is made for contraction and expansion while the construction is proceeding on long lines. The action of the sun in hot weather upon these rails, if the rail is exposed, naturally would be rather disastrous.

Mr. Butts: We have operated a road for the past four years, as outlined in the paper, and there is no perceptible tremor, deflection or yielding of the rail. We have been constructing track on this system continuously every year from that time up to the present day, and we are still doing so. Any tremor would probably be caused only by the use of poor material or employing soft material too close to the rails. In regard to the cast-welded joint and the expansion and contraction of the rails, I would say that our method has been to put the concrete around the rails before the welded joint is put on. That holds the rail in place perfectly, and there is no displacement on straight lines, although we have had to do some little extra work on curves on account of cast-welded joints on the curves. This was because the joints were put in before the concrete had settled thoroughly in these places. In concreting the track we leave an aperture where the welded joint is to be placed. After the concrete has set a sufficient time we go along with the welding machine and cast-weld the joints. In that way we have not had any bad results.

Mr. Jones, of Memphis: I would like to hear from Mr. Butts or some other gentleman who has had experience with this rigid foundation for the track, as to how he arranges to put in that construction and operate his road on the regular service.

Mr. Holmes, of Kansas City: We use portable cross-overs, and cut out so many feet of the track, say 1000 ft., depending on the traffic on the line. The cars going in both directions use that one track for that distance. If the weather is warm the concrete will set in four or five days, but, of course, it is very slow work. It is sometimes possible to divert the travel from the track which is being rebuilt, and to put the cars on some parallel street.

Mr. Wason, of Cleveland: There are one or two points which have developed in the use of cast-welded joints that we have laid in Cleveland, which hardly encourages us to repeat the experience. We have had some experience with electrically welded joints of this character, but we have been unable to keep perfect alignment, both as to gage and surface. The track which we have put together with the twelve-bolt angle-plate has proven much more satisfactory than the cast-welded joint track. We have not used the foundation which Mr. Butts has described, but we have a very liberal supply of ties with very careful tamping. We are now using broken stone cement around and underneath the ties, allowing it to set and afterwards filling up underneath the rail. I do not think we shall use the cast-welded joint any longer, but depend entirely on the angle-plate with the twelve bolts to hold the track in line. It does not seem to me that it is possible to ignore the contraction and expansion of that amount of material, no matter if it is seven-eights covered in the ground and held in place in a measure by concrete or block pavement. The suburban work, it seems to me, cannot be made too well, and if you follow the lines laid down by steam railroad practice you surely will not lose money. If you cannot afford that construction, do not build the road.

Mr. MacGreggor, of Houston: Mr. Butts does not say anything of cast-welded construction in unpaved streets. I presume he has had some experience (I have had a little), but I do not know whether he has had any unfavorable results in using cast-welded tracks in streets not paved. The question of bonding is not mentioned in his paper, and I would like to know whether the tests for carrying the large currents without any bonding through the cast-welded rail have been satisfactory. Then there is another question, which perhaps hardly belongs to that paper, and that is the matter of the head of the rail, on which I would like some information. I have taken a fancy to what is known as the Trilby head of rail. I have not used any, because I have always ben able to use a T rail, but it is coming to that position with us that we will have to use something else to satisfy the municipal demand, and I would like to know from somebody who has used it if the Trilby rail is satisfactory for a girder rail. Another trouble we have had is that the large roads are setting the pace and the small roads are expected to come up to their standard. Yesterday the difference between the small roads and the large roads was exemplified in the use of four motors on a car. I can readily understand that a company having a large business can feel it to be a matter of small expense to use four motors, instead of one or two; but to a road with small business and fixed expenses it would be a disadvantage, and I think that if we could draw a distinction here between those roads which have all the business they can handle, and more, too, and those roads which have not the business, we will get a standard for each, and I think that is what we need.

Speaking of this rail question, the large roads have set a pace requiring a 9-in. rail. I have been using a 6-in. T rail. I wanted to get a girder rail to correspond with that 6-in. T rail, but the supply people cannot furnish it, except with a 4-in. base. I do not think anyone running an electric railroad desires to put down a 4-in. base-rail, but that is all I could buy—a 4-in. base with the old-style head. I want a wide base and a modern head to the rail, but they say that everything in this style is 9 ins. high. We have not any ballast down our way, and we try to get up near the top. Every mile of concrete that we lay costs us $1200 a mile, and we skim along because our pocketbook is thin and we want a standard to carry the light traffic we have. We earn from $10 to $25 a car day, and many of these large roads earn from $50 to $100 a car day. We want to get into the small road class, and have some discussion here which will apply to that class of roads.

As to the experience with ties, being close to the cypress swamps, we use cypress ties, which are creosoted. My experience has been that the lengthening out of the tie to from 7 ft. to 8 ft. does not benefit us. With the question of bonding is brought up another question of the experience, outside of the paved streets, with the cast-welded joints. I am putting in cast joints, but I have not yet the experience to enable me to express an opinion on the results. I would like to hear from those who have had experience along this line.

Mr. Heidelberg, of Chicago: I did not intend to say anything when I came here, but hearing the cast-welded joint discussed so much, I must say that our company was the second to employ this joint after it was introduced. St. Louis was the first city to try it, and we were the second, and in 1895 we started to put the cast-welded joint on our road. There has been some discussion here about the alignment and the level of the track. I will call your attention to some track that was laid only last week on Eighteenth Street, from Wabash Avenue to Indiana Avenue, and on Indiana Avenue, from Eighteenth Street to Thirty-ninth Street. We have 10 miles of this track on Halstead Street, from Archer Avenue to Sixty-ninth Street, done this summer, and I do not think that you will find one joint out of alignment or out of level. I can only tell you the experience of our road, as I never worked for any other railroad, and have been with this company for fifteen years. In the matter of ties, I believe that local conditions have a great deal to do with the life of a tie. I have made experiments, and find that the creosoted cedar or hemlock tie is the only tie to use in sand, whereas in a clay soil we have found white oak the only tie to use. We use a 5-in. x 8-in. x 7-ft. tie, chisel-point spike and side brace-plate, which we use extensively on our own road, and a great many other people have now adopted the brace-plate that we use.

As to the rails, we have tried all kinds. First we had the old flat rail, and from that we came to the first girder rail made, 42-lb. Johnson, and then 63-lb. Johnson. Then we went to the 70-lb. 6-in.; to the 77-lb. 7-in.; to the 85-lb. 7 3-16-in., and then we took up the improved 9-in. girder rail at 90 lbs to the yard. We laid a great deal of this latter rail, but it did not give satisfaction. The reason is that we have various kinds of pavements, such as macadam, cedar blocks, etc., and the rail was too high, it rocked too much on us. Another fault that we found with the 9-in. 90-lb. rail was that the web was too thin for the height. The extreme changes of weather here, in winter we sometimes get a warm rain in the morning and a hard, cold snow storm in the afternoon, were too much for these rails, and they would pull and break, because the metal was rolled out too thin. We would like to construct our roads as we wish, but the municipal conditions will not allow us to do so.

Some one spoke here of putting the concrete under the rails. We have none of this form of construction, but our cable lines are all laid in concrete, and we find that in from eleven to fifteen years the concrete rots out and crumbles. Our yokes and rails go down into it, and it becomes a trench, and every time a car goes over it it oscillates and goes down. When it does so you know what it means—the car is being pulled up hill all the time, and that means power.

Mr. Butts, in his paper, stated that he poured the metal for the cast-welded joints at a bright yellow heat. My instructions to my men are to pour no metal into a mould unless it is at a white heat. If it is not at a white heat they are to make a pig of it. The reason is that after sand blasting the joint and getting all the pits of the rail perfectly clean the metal must be very hot in order to flux and amalgamate to the rail. If you do not do that you are not sure of a bond. When you do that, and have a man watch and see that the metal is at a perfect heat, then your bond is sure, for we have made a great many tests, and have not found any defective electrical connection when this method is carried out. In the early part of the history of welded joints we were a little skeptical about the process, but on making test after test and becoming more thoroughly acquainted with this work we found that the extra bonds were useless and a waste of money.

As to the matter of maintenance, no one seems to have spoken of organization in maintenance. In the maintenance of railroad tracks it is very essential to have a thorough organization of all the men under you, so that you can get them together at any time. I can get all of the force in our track department together at one point inside of an hour. That is a point which everyone should study. Track work has been my study for years, and I believe in giving the men good tools and having them thoroughly organized. We have a track master and a section foreman. We have six sections on our road and nearly 40 miles of road in each section. The sections are not divided strictly according to length, but according to the attention that they require; that is, if there are many railroad crossings in one section we take some straight line off that section and put it on some other section. The employees for each section are summoned by one man, whom we term a caller. The telephone operator at the main office calls simply this one man in each section, a man who lives near to the barn, and that caller calls all the rest of the men and tells them where to go. These things are very essential, especially in the North, where a hard drifting snow with very cold weather may come upon one in thirty minutes.

In conclusion, I wish only to say that I have been trying for eight years to cure a certain thing, and that is a wavy rail. We have some rail here which is what we call a wavy rail—there is a depression in the rail about every 3 ins. I have taken that rail out and sent pieces to the best experts in America, but I have never got any satisfaction from them. I want to know if anyone can tell me what is the cause of the wavy rail.

Mr. Butts: In answering some of the questions I would say that I have not advocated in my paper anything less than a 6-in. rail. We have not experienced any breakage of welded joints, and we have welded not less than 3000. They do not break, because the heat is refracted off into the earth as fast as it enters the rail, so that there is an equilibrium throughout. I would like to inquire what depth of rail the gentleman has on his cable construction?

Mr. Heidelburg: We now have a rail 7 3-16 ins. in depth. Previously we had a 6-in. rail, with a foot and a round base.

Mr. Butts: The rails in cable construction are laid on yokes, spaced every 4½ ft. to 5½ ft., and are not imbedded in concrete, but are supported entirely by the yokes, and therefore the experience with concrete in cable railroads does not apply to the concrete trench construction, as we understand it. For instance, there is a vibration between these yokes that will wear out almost anything. It is not a rigid construction. We do not bond the rails where they are cast-welded. The welded joint has the full electrical capacity of the rail. Where we do not put on the welded joint we bond with a No. 0 bond. We have had no experience with cast-welded joints in unpaved streets, but I believe that the success of that problem depends entirely upon the amount of metal that is embedded in the earth, as compared with the amount of metal exposed to the sun. I do not see why, if it could be maintained imbedded in the earth, it would not be as successful as if it were imbedded in other material.

The President: We shall now call for the report of the nominating committee, of which Henry C. Moore is chairman.

Mr. Moore presented the following report:

CHICAGO, Oct. 19, 1899.

To the President and Members of the American Street Railway Association:

Gentlemen—The nominating committee respectfully reports that it recommends Kansas City, Mo., as the next place of meeting, and the following gentlemen for officers of the association for the ensuing year:

For President—John M. Roach, general manager, Chicago Union Traction Company, Chicago, Ill.

For First Vice-President—John A. Rigg, president, Union Traction Company, Reading, Pa.

For Second Vice-President—H. H. Vreeland, president, Metropolitan Street Railway Company, New York City.

For Third Vice-President—F. G. Jones, vice-president, Memphis Street Railway Company, Memphis, Tenn.

For Secretary and Treasurer—T. C. Penington, treasurer, Chicago City Railway Company, Chicago, Ill.

For Executive Committee—President, vice-presidents and C. S. Sergeant, second vice-president, Boston Elevated Railroad Company, Boston, Mass.

C. K. Durbin, general superintendent, Denver Consolidated Tramway Company, Denver, Col.

Nicholas S. Hill, Jr., general manager, Charleston Consolidated Street Railway & Electric Company, Charleston, S. C.

Charles W. Wason, president, Cleveland, Painesville & Eastern Railroad Company, Cleveland, Ohio.

John R. Graham, president, Quincy & Boston Street Railway Company, Quincy, Mass.

Respectfully submitted,
HENRY C. MOORE, Chairman.
E. C. CONNETTE,
ALBION E. LANG,
E. C. FOSTER.

Mr. Moore: The committee received invitations from three places—Cleveland, Kansas City and Charleston. We found ourselves in a very difficult position. We love you all equally well, but we had to make a decision. We have also received an invitation from the city of Milwaukee for the year 1901, and from the city of Toledo for the year 1902.

Mr. Harrington, of Camden: I move that the report of the committee be accepted and the secretary authorized to cast the vote of the association for the gentlemen nominated, and for the place of meeting next year. Carried.

President Sergeant appointed Mr. Dimmock and Mr. Connette as tellers to receive the vote.

The secretary duly cast the ballot for Kansas City as the place of meeting and for the election of officers as nominated by the committee.

The President: I am pleased to declare that the gentlemen nominated have been elected, and that Kansas City has been selected as the place for the next meeting. (Applause.)

Mr. Holmes: Gentlemen, I desire on behalf of Kansas City and the Metropolitan Street Railway Company, which I represent, to thank you all most sincerely, and especially

the committee, for this compliment. I will say that while you are with us in our city we will do everything we can to make your visit a pleasant and profitable one. (Applause.)

The President: We will now have the pleasure of listening to a paper by Ira A. McCormack, of Syracuse, N. Y., on "Train Service and Its Practical Application." This paper is published elsewhere in this issue.

The President: Gentlemen, we are to be congratulated on having so interesting a paper on a subject which I think has never been presented to us before. We are indebted to W. H. Holmes, of Kansas City, for the suggestion of this subject, and I think it is only fair to ask him to say a few words upon it.

Mr. Holmes: I do not know that I can add very much to what has been said already on this subject by Mr. McCormack, but I will touch on a few things here before we adjourn. This is hardly a time to grow reminiscent, but my connection with the street railroad business dates back twenty-two years. I well remember when Kansas City was visited by the grasshoppers, which swept everything before them. It was not then a question of how much it cost us per car mile or per kilowatt hour, but the questions which concerned us were what would be the average life of the street car mule, and whether corn would sell at $1.50 per bushel. I am glad to say that we have grown from a little city whose street car needs could be filled with five cars to a large city carrying 50,000,000 people each year on the street cars, and with every indication of a continued growth. In this connection it seems to me that the employment of men is one of the important things to be considered, and I think it is pertinent. We have adopted a plan of setting aside a portion of one day in each week, which is Monday morning from 9 o'clock to 12 o'clock, to receive applications for employment, and at that time we generally call in some of the division superintendents to look the men over as they pass through the office. After selecting what men we need, they are required to make out an application, stating where they have worked and giving us such references as they are able to give. We have found that to be the best way of handling the matter, and we have been able to get very good men. I think this is a very essential thing in the street railway business, as Mr. Vreeland very happily said. The treatment and handling of the men is a very vital thing in the management of street railroads. I think it is possible to have your men like you and respect you at the same time. I have arranged this winter to give my men, the motormen, especially, a course of lectures, and have arranged with Professor Black, one of the best lecturers in the West, to come to Kansas City and deliver to our men a lecture on the practical application of electricity, at least every two weeks during the winter months. Our company will carry the matter as far as the men want to go. If they want to take a course in electricity, we shall be glad to see them do it. My opinion about the train service is that we are merchants, and we are selling rides, and we should use great care in the selection of the men, as the company is judged almost entirely by its employees. The public seldom comes in contact with the president or manager, and I think it is of more importance than anything else to use great care in the selection of men. We have followed the policy of promoting men from the ranks. We think that it is best to select married men, if we can find them. Many young married men come to our city to study the professions. They become dentists and doctors and lawyers, and often take up street car work for three or four years, until they complete their education.

The President: There is one street railroad in the United States that has the most difficult problems to deal with of any road in the country. That company, fortunately, is represented here, and I think that we ought to have a few words from Mr. Vreeland, of New York City, on this subject.

Mr. Vreeland: Any information that I could give the association with reference to this important subject presented by Mr. McCormack would hardly be available with the work on most street railroads. The work that we have in New York City, the greater part of the twenty-four hours, is to see how many cars we can run on the lineal feet of track which we have, consistent with the right-angle crossings at various points. Right-angle crossings and terminals govern our headway more than anything else on the greater part of the system. No doubt some of you gentlemen noticed some remarks I made, which I think were copied from the railroad papers, to show the magnitude of our proposition. The steam railroads of the United States last year handling 560,000,000 passengers, approximately, within the borders of the United States. We moved last year 265,000,000 cash passengers and 90,000,000 of transfer passengers, or a total movement of nearly the total of the whole of the steam railroads of the United States. (Great applause.) By these figures of comparison you will see, as Mr. McGregor said some time ago, you will have to make a separation of this proposition, and we will have to put our worthy president, Mr. McCormack, Mr. Holmes and a few of us in one class, and talk on these matters among ourselves, because these conditions do not obtain very largely in other systems.

I might say, by the way of following the lines as suggested by Mr. McCormack, that our system is handled with reference to time tables and the method of regulating time tables and making time tables, on the same general plan, as Mr. McCormack has suggested, and on the lines which we have frequently talked over together. The essential thing in arranging traffic, irrespective of its volume, is a study of conditions. The division superintendent and the general foreman, with the amount of detailed business that they have devolving upon them, are not the men who can make a time table. I made all the time tables for one of the largest steam railways in this country for five years, and I would not attempt to make a time table for one of our lines in New York. A man must give his time and attention to the local question surrounding the problem. An expert comes to lay out a prospective railroad, and his ideas of what the volume of business, of what that property is to get, are based upon a complete and thorough study of the characteristics of the particular section of the country and its people. The same study must be made with reference to the daily requirements of the street car lines in car mileage and the distribution of the same. To show how essential this is, I will say that I had a conversation some time ago with a superintendent who had operated a very large line for twenty years. I said to him one day: "What are the heavy hours of traffic on your line? How are you distributing the car service?" He said: "During the commission hours we run a large service, and then we reduce the service, and put it on again in the commission hours in the afternoon." I said to him: "Do you know that during the middle of the day you have the heaviest hours of traffic on your line?" He claimed that it was not so, and I told him that I would prove it to him by figures. I had a man take it up, and I actually showed that superintendent, who made a time table to regulate this running time, and took off cars during the middle of the day, that more people were moved per mile of track between 12 and 2 o'clock than during any other two hours of the day, and that during this time his cars were stored in the house. He used his best judgment, predicated upon some years of experience, by giving

the fullest service in the early morning and in the evening, but did not give it at the time it was actually most required.

We do not allow a division superintendent, a general foreman nor a chief inspector to make time tables for our system. A study of the situation is made thoroughly, as indicated by Mr. McCormack, and then the time table is laid out by a man who is employed for that purpose and followed up in that way. I shall take your time a little longer, and give you an illustration to show how pertinent these questions are. East and west of Central Park, in New York—of course, I can only bring illustrations from the line with which I am actively engaged—there are three lines on each side of the town. The arrangement of the car service on these lines was almost equal during the early hours of the day, but a close study of the people and their habits brought us to the conclusion that on the east side of the town the large car service should be started at 6 o'clock in the morning, and the large car service on the west side of the town should be started at 8:30 o'clock in the morning. We were previously running very nearly the same service on both sides of the town, and the change meant, of course, the saving of a great deal of money.

On the question of the average of speed, etc., we have to study these factors very closely to keep these things moving. We found it was impossible, even on short distances, to keep up the voltage of our lines during the hours of heavy loads, and we had to put in 4000-h.p. capacity storage battery plants, which are automatic in their action, to keep the voltage up, so we could do our business. For a long time there was a question of what affected the time tables. We sent out men to take measurements, and it was determined that it was not the fault of the motormen, althought at first they were blamed for it. They would have a car full of passengers, and the voltage was down to 400 or 450. By the increase of power obtained through the use of the storage battery plants we keep a uniform voltage of approximately 550 volts and meet the condition in that way.

The question of efficiency of employees, questions of that character are all pertinent to be discussed in this connection.

I think that traffic diagrams are the most important things for a man to have in connection with the operation of a street railroad. We have traffic diagrams taken at least once in every two weeks of every division of our system for the twenty-four hours—passengers against hours, similar to the one furnished by Mr. McCormack, and a copy of that is furnished to the general foreman or inspectors on the line, as well as the man who makes the time tables. Our diagrams go into the volume of business, showing the number of passengers carried per hour in each direction on every line of the system, in the twenty-four hours; thus, between 9 and 10 o'clock 4000 passengers went south, and from 9 to 10 o'clock 3000 passengers went north over the system. It is impossible to get any system of accurate inspection that will show where these people get on and off, without supplementing this work by the system which Mr. McCormack indicated, of special inspectors at certain points. I can say, heartily agreeing with the paper of Mr. McCormack, that it is very valuable for all of us to consider in connection with our work and that it would be utterly impossible for us to do the business we do in New York City, running the number of cars and handling the number of people we do every twenty-four hours, without making this one of the very important studies of our transportation department.

Mr. McCormack: I will ask Mr. Vreeland whether, in making a diagram of this kind, he shows the up and down trips in parallel, as I have? In my diagram the upper line shows the down trip and the lower line shows the up trip. You can see the traffic is uniform there from 5 to 8, and then on Sunday we show the traffic curve up and down by different lines.

Mr. Vreeland: It is our practice to sub-divide the blueprint sheets, using the upper half for the twenty-four hours south bound and the lower half for the twenty-four hours north bound. We worked on the system that Mr. McCormack has laid out there, but I do not consider it as valuable for the regular operation as it might be for this purpose here, and the fact that you put these charts of traffic in the hands of men who must take them in at a glance. They are not time table men, but practical operating men, who are going to criticise the time table, and you must have it so that it is a graphic illustration of the idea you want to convey. By interlacing your lines you throw it out. We show a clean sheet of south-bound and north-bound business on the same sheet, the two peaks coming together towards one another and practically making it the same, although they are distinct in their location on the chart.

The President: We want to get both sides of this subject covered, the small roads as well as the large ones.

Mr. Heidelburg: I am interested in the question of train service, and there is one question I would like to ask: The greatest trouble to-day in our train service in Chicago is something we do not seem to be able to cope with, although we have tried in very way, and that is the trading of transfer tickets at transfer points. I understand that in New York City they have had this matter before the State courts, and I would like to hear what they did with it from Mr. Vreeland. The situation here is that anyone riding over a line in Chicago will find at a transfer point a boy who will transfer you. The boys get the transfer tickets and sell them, and another passenger will ride on the original nickel paid the company.

Mr. Vreeland: I fully appreciate the difficulty under which the transfer business is done in Chicago, because in walking up-town the other day I stepped into a drug store to buy a cigar, and when I was going out the clerk said: "Are you going to take the cars, if so, here is a transfer." The transfer went with the cigar. The history of this thing in New York is a long matter of detail, too long to bring before the association at the present time, and I would suggest for the information of the gentleman that this subject was very thoroughly discussed, not only by our attorney, but by the men who are the head of our transfer business, together with the gentlemen who handle the transfer system of the Brooklyn Heights Railroad, which is as intricate as ours, at the convention of the New York State Street Railway Association held last month at Ithaca. It is fully given in the report published in the Weekly News Edition of the STREET RAILWAY JOURNAL for Sept. 16, and while I would be glad to give the information now, I appreciate the fact that it would be altogether too long to take up the time of the convention to do it. The answer of our attorney to a similar question propounded by some one with reference to the effect of that law was very full.

Mr. Dimmock: I would ask Mr. Vreeland what laws in the State of New York, if any, govern the crowding of the platform, and what the rules of the company are pertaining to the passengers crowding the rear platform of the car?

Mr. Vreeland: There are no regulations on this matter, except the regulation of the Board of Railroad Commissioners that passengers shall not be allowed on the front platform with the motorman of either open or closed cars. We did not follow it and a law was introduced to compel us to close the front gate and also keep passengers off the front platform. I went to Albany, and made an argument

against the proposed law, stating that the railroad company had absolutely no interest in it; that the law would not regulate the railroad company, but would regulate the public, and that if it was put into effect the practical effect would be that the public would be told that so many thousand of them must not go home until 9 o'clock at night, and they would at any rate have to delay their dinner. I suggested an amendment to the law which would cover the situation thoroughly, and that was a law compelling half of the passengers who desired to go north to turn around and go south, so that the carrying capacity of the cars would be adequate.

Mr. Dimmock: Have you not some law in regard to the crowding of the rear platform, so as to make it inconvenient for other passengers to get into the car.

Mr. Vreeland: There is no regulation, either municipal or State, on that question. We have, as you probably all know, the double door in New York City, which opens practically the full width of the rear platform, and we insist that our conductor shall not allow passengers to stand on the platform between the door and the side on which passengers are getting on, but that is not followed out very carefully. It is more a question of inches of capacity per foot on the car. I want to say, to show you how peculiarly we are situated in that respect, that the Board of Railroad Commissioners, with their inspector, came down last winter and looked that situation over thoroughly with reference to our Fourth and Madison Avenue line, and they said after their inspection: "We have nothing to recommend, and we do not see what you can do unless we say the people shall not ride. You are running as many cars as you can, and running them to the fullest limit during rush hours. You are running with regularity and dispatch, and doing everything you can to handle the people, and we must place ourselves in the position, not of saying to you what you shall do, but saying to the public what they shall do;" and, of course, in their own interest, they do not care to tell the public what it shall do.

Secretary Penington then read a resolution of thanks passed by the supply men to Ira A. McCormack for recommending to the executive committee resolutions for setting aside one day for the express purpose of inspecting the exhibits.

The secretary then read a telegram from D. B. Dyer, regretting his inability to attend the meeting.

Mr. Lang: Mr. President, I desire to offer this resolution:

Resolved, That the thanks of the American Street Railway Association be, and they are hereby tendered, to the several passenger associations, for having so kindly granted reduced rates to the members of this association and their friends who are in attendance at this meeting. Carried.

The President: It has been customary heretofore, as you know, to install the new officers on the forenoon of the last day of the convention, the banquet being held the night before. In consequence, the new officers have been installed in the presence of only a few members. The committee decided this year that it would be an interesting feature of the banquet to have the newly-elected officers installed at that time, and this will be done. When we now adjourn, therefore, we shall not adjourn until next year, but to be called to order at the banquet to-morrow night.

Mr. Vreeland: Before we adjourn I wish to be permitted to say a word. I regret that my engagements will compel me to return to New York this afternoon, and I desire to say that this is the first opportunity I have had since I have been connected with the street railroad business of attending a convention of this association. It has been exceedingly enjoyable to me, and I have made a good many friends here, I think, by the expressions they have given me since I have been here. I have certainly been very much benefited by these proceedings, and, although Kansas City is a long way from New York, if I should happen to be in this country next fall—which I do not expect to be—I shall certainly call on Mr. Holmes, as a result of my visit here.

The meeting then adjourned.

The Banquet

It is well within bounds to say that the banquet on Friday night was one of the two or three within the remembrance of the oldest convention habitué which was without a flaw from beginning to end. It was held in the banquet hall of the Auditorium, which was beautifully decorated for the occasion, and the scene was a picture of light and color which has rarely been equaled at any previous banquet. The menu was good in itself, was served *hot* by skillful waiters, and was not too long drawn out to be tiresome. The menu cards were beautifully engraved with appropriate designs. The speeches were short, crisp and well handled, and the entire function was over at 11 o'clock, giving another hour for social chat in the parlors thereafter. Altogether, the banquet committee, the Auditorium management and the speakers, are to be heartily congratulated on the skill with which this more or less difficult gastronomical and oratorical combination was this year carried out.

A much appreciated courtesy at the banquet was the presentation to each lady present of a beautiful little basket of flowers, "with the compliments of the Christensen Engineering Company."

At the table of honor sat the retiring president, C. S. Sergeant, of Boston; the president-elect, John M. Roach and Mrs. Roach; Past President Albion E. Lang, of Toledo, and Mrs. Lang; President J. F. Calderwood, of the Street Railway Accountants' Association, and Mrs. Calderwood; Past President Robert McCulloch, now of Chicago, and Mrs. McCulloch; Mr. and Mrs. George A. Yuille; President-elect C. N. Duffy, of the Accountants' Association, and Mrs. Duffy; Hon. W. J. Hynes and Hon. W. E. Mason.

President Sergeant acted as toast-master, introducing the principal speakers in a very happy manner, without committing the grave mistake so often found at similar functions of "taking the wind out of the sails" of those who were to respond to the toasts. Mr. Sergeant's odd conceit of the American Street Railway Association banquet of the future as one in which, instead of the brilliant company now annually assembled, would appear but two jaded, careworn men meeting together, one representing all the street railways of the country in combination, the other, a trust of all the manufacturers, excited great laughter, and he further summarized the present situation by saying: "No longer does the representative of the supply company sit in the ante-room of the railway manager waiting for an audience, meanwhile, perhaps, casting his eyes upon some such notice as this: 'The purchasing agent will see persons having articles to sell on alternate Tuesdays, from 2 to 3 A. M. On the contrary, the offices of the rolling mills and car factories are filled with dignified directors of the street railway companies, soliciting the high privilege of placing orders for delivery (not guaranteed) in 1910."

Senator William E. Mason was the first speaker at the banquet, and his subject was "Chicago." It was full of wit and humor, with a serious undertone, however, which gave for dignity. Senator Mason was followed by James W. Duncan, who responded to the toast "Illinois," a name

which, he said, represented a territorial area so nearly the same as that described by the previous toast of "Chicago," as to leave little ground to stand on for one who followed "Chicago" with "Illinois." The pride of the State of Illinois in its distinguished citizens—Abraham Lincoln, U. S. Grant and John A. Logan—was eloquently voiced by Mr. Duncan, as were also the physical and commercial features which have given her so prominent a place in the American sisterhood of States.

The toastmaster next introduced J. H. Stedman, of Rochester, as the man who had the temerity to undertake to designate and identify the lady passenger by punching her picture upon the margin of a transfer—an undertaking which signally failed, because of the gallantry of the conductors in punching all ladies as "young." Retiring President Calderwood, of the Accountants' Association, was next called upon, and he read an original poem on the subject of "Grease." The final speech was made by W. J. Hynes.

At the conclusion of the regular speeches, President Sergeant, with a few graceful words, delivered his gavel, the emblem of presidential authority, to President-elect Roach, who accepted it, together with the duties and responsibilities of the presidency, in a little speech, in which he expressed the hope that in his term of office he might be able to serve the association and street railway interests as well as Mr. Sergeant had done.

Following Mr. Roach's installation as president *de facto*, in charge of the festivities, Third Vice-President-elect F. E. Jones, of the Memphis Street Railway Company, and Secretary Penington were called upon for speeches, after which adjournment was taken to the parlors for a final hour of social enjoyment.

The Entertainments

On Wednesday afternoon a special train arranged for by the entertainment committee conveyed nearly 500 of the convention attendants to Lockport, Ill., the terminus of the main drainage canal of the sanitary district of Chicago, and at several points on the outward journey the train was stopped to permit inspection of this, Chicago's largest and most magnificent engineering work. It is probable that the immensity of this achievement could be realized by but few, if any, of the party, partly through lack of knowledge of the conditions which make such a work necessary, and partly because there is little in the neighborhood of the canal by which to gage its really enormous size. Figures also are of little value at such a time, but when it is stated that the necessary excavations involved in the entire work will be about equivalent to the removal of a layer about 3 ft. deep from the entire surface of Manhattan Island south of 125th Street, and that the entire cost of the work is estimated to be between $40,000,000 and $50,000,000, it will be seen how courageous is Chicago's spirit in grappling with so tremendous an undertaking. While the present plans do not involve, as some suppose, the construction of a ship canal from the lakes to the Mississippi River, it is true that there will be a continuous waterway which may eventually be developed into a ship canal.

Perhaps the greatest of the industrial enterprises of Chicago is the slaughtering of animals and the preparation of food products. This is one of the most highly organized industries to be found in the world, the division of labor and the introduction of labor-saving machinery being carried to their highest development. It was natural, therefore, that a visit to the famous Union Stock Yards of Chicago should be on the programme prepared by the committee on entertainment, and this excursion took place on Thursday afternoon. It had been intended to allow the attendants a liberty of choice between the stock yards and a tally-ho excursion through Jackson Park, but the weather was so raw and unpleasant that a change in programme was made, by which those who chose to do so rode to the stock yards in the tally-hos and returned through Jackson Park, the others going by trolley cars. The stock yards made a great impression upon the delegates, because of the wonderful system of handling the business seen there and the perfect cleanliness of all the processes.

On Friday, carriage parties to the principal stores, the Art Institute and Lincoln Park, were made up for the ladies in attendance, and the merchants of Chicago, particularly such concerns as Marshall, Field & Company, who own the greatest dry-goods establishment in the world, were doubtless the richer by many thousand dollars for this feature of the programme.

On Friday afternoon also a special excursion to the power station of the South Side Elevated Railway Company was made, upon invitation, and under the charge of the Westinghouse Electric & Manufacturing Company. A special train, kindly furnished by the South Side Company, left its office at 2:30 P. M., and about 100 were in the party. The station is equipped with four 800-kw. Westinghouse generators and two new 1500 Westinghouse generators are being erected at the south end of the station. Other apparatus represented in the station were the boilers of the Babcock & Wilcox Company, the economizers of the Green Fuel Economizer Company, the engines of the Edward P. Allis Company, the auxiliary steam apparatus of the Wheeler Condenser & Engineering Company, and S. J. McLeod.

The reception given in the Auditorium parlors on Tuesday evening by the entertainment committee and many ladies of Chicago was a *conversazione*, enlivened by music and refreshments, but with little dancing. Its object was to place the delegates and their Chicago friends on an immediate social footing, as well as to renew old convention friendships of many years' standing. Chicago's hospitality proved very warm and cordial, indeed. The reception was wound up by an impromptu concert, in which the Auditorium piano and several score of voices—soprano, alto, tenor and bass—took part, the soprano and alto gradually dropping out as evening passed into morning, until at length was left only the hoarse croakings of an occasional *basso profundo* reverberating from the marble walls of the Auditorium subway, and finally losing itself in the Turkish room or in long-neglected chambers.

Several private dinner parties at the Chicago clubs and in the hotels formed enjoyable features of the convention, and the absence of an iron-bound, rock-ribbed programme of entertainment made these special gatherings possible and most enjoyable. Right here, the action of the local entertainment committee in laying out its programme of social functions ought to be especially commended, in that so large latitude of choice was left to those in attendance at the conventions in the matter of entertainment features, particularly in the evenings. Wednesday evening, for example, was entirely free, while on Thursday evening those who cared to do so were privileged to make up theater parties to see "His Excellency the Governor," for which nearly the entire house had been secured by the entertainment committee for delegates and their friends. Many of those who attend the conventions have friends in the convention cities, for seeing whom they wish to reserve time, and where the entertainment is practically a "continuous performance" it is difficult to break away, unless, as in this case, optional features are introduced on one or more evenings.

STREET RAILWAY JOURNAL

NOVEMBER, 1899.

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, BEARD BUILDING, 120 LIBERTY STREET.

BRANCH OFFICES:

CHICAGO.....Monadnock Block.
PHILADELPHIA.....929 Chestnut Street.
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ST. PETERSBURG.....Alexander L. Lineff, Ligovka, 67-22.

Long Distance Telephone, "New York, 4044 Cortlandt."
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada.....$4.00 per annum.
In all Foreign Countries, per annum.....$6.00 / 25/ / 31 fr

Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

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All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

Address all communications to

The Street Railway Publishing Co.,
Beard Building, 120 Liberty Street, New York.

The two street railway conventions just held in Chicago cannot fail to materially strengthen both organizations, the American Street Railway Association and the Street Railway Accountants' Association of America. The business of both conventions was admirably managed by their officers and executive committees, so that there was not a dull moment from the time of arriving in Chicago till that of leaving. The sessions commenced promptly at the hour specified in the programme, and the meeting rooms were at all times crowded with delegates, instead of being neglected in favor of the exhibits or other attractive features, as has frequently been the case in times past. The greater interest on the part of delegates to the larger convention (the meetings of the Accountants' Association have always been well attended) was due to two reasons. The first paper on the programme to be read on Tuesday was one in which all were interested, both because of the prominence of its author, Mr. Yerkes, and the importance of his subject. The hall was crowded, therefore, during the reading of this paper and in the following discussion thereof by some of the ablest men in the industry, and this first meeting "set the pace" for the entire convention. The second reason was the wise determination by the executive committee, at the instance of Mr. McCormack, to leave one day, Friday, free for the inspection of exhibits, and at the same time to make certain that all or nearly all the delegates remained in town by placing the annual banquet on the evening of that day, instad of on Thursday, as has usually been done in the past. The results of this change of plan were most happy, and quite surely mean its adoption as a regular feature of future conventions, for it not only secured for the convention meetings themselves a larger attendance, as has just been stated, but opinion is practically unanimous that more actual business has been done at this convention than at any previous one in the history of the association. The delegates and "supply men" were able to get together without difficulty to close contracts, and a number of very large orders were placed for all kinds of material and supplies. This is decidedly as it should be, for such a meeting place as is afforded by these conventions ought to be a great convenience to both purchaser and seller.

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Although the exhibit hall in Chicago was much smaller than that in Boston last year, and many of those who wished to make exhibits had to be denied space at the last, while the applications of all, or nearly all, were cut down almost 50 per cent, yet the exhibit seemed practically as complete as in previous years, and was well arranged for business purposes. All in all, the number of exhibitors was but little smaller than last year, while the amount of space taken was slightly less than 25,000 sq. ft., as against 33,000 sq. ft. last year. The committee on exhibits, of which James R. Chapman was chairman, certainly deserved credit for the remarkable success which it achieved in transforming Tattersall's, which is, in reality, an ugly and unpleasant building, into one which was almost a "bower of beauty," with its flag and streamer decorations, its complete arc and incandescent lighting service and its variety of exhibits. There is nothing but praise also for the care given by this committee to the interests of exhibitors. Everything worked smoothly and well, the transportation facilities were good, and on Tuesday morning all the exhibits were practically in place, ready for inspection, something which is not always, by any means, accomplished at conventions. At a meeting of supply men, held in Convention Hall, Oct. 19, with Elmer P. Morris chairman, and H. C. Evans secretary, resolutions were passed commending the action of Ira A. McCormack, of the executive committee, for recommending and having adopted the resolution, setting aside one day for the express purpose of inspecting the exhibits. At this meeting a vote of thanks was also extended to the association for its courteous treatment of the supply men.

* * * * *

The meetings of the Accountants' Association were, as has always been the case, businesslike and valuable to a

degree. This association has, in its two years of life, accomplished more than could possibly have been expected of it, and the high tribute to its work in standardizing street railway accounts recently paid by the committee on standardization of the National Association of Railway Commissioners, is most surely well deserved.

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It is perfectly true, however, as Mr. Kittredge remarks in another column, that the Street Railway Accountants' Association is only on the threshold of its work. What has been accomplished so far, while most important and valuable, is still little more than the standardizing of a form of statement, not the development of a complete economical accounting system. We believe firmly that nine-tenths of our street railway companies are employing far too large a force in their accounting departments—that they are multiplying work—and that they are not in touch with modern commercial methods and labor-saving devices. When the largest street railway company in this country (gaged by gross earnings) is able to handle from $12,000,000 to $15,000,000 of money per annum in receipts and expenditures, and $5,000,000 to $10,000,000 more on construction account with but seven men in its auditor's department and two or three in its treasurer's, there would seem to be little reason for much smaller companies having the force of men which they now employ. We shall have more to say about the organization of accounting departments in the coming year, but meanwhile we urge our street railway friends to most carefully investigate accounting practice in the best models, and particularly to study the mechanical labor-saving appliances of modern accounting as exhibited, for example, in the great department stores or in some few of the street railways which have so far adopted them.

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The new officers of both associations are worthy of their posts and of the traditions of the associations. President-elect John M. Roach has been connected with street railways for more than twenty-seven years in important positions of responsibility, and has always been a warm friend of the association. As he was chiefly responsible for bringing the convention to Chicago this year, and as he has done more than any other one man to make the visit the complete success which it certainly has been, he was the logical candidate, and had no competitor. First Vice-President John A. Rigg, of Reading, is at the head of several important Eastern properties recently brought together for the purpose of effecting operating economies, and is a man of the highest personal character and reputation. Second Vice-President H. H. Vreeland, although but six years in the street railway field, is generally recognized as one of the wisest and most successful managers in the country, possessing as he does in a high degree financial acumen, organizing ability and a knowledge of the influences that move men's minds, together with a broad, kindly and entirely genuine sympathy with the labor which he controls, and which is, to a man, enthusiastically devoted to him. Third Vice-President F. G. Jones, of the Memphis Street Railway Company, is one of the most prominent men in his section of the country, and C. K. Durbin, of Denver, Charles W. Wason, of Cleveland, John R. Graham, of Quincy, and Nicholas S. Hill, Jr., of Charleston, will add strength to the executive committee. Mr. Hill won a host of friends in this convention by his brilliant, aggressive and persistent campaign in behalf of Charleston as a meeting place for the convention next year, and while, for various reasons, he failed in this, his first effort to extend the hospitalities of Charleston to the association, the general feeling is that another year he will be more successful, if he still desires to entertain the convention. Finally, the association is fortunate in retaining for the new executive committee the services and experience of the retiring president, Mr. Sergeant—one of the best presidents who have ever occupied the chair.

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The election of C. N. Duffy as president and W. F. Ham as first vice-president of the Accountants' Association is a natural and fitting result of the magnificent work which they have done as members of the committee on standardization, and of their devotion to the interests of the association. They have been always generous of both time and money in furthering the interests of the association, and, both being men of indefatigable energy and acute and intelligent thinkers, it is not surprising that the work of this important committee should have called forth the almost enthusiastic expressions of approval from the committee of the Association of Railroad Commissioners, quoted in the last report. W. G. Ross, of Montreal, the second vice-president, has always been prominent in the councils of the association. It would be impossible to name a man who could and would fulfil the duties of secretary and treasurer with greater care, patience and courteous attention to every inquiry than Mr. Brockway, and the amount of work which he has accomplished during the past two years is little short of marvelous. The department of blanks and forms, which he has created, is admirably conceived, and will be of such benefit to those who are desirous of improving their system of accounting that a trip to Toledo from any part of the United States is fully worth while, though by the system of correspondence which Mr. Brockway has instituted, such a trip is not always necessary. The Street Railway Accountants' Association of America has every reason to be proud of the fine lists of officers and executive committees who have been in charge of its affairs since the beginning.

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In deciding upon Kansas City as the meeting place for the convention of 1900, the association has departed somewhat from precedent, in that two Western cities have been chosen in consecutive years, but this action has not been taken without good reason. While it is true that over 80 per cent of the street railway mileage of the country lies east of the Mississippi River, there should be at least an occasional meeting held in the further West, and we believe that Denver, or even San Francisco, would be popular, on many accounts, as convention meeting places, and that so many vacations would be arranged to take in the necessary transcontinental trip at convention time that the attendance would be little smaller than in the Eastern cities. Kansas City is certainly not too far west to attract practically all the Eastern delegates, while it is sufficiently far to perhaps bring into the association and to the convention many of the extreme Western companies, and the city itself, under the leadership of Mr. Holmes and the Metropolitan Street Railway Company, will certainly ex-

tend a hearty welcome to the 1900 convention, and will take good care of it in every way.

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The buttons this year were very handsome. The head of the famous Chicago girl was the *motif*, above which were the initials " A. S. R. A.," and below the word "Chicago," while "1899" was in the central disk. The delegates' buttons were in a rich blue, the accountants', in yellow, the ladies', in white, and those given to "others in attendance" were in red. As usual, the buttons acted as "free passes" upon the local surface and elevated railways.

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Secretary Penington was, as usual, one of the most popular men of the convention, and his uniform courtesy toward all, and his disposition to do everything in his power to promote the comfort and pleasure of every delegate and supply man, were highly appreciated. His management of the finances of the association has been, as always, excellent, and the surplus is constantly increasing.

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Among those usually seen at the conventions, but who did not, for various reasons, attend this year, were John A. Brill, vice-president of the J. G. Brill Company, who is absent in Europe; C. W. Price, proprietor of the "Electrical Review;" Edgar Peckham, president of the Peckham Motor Truck & Wheel Company; John W. McNamara, general manager of the Albany Railway; James H. McGraw, president, Street Railway Journal; Clinton L. Rossiter, president of the Brooklyn Rapid Transit Company; William F. Ham, auditor Brooklyn Rapid Transit Company; Bert L. Kilgour, electrician, Cincinnati Street Railway Company; W. F. Kelly, recently of Columbus, now of Oakland, Cal.; J. B. Cahoon, formerly of Elmira, but now connected with electric lighting enterprise in Syracuse; W. B. Ferguson and E. P. Shaw, owners of many street railway properties in Massachusetts; C. M. Wickar, formerly of the North Shore Traction Company, now of the Chicago Union Traction Company; P. F. Sullivan, general manager of the Massachusetts Electric Companies; Henry C. Payne, of Milwaukee; Richard McCulloch, formerly of St. Louis, now of Geneva, Switzerland; Harry Scullin, of St. Louis, who is not now connected with street railway enterprises; O. T. Crosby, of the Washington Traction Company, now traveling in Africa; John Graham, of Wilkesbarre, and W. J. Johnston, formerly of the "Electrical World," now traveling in the Orient.

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The "Street Railway Review" deserved much credit for its enterprise in publishing during the convention a daily edition containing lists of attendants, proceedings of the day before, and descriptions of the exhibits, etc., together with illustrated articles on the Chicago drainage canal, the Union Stock Yards, and other Chicago enterprises. Only those who have been through a work of this kind can understand the immense amount of labor which it involves, the editorial force having to spend practically the entire twenty-four hours preparing matter, correcting proofs, etc. Although many errors will inevitably creep into any work of this kind, so hastily done, they are always excusable and nearly always excused, while the convenience of such a daily resume is considerable. In these daily bulletins and in its special issue of October fifteenth, devoted almost entirely to a description of Chicago as a business, artistic and street railway center, the "Review" has well upheld the traditions of a city noted for its generous hospitality to visitors, and for the care which it takes to make certain that they appreciate its many attractions.

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We cordially commend to street railway managers Mr. McCormack's paper on "Train Service and Its Practical Application." It is an able discussion of a problem which is, next to the management of labor, the most important which a company has to solve, i. e., that of running a sufficient number of cars to accommodate the public without eating up all the receipts in operating expenses. It is not too much to say that the net revenue of a road depends upon the management of its car service. More than once has a property been saved from bankruptcy and set firmly upon its feet by a change of management and a better balancing of car service and traffic. It is impossible to generalize upon this subject, as the conditions are so wholly local in every city. All that can be done is to suggest, as Mr. McCormack has done, convenient ways of finding out what service the public really needs and is prepared to pay for. The "car-service engineer" of a street railway is to put these and other methods into practice, and should be a man of the highest intelligence, acumen and energy.

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The paper by Mr. Vanderveer on the "Care of Car Equipment" was an interesting one, and upon a branch of street railroading which is of great importance. The old proverb of "a stitch in time saves nine" applies nowhere more forcibly than in the care of railway apparatus, and it is the best kind of economy to keep both the rolling stock and its equipment in good condition by frequent inspection. The speaker limited the advisable night inspection to that only which is absolutely necessary, and preferred to make all repairs by daylight. This opinion was indorsed by all the speakers who discussed this subject, and it will receive general acquiescence. The paper was the prelude to a general discussion on the advisability of running single motor equipments. The experience with single motors, elicited by these expressions of opinion, seems to have been that they require more repairs than double or four-motor equipments, but to us this fact seems attributable not to the number of motors per car, but to a lack of power capacity on the car. Considering the proper equipment of a car from the standpoint of repairs only, the motor repairs per car should vary approximately, though not exactly, with the number of motors on the car, provided, of course, that the single motor equipments have double the capacity of each motor in the double-motor equipment, or four times the capacity of each of the motors in the four-motor equipment. There ought not either to be any great difference in motor efficiency under the same conditions, and any difference which would exist would naturally be in favor of the motor of larger capacity. Both of these points can be readily seen by considering the parallel case of stationary motors. From both a repair and efficiency standpoint, one 80-h.p. motor would give better results, say, than two 40-h.p. motors or four 20-h.p. motors. In railroad operation, however, these two are not the only points to consider. Traction is a very important question, and one to which is intimately connected that of quick ac-

celeration, on which in turn depends the third important question of current economy. On roads where these are desiderata, and among such roads should be classed those desiring quick service and high speed and having grades, the disadvantages of the multiple-motor system will be more than outweighed by its merits.

Treatment of Labor After the New York Strike

We recur briefly to the so-called strike in New York city, in order to bring to light certain incidents of the strike and the after treatment of the employees who so loyally stood behind the administration of the Metropolitan Street Railway Company, when urged to desert it by spurious and self-seeking labor leaders. It is a well-known fact that President Parsons, of the Knights of Labor, was extremely anxious to avoid throwing down the gage of battle, knowing the inevitable result, but was forced into it by a few discharged employees on some of the more recently acquired lines, who desired to make mischief for their own ends. Mr. Parsons was wiser than his associates. On the day the strike was declared many of the men on the different divisions refused to go home after completing their regular hours of service, but voluntarily stayed in the barns all night in order that they might take the place of any of the men who might desert the company. Some of the motormen bitterly resented the presence of policemen on their cars, saying that they had been able to take care of their cars hitherto, and needed no help now. Others fought for the privilege of taking the first car out on the morning of the strike. In general, the utmost contempt for the malcontents, and loyalty to the administration was the rule and not the exception. Such loyalty as this deserved its reward, or so the management felt, though reward was apparently the last thing the men on the system thought of. The question of how recognition could best be given came up for discussion, and some of the employees longest on the system were called in consultation by President Vreeland. Three plans were submitted to them for consideration, one, a large donation to the Employees' Mutual Benefit Association; the second, the granting of a cash present to all men, and the third, the granting of a three days' vacation with pay. After considerable discussion, it was unanimously agreed that the last plan offered something which the men would appreciate more than the others, and for the first time in the history of any great street railway system, so far as we know, the men were enabled to take an outing without feeling that the children must lose a pair of shoes or the wife a bonnet in consequence. The surprise and pleasure of the men at this unexpected act of the company are almost touching, as showing how highly this opportunity to take a little pleasure has been appreciated. One further result of the strike should be mentioned. The men who left the company's service at the beginning of the strike, many of whom did so much against their will by reason of threats or appeals by the strikers, were given twenty-four hours in which to return to service. After the expiration of this time, not a man remaining out was, or ever will be, accepted as an employee by the company. The strongest influences have been brought to bear in some cases to secure the reinstatement of certain men, but in every case such reinstatement has been absolutely and finally refused, it being felt by the management that disloyalty should not be placed on a par with loyalty even in a single instance.

Recent Practice in Track Construction

Among the many changes which the last ten years have made in street railroading none, with the exception of motive power, has been more radical than in the department of track construction for paved streets. Eight years ago the most approved form of street railway track could easily have been defined, but looking back at that period now we can hardly find a single feature of the former construction, with the exception of the form of rail-heads, which is generally accepted as standard practice for paved streets. Changes have been made in the height of rail, weight of rail, length of rail, percentage of carbon, joints and character of sub-construction. To be sure, all of these innovations have not been accepted as desirable by all track engineers, but it is undeniable that many of them, including the increase in weight and length of rail, have been accepted by all, height by most, and joint construction and concrete sub-base by a slightly less number The latest developments in this "modern" construction, as it may be termed, are described quite fully in the papers in this issue by Mr. Butts, of Kansas City, and Mr. Silliman, of Scranton; and while in details the constructions differ in many particulars, both employ the concrete sub-base as a continuous support for the rail. The discussion on Mr. Butts' paper by the American Street Railway Association was, on the whole, favorable for its use for heavy city construction, although there were some dissenters, and it must by no means be assumed that track engineers are universally in its favor. In some respects, Mr. Silliman's construction seems more substantial than that employed in Kansas City. We think the use of steel ties or cross-girders (Mr. Silliman employs for this purpose 52-lb. girder rails every 10 ft.) would be an essential factor in keeping the track in alignment and superior to the exclusive use of tie-rods for this purpose, as the rail is better maintained in an exactly vertical position. With the imbedding of the steel ties in the concrete, however, difficulty will be encountered in making the track connections when the rail is renewed, unless the old tie is torn up. The joint connections, of course, are also different, in one case being riveted, and in the other cast-welded. There is also a variation in the form of concrete sub-base used; in Scranton the concrete is laid entirely across the track, while in Kansas City it is laid in trenches under the rails. We presume the latter construction would have been employed in the former city if the pavement had already been laid on concrete, and will be employed when it comes to renew the rails. Neither of the speakers referred to the subject of track renewals, which is, of course, an important question where a concrete sub-base is employed, as where the rail is imbedded in concrete the entire old base must be renewed when the rails wear out and new rails are substituted.

While the use of concrete sub-base is increasing, the use of wooden ties for city work has also many advocates. The latest and best track construction in Chicago is on wooden ties, mounted on a broken stone ballast, and it is interesting to note that in the most recent work in New York City, that of the Third Avenue Railway Company, the use of

wood in sub-construction was considered so desirable that it is being employed in the form of stringers under the rails, even in electric conduit construction. Undoubtedly, the use of wood in track construction conduces to easy riding, a very important feature, as shown by the fact that in the work of the Third Avenue Railway Company, already cited, steel springs are being used under the rails in the old construction, where the shape of the existing yokes did not permit the introduction of wooden stringers under the rails. Independent of the question of durability, the result sought for in this construction has certainly been accomplished, and the elasticity given the track is very noticeable.

We are unwilling to state that either the concrete sub-construction or the wooden tie construction is the most desirable under all conditions of track construction in paved streets. As a matter of fact, we believe that the special circumstances which warrant the introduction of each will be determined by experience. At present the concrete sub-base seems to have the advantage of durability. As it would have to be renewed when the rail wears out, however, there is no advantage in making it longer lived than the rail, which is the really limiting factor. On the other hand, if the life of the rail varies inversely with the number of tons passing over it, while in that of the sub-construction, time is the principal factor, the durability of the sub-construction is a more important question on roads of comparatively light traffic than on those of heavy traffic. It is not impossible, therefore, that we shall find practice in paved streets following the somewhat anomalous line of using the more substantial concrete construction on the smaller roads, and the lighter and more elastic wood construction on the roads of heavy traffic.

A Question of Units

Mr. Mackay, in his paper on "Car Mileage," makes a strong plea for the use of the "motor-car hour" as a unit in place of the "car-mile run," now in quite general service. The motor-car hour, as he defines it, is the car mileage divided by the average speed in miles per hour. If, for example, a railway runs its cars at an average schedule speed of 8 miles per hour, and they aggregate 2000 miles per day, there would be 250 car hours run, and the cost per car hour would in that case be eight times the cost per car mile. The advantage of this unit is found chiefly in comparing roads, or divisions on a large system, where schedule speeds vary greatly. There is no question that the principal part of the great variation in cost per car mile shown by different roads is due to the differences of schedule speeds. In a road running at 20 miles per hour, for example, and paying its conductors and motormen 20 cents per hour each, the transportation wages amount to only 2 cents per car mile, whereas in a city road running at, say 6 2/3 miles per hour, the equivalent cost is 6 cents per car mile, with the same rates of wages paid. On the motor-car hour basis the transportation wages would be the same, viz.: 40 cents per car hour; the two roads will, to that extent, at least, be placed on an equal basis, and the effect of mismanagement or poor economy in departmental work will be more clearly brought out. This is Mr. Mackay's argument, and it is undoubtedly a strong one from some points of view.

The attempt to find a single unit of measurement which shall gage the respective efficiencies of management of two street railway properties is, however, as futile as was the search for the philosopher's stone in the middle ages. The difficulties are inherent and insurmountable. Street railway operation is made up of so many processes wholly different in their nature that they cannot possibly be brought down to expression in any one form, even on a single property—much less in comparing two properties having widely different conditions. How true this is may be seen by inspecting some of the detailed operating expenses which go to make up a total. In the department of transportation we can, to be sure, pro rate nearly everything in car service upon a car-mileage or motor-car hour unit. If we pro rate operation of power plant also upon this unit, it will give us some results of value, from a transportation standpoint, although we cannot by this means gage the relative economy of different power stations, but must for that purpose use the kilowatt-hour unit. In the maintenance accounts, however, we run across trouble at once. Maintenance of cars and their electric equipment can be gaged by the motor-car hour or car-mile unit, but directors would get a much clearer understanding of the relative economies in different comparative reports of operation if the accountant should pro rate maintenance of track and roadway upon miles of track; maintenance of electric line upon miles of road; maintenance of steam and electric power station plant on kilowatt output, as a part of total cost of power; or should express all these costs, together with maintenance of buildings and fixtures, in the form of percentages on original cost. So, too, in the department of general expenses, what a board of directors would look for from their accountant is a statement as to what percentage of their gross receipts is being used for general expenses of administration in detail and in toto, and whether this percentage is increasing or decreasing. We do not mean to say that all these items in operating expenses are not to be expressed in the car mile or motor car-hour unit, for the manager and the directors often wish to get an idea of the relative proportions of each item of expense to the total, and this can well be shown in either of these units, but it is certain that, in comparing many of these items outside the transportation department, from year to year, in order to see where economies are possible, they will find the motor-car hour or car-mile unit absolutely useless. If these things are true of an individual road, how much more must they be true when comparing, as Mr. Vreeland said, a mountain road with a plain.

The truth is that we must have a large stock of units in order that the directors and managers of a property may be able to effect the economies which it is the object of all accounting to facilitate. The motor-car hour is a valuable addition to this stock, and Mr. Mackay is to be given due credit for bringing it so prominently before the accounting world and explaining its merits. While it is not, and never can be made to be, the touchstone which will measure efficiency of management of two different properties, it will help the manager of a large corporation to learn more about the work of his respective division superintendents, because they cannot plead differences of speed as being responsible for differences in result. We believe, however, that the car-mile unit is firmly entrenched in the practice of so many companies and is, on the whole, so satisfactory in making comparisons from year to year on the same systems, that it is not likely to be displaced.

In the final analysis the presentation of operating results by the accountant in any or all units is not the *end*, but only the *beginning*. It is the manager's duty to explain these results to his directors and stockholders, to show why the cost per car mile of car service, for example, was greater this year than last, or to state with due satisfaction that by such and such means he was able to bring the cost of power down this year to 1½ cents per car mile, while it cost 2 cents last year. It is the business of the accountants to make this work of explanation as easy for the manager as possible, and for this purpose a table of detailed comparisons in appropriate units separate from the main presentation of results should accompany every profit and loss account.

How Can Street Railway Investments be Made Secure and Remunerative

The paper on this subject just delivered before the American Street Railway Association by Charles T. Yerkes, one of the most successful investors in street railway properties in America, is certainly worthy of careful attention, and is full of suggestions and ideas, upon which, however, public opinion is by no means unanimous. Mr. Yerkes first describes the tremendous physical and financial differences between the horse railways of twenty years ago and the cable and electric railways of to-day, referring especially to the great investments now required as compared with those necessary for horse railroading, and he considers that the investment risks now are such that if twenty-year franchises were fair under the old regime, two hundred-year franchises would be equally fair at present. A long charter or franchise tends more, he thinks, to the greater security of street railway investments than any other one element. Mr. Yerkes believes that street railway companies should pay for their privileges by turning over to the public treasury a fair percentage of the earnings of the company, but that it should be borne in mind that a company serving a large city must always carry a large amount of unproductive mileage, which the future only is to make valuable, and therefore cities should not make extortionate demands upon the companies. He advocates the appointment of State commissions to carefully and intelligently supervise the operation of street railways in much the same way as is now being done in several of our States. Finally, to the end of making street railway securities more secure, Mr. Yerkes advocates straightforward dealing with the public, and a broad and liberal policy in introducing improvements.

All these suggestions are good and valuable, but they do not reach the heart of the problem. The more we examine into the reasons for the increasing number of controversies between municipalities and private capital engaged in public service industries, the more certainly is the conviction forced upon us that *the only way in which most of the grave problems which confront street railways to-day can be solved, and street railway investments can be made both secure and remunerative, is by making friends with the public and taking it into a bona fide partnership of profits.* At the root of all our troubles of to-day—excessive taxation, labor strikes, "cruel and unusual" punishments of various kinds inflicted or attempted by politicians—lies a grossly exaggerated idea of street railway profits, and this idea is fostered by *secrecy*. All of us in the business know that street railway profits are not excessive, but are, on the contrary, small, while the business itself may be classed as "extra hazardous." The comparatively few men who have apparently, or actually, grown rich from their street railway security holdings, have done so, as a rule, through the capitalization of expected profits, not the actual receipt of real ones. In nine cases out of ten where the annual profit and loss accounts have seemed to show a large return on investment, it is because depreciation of plant and equipment has not been properly taken care of, as is universally done abroad, or else because an open "construction account" has been charged with what are really operating expenses, in order to serve the purpose of those who are trying to unload their stocks upon the public.

It is hard—probably impossible—to bring these facts home to the public, particularly because the truth is kept from them by both politicians and street railway managers themselves, though for differing reasons. The manager is the agent of his company's security holders, and cannot take any radical action which would depreciate the value of their securities among investors. The politician, even if he knows the truth, which he rarely does, perhaps, would not ordinarily hesitate to climb to power on a purely demagogic appeal to public ignorance and prejudice. Meanwhile, secrecy is maintained, and the burdens of taxation are piled on heavier, until, from one cause and another, the final crash comes and the property is bankrupt.

A partial remedy for this state of things is the non-partisan State commission, which Mr. Yerkes advocates. Such a commission is found in Massachusetts and New York, and in Massachusetts, particularly, its functions have been so fixed by law and interpreted by the courts, as to really protect the public against overcapitalization and "wild-cat securities." It is impossible to-day to overcapitalize street railways in Massachusetts. The Railroad Commissioners will permit issues of stock and bonds together only to an extent warranted by the actual cost of duplication of all the tangible assets, and the bond issue must not exceed one-half the stock issue. Organization expenses even cannot be capitalized, and if there be at any time an impairment of capital account, as shown by inventories dividends must be reduced or suspended until the impairment is made up. The commission even fixes the price at which stock shall be offered to the public, never putting it below par, and frequently providing that a heavy premium shall be paid into the company's treasury—not into private hands. Such protection as this is genuine, permanent and desirable from every point of view except that of the man who wishes to make money too rapidly, and street railway investments are highly regarded in Massachusetts as being secure and reasonably, though not largely, remunerative.

In spite of these carefully made provisions, however, there is a growing agitation even in Massachusetts for public ownership of street railways, and unless a better and more logical plan than this semi-socialistic one is found, there is grave danger that the immense advantage to the public of private ownership or trusteeship of this industry may eventually be lost. We need not here repeat the arguments against municipal ownership of street railways, except to epitomize them by saying that never in the his-

tory of the world will a municipality, with its 50,000, 100,000 or 1,000,000 inhabitants as "stockholders," represented by fifty or one hundred councilmen, as "directors," handle any public service enterprise with the same promptness, decision, breadth of view and outlook for the future, as will be done by properly encouraged private capital, managed by a half dozen responsible trustees. In a thousand ways, more or less indirect and unrealized, the people will be the poorer for a municipal ownership experiment, even should their treasury be slightly the gainer.

What then is the true remedy if it is not found in the Massachusetts plan? In what way can municipal ownership agitation be stopped and the immense benefits of private ownership be retained for the public good? Is there any one plan which can be put in universal application with justice to all concerned?

Possibly not, but if such a plan be found it will surely involve the profit-sharing principle in some form, together with absolute publicity in every department of the business. In a plan of this kind the expenditure of gross receipts might be made on some such basis as the following, the charges on receipts taking precedence in the order given:

1. *Operating expenses,* including a proper allowance for depreciation.

2. *State and local taxes* paid on real estate and personal property—the ordinary burden of citizenship.

3. *A reserve fund* for accidents, uninsured losses of various kinds, and other contingencies.

4. *An amortization fund,* to insure a return of invested capital at end of franchise life.

5. *An employees' benefit fund* to provide against sickness, accidents and old age.

6. *A minimum* (e. g. 4 per cent) *annual return* on the private capital invested.

7. Equal division between the municipality and the private capital invested of the remaining profits.

With such a plan as this, embodied in contract form, between municipality and company; with regular monthly, quarterly and annual reports of operations, duly audited by city officials; with arbitration of disputed points by a State railroad commission; and, above all, with absolute good faith on the part of both city and company, is it possible to doubt that demagogues and political "strikers" would be driven out of business so far as street railway matters are concerned, while, the interests of the municipalities and the companies being substantially identical, the present distressing conflicts would almost entirely disappear, and street railway investments would become both secure and remunerative?

Finally, the policy of distributing street railway securities locally—a matter not referred to by Mr. Yerkes in his paper, but touched upon by Mr. Vreeland in his discussion—is one which should be adopted by every company, even at some sacrifice of time, convenience and money. In disposing of bonds to banking houses, as large a proportion as possible should be reserved for sale to local capitalists, either by the companies direct or by the bankers as financial agents, and as much stock as can be spared should also be placed at home. In cases of this kind it is dangerous to be *isolated* in a community, for a company is thereby subject to the attacks of "strikers" or demagogues, without friends to help it fight its battles. Fifteen or twenty prominent local men as stockholders can bring immense influence to bear at times in preventing trouble, and if the number can be made 100 or 1000 or more, thereby making an even larger portion of the public sharers in the enterprise, so much the safer is the invested capital.

Franchise Valuations

A franchise may be defined as a special privilege granted by public authority to an individual or a body of individuals. The value of a franchise may be large, small, nothing or worse than nothing—the latter if it involves losses or obligations which cannot be escaped. The true value of a franchise, when it has a value, is an amount equal to *the capitalization of excessive—not of total*—profits. Every investor has a right to expect a reasonable rate of return upon his investment in tangible assets, organization expenses, etc., this rate varying with the current rates for money in the particular locality where the investment is made and upon the general estimate placed on the safety of his enterprise in comparison with that of others, into which he could put his money. If, because of the possession of a franchise conveying special privileges, he gets a rate of return larger than the average, the capitalization of the excess, at the ruling interest rate, is the value of the franchise.

Suppose, for example, that a company obtains a thirty-year street railway franchise, that it pays $1,000,000 for plant and equipment, and earns $50,000 per annum for thirty years, in a community where the ruling rate for an equally safe investment is 5 per cent. The value of its franchise is nothing, since the same return can be obtained from an investment involving no franchise. If it makes $100,000 a year for thirty years, the value of its franchise is $1,000,000, since, because of the franchise, 5 per cent can be earned upon $2,000,000.

This is a fair and reasonable method of arriving at a franchise valuation, and where the true investment account can be ascertained, distinct from overcapitalization, the value of a franchise can readily be obtained at the end of its life. If, however, the attempt to do this is made earlier, estimates, based on more or less fallible judgment, must necessarily be employed. It may be expected, for example, that general market interest rates will fall during a long time franchise, thus increasing the franchise value by increasing the capitalization factor. The value of real estate may also go up, thereby increasing the selling value of that portion of the investment and increasing the total net profits for the period. On the other hand, equipment may deteriorate and earnings, gross and net, may be greatly reduced through accidents, competition or "improvements in the art" necessary to obtain at whatever cost.

At a time when municipalities seem to be combining to drive street railway companies out of business by excessive taxation, it is necessary to occasionally clear the atmosphere by defining first principles, and we trust that the time will come when there will be less loose and indefinite talk about franchise valuations than is now so generally heard.

A Word of Appreciation—and Explanation

It is with much pleasure—tempered, however, with some surprise—that we have received the congratulations of a thousand or more (so it seems to us) friends and well-

wishers at the convention and elsewhere, on what they are pleased to term "that magnificent 'World's Practice Number' of yours." Pleasure in such congratulations is always natural, for it indicates appreciation of good intentions, if not of good work. The surprise comes in finding that the achievement in this particular case should be considered so remarkable. It is true that our "World's Practice Number" was a large issue, containing no less than 163 pages of reading matter and 276 pages of advertising, but this result compares with our regular fall convention numbers of previous years only in about the same way that the general prosperity of 1899 compares with that of 1898. Possibly an issue of this kind, dealing as it does with electric railway practice all over the world, and bearing within it so many evidences of the close engineering and commercial inter-dependence of the different countries, in these days of enterprise, competition and intelligent study of results, is needed to demonstrate the broad international character and world-wide connections of a periodical which is universally recognized, we believe, as the leading exponent of the street railway industry. The very fact that British, French and German manufacturers used between forty and fifty pages of our October issue to advertise their material and supplies among tramway purchasers, not here, but in Europe, Asia, Australasia and South America, and that no other foreign or American paper is used to anything like the same extent, is certainly significant, but it did not occur to us, until hearing the many expressions of surprise at this large foreign patronage, that the position of the STREET RAILWAY JOURNAL abroad may not be fully understood in America. We may be pardoned then, perhaps, if we state here, for the benefit of those who have not closely followed our work in foreign fields, that for some years past we have been publishing two regular monthly editions of the STREET RAILWAY JOURNAL, one, the American edition, intended for circulation in the United States and Canada, and the other, the International Edition, for circulation in all other parts of the world. Each edition contains considerable matter not found in the other, though it is intended that nothing shall be omitted from either edition of interest to its special clientele. In each issue of the International Edition appears a digest of contents in German, Spanish and French, and for the benefit of the combined service we have a staff of regular editorial representatives and occasional correspondents in the principal capitals of the world, composed of leading engineers and managers, of the several countries.

Partly as a result of this more recent work, but largely through the inheritances of earlier years, our foreign subscription lists contain not only the names of practically all the principal European engineers, tramway managers and manufacturers interested in improved tramway and railway motive powers, but cover such distant countries as Persia, New Zealand, Java, Turkey, Trinidad, Siam, Japan, Hawaii and all parts of Africa and South America. The little unpleasantness now going on in South Africa, for example, directly affects us, inasmuch as we cannot be sure that our current issues will reach our numerous subscribers in and near the seat of war, in Kruegersdorf and Pietermaritzburg, Natal, Johannesburg and Pretoria, South African Republic.

The STREET RAILWAY JOURNAL is not a *local* paper.

"A better convention has never come to Chicago in the course of my experience." So spoke the genial chief clerk of the Auditorium on Friday night, and he followed it up in explanation by saying that it was a convention which "took care of itself," did not overstep bounds, made no complaints, understanding the difficulties of the situation.

Proposed Resolution for Bringing About a Standard Determination of Cost of Public Service

The following resolutions, prepared by Allen Ripley Foote, have been presented for action to a number of economic, municipal and private industrial associations, with a view to bringing about a scientific determination of the cost of public service, and of thereby furthering the comparisons between the cost of public and private ownership to the advantage of all concerned. Among others, the executive committee of the American Street Railway Association has these resolutions under consideration:

Whereas, The American Street Railroad Association has discussed certain features of municipal public policy relating to the ownership and operation of public service industries, and whereas, such industries must necessarily be owned and operated by public or private capital, and, in either case, the application of a definite system of regulation identical in all of its details for both public and private ownership is fundamentally essential to promote and protect the welfare of users, taxpayers, employees and investors,

Be it Resolved:

First—That practical civil service regulations, strictly and continuously enforced in the case of public ownership, and a just system of profit-sharing in the case of private ownership, are necessary provisions to safeguard the interests of employees, and to insure efficient economic management for the service of users and taxpayers.

Second—That a system of accounting, uniform throughout the State, prescribed and audited by authority of a general State law, designed to show the true and entire cost of every public service industry, identical in every particular for public and private ownership and operation, is an indispensible condition to secure intelligent and just regulation.

Third—That a general State law should specify that there should be included in all statements of costs, used as a basis for determining prices to users and taxpayers, interests on the investment at the rate paid on its bonded debt by the municipality in which the industry is located, a sufficient provision for insurance against loss by accidents of every kind; the amount of taxes relinquished if a publicly owned industry, and paid, if a privately owned industry; an ample provision for insurance against the impairment of investment; the true and entire costs of all materials used and salaries and wages paid, and an accurate statement of all miscellaneous expenses.

Fourth—That prices to users and taxpayers should be based on cost, plus a provision for the payment of all capital secured by taxpayer or the sale of bonds in case of all publicly owned, and cost plus a legally limited profit in case of all privately owned industries.

Fifth—That prices should be determined for periods of five years.

Sixth—That all service rendered to private and public users should be valued and paid for at prices determined, as specified in number four. All free service should be prohibited.

Seventh—That no service should be sold for less than its cost, and no discrimination in price shall be allowed between users taking service under like conditions.

Eighth—That the divisible profits of private ownership and operation should be determined and limited by a rate upon the investment, which shall be equal to twice the rate per cent paid on its bonded debt by the municipality in which the industry is located, in all cases where costs are calculated and allowed, as specified in number three.

Ninth—That all profits in excess of the legal profit should be divided equally between the municipality and the private owners.

Tenth—That in making contracts with private corporations for the purpose of carrying the foregoing regulations into effect, the initial investment used as the basis of calculations should be determined by process under the law of eminent domain, or by arbitration, as may be mutally agreed upon between the municipality and the corporation.

Eleventh—That this contract should provide that at the expiration of every period of five years the municipality shall have the option of paying to the corporation the full amount of its investment and thereupon taking possession of the property, and thereafter operating it as a municipal industry, and in case this is not done, that the prices shall be determined for another period of five years, and the contract continued in force without further change.

Twelfth—That this system of public regulation is preferable to public ownership and operation.

NOTES AND COMMENTS ON THE ACCOUNTANTS' CONVENTION

BY A. O. KITTREDGE, C. P. A.

"Well, what did you do there, anyhow?" or some similar question, is likely to be the greeting of all of those who were in attendance upon the convention of the Street Railway Accountants' Association of America, as often as they are met by those who are interested in the general proposition of perfected accounts, and who were unable to be present. The subjects announced by the programme for discussion were such as are of interest to all street railway men. They are of special importance to those companies who have taken membership in the organization. But, at best, the attendance at the several sessions was only about one-third the membership. It would seem, therefore, that the question would have to be very widely answered if the general desire for information is to be satisfied. Right here becomes apparent the usefulness of the silent member, who takes notes while others talk, and the utility of the press, that makes known to all the results of his observations. What, then, was done by the accountants' convention? A verbatim report would fail to reflect the lights and shadows of the occasion, even though it recorded all the stated motions and faithfully reproduced the speeches. It is an effort to supply what the verbatim report cannot convey that these notes and comments are penned. First, let it be stated that what was done included a part of what was suggested by the programme, and much more that was spontaneous to the occasion. As I look back to the days devoted to the meetings I am inclined to the opinion that the less importance attaches to those matters which were in the original programme, including those that were covered by formal motion made and seconded, and the far greater importance to those matters which were unexpected, and which by the manner of their presentation amounted to little else than apropos suggestions and genuine thought provokers.

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There was more of the practical in the welcoming address of L. E. McGann, Commissioner of Public Works, who, as the representative of the city of Chicago, welcomed the accountants, than is usually found in such efforts. He invited the accountants, as well as members of the American Street Railway Association, to visit the City Hall to examine into the methods of doing business there in vogue, and particularly to inquire into the methods of granting railway franchises. He very appropriately remarked in connection with this invitation that the question of granting franchises is as great as that of accounts. He declared that much of the popular prejudice that exists with respect to such matters could be designated in a very few moments if only the methods were inspected. Only two or three of the accountants were able to find the time to accept this invitation, but those that called at the office of the commissioner reported both a profitable and highly enjoyable hour. President Calderwood's acknowledgment of Mr. McGann's welcome and invitation was in his happiest vein. In characterizing Minneapolis as a suburb of Chicago he touched the heart of every Chicagoan present.

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Several prominent thoughts were left in the minds of his hearers by the annual address of President Calderwood, among which were the following: The street railway business, notwithstanding the energy and capital invested in it to date, has not yet been developed, in the estimation of men competent to express an opinion, to exceed one-fifth part of its possibilities. Accounting is the vital element of all branches of business, street railways not excepted, and the economies of accounting, both as to the character of the results obtained and stated, and the cost of performing the work, are of the utmost importance every where. Keeping in mind the fundamental principle of comparison, President Calderwood, often complimenting the association on what has been accomplished in the classification of expense accounts, pointed out that before the association will have fulfilled its mission it must have a unit of comparison. Just what that unit should be he did not in the least intimate, leaving its determination to the association, to be developed, perhaps, by the discussion of Mr. Mackay's paper on "Car Mileage." The address also referred briefly to the action of the Association of Railroad Commissioners in indorsing the classification worked out by the street railway accountants, and also to the work of the secretary in the matter of blanks and forms. President Calderwood closed with a feeling appeal to the members of the association to avoid hobbies in accounting, and to be careful to give the managing officers of the several roads only such salient facts as are likely to be useful to them.

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The report of the executive committee presented by Mr. Wilson was a model of brevity. A description of it would require more words than the report contained. The committee held three meetings during the year, and had five mail votes, admitting thirty-four new members (companies). A change in annual dues from $10 to $20 was recommended. The question of a change in time and place of meeting, so that the accountants would not assemble when and where the American Street Railway Association was holding its sessions, was recommended for consideration. The books of the treasurer were reported to be correct. The secretary and treasurer's report, on the other hand, went into details, and occupied much more time in reading. A detail list of the thirty-four companies admitted to membership was given. The fact that both the great companies of New York City were included, and that London, England, and Glasgow, Scotland, were also represented was received with special gratification. The association has had a total of 103 members since its organization. Three have dropped out, leaving the membership at the time the report was written at an even hundred. There were several additions during the days of the convention. The financial report showed a deficit of some $75, which means that, with the rigid economy which has characterized the management from the start, many expenses belonging legitimately to the association having been paid out of private funds, the income does not suffice for the work of the body. This deficit was more than made up by voluntary subscriptions before the convention adjourned, and the proposition to double the dues (commencing Jan. 1, 1900,) was carried. One motive that influenced this latter measure, and which was prominently brought out in the discussion, was the tendency to consolidation among street railway companies, resulting in a lessening of the number of possible members. With an assured income of $2,000 for the ensuing year, as against $1,000 for the year just closed, it would seem that the work might go on without serious financial embarrassment.

The paper by Mr. Mackay, to which all had looked forward with interested anticipation, was in a sense an attack upon the "car-mile" as a unit of comparison, and a defense of the "motor-car-hour," with incidental reference to the shortcomings of such units as the "passenger-mile" and others more or less in use. Not a little interest centered in Mr. Mackay's account of the questions he had addressed to a considerable number of street railways throughout the United States and Canada, and the answers thereto. From these it appeared that out of ninety-four roads answering as to the basis upon which mileage is computed, seventy-three depend upon conductors' or motormen's reports, fifteen on foremen's, dispatchers' or switchmen's reports, and four upon time tables. Of ninety-seven roads answering the question of keeping a record of the mileage of each car, fifty-one reported that such records are kept, while forty-six replied in the negative. Of ninety-three roads answering as to means of verifying mileage figures, forty-five reported none but care in computing, twenty-eight depended upon time tables, eight on dispatchers' reports, four each on foremen's reports and pay rolls, three on motormen's reports, and one upon trip receipt returns. It further appeared that of ninety-seven roads answering the question of including "dead mileage" in their computations, fifty said that it was not included, thirty-six said they did include it, and eleven declared they have no dead mileage. In the matter of trailer mileage forty-six companies reported no trailers used, thirty-seven who use trailers more or less of the time, include trailer mileage in their figures, while eleven declared that trailer mileage was omitted, and one road reported that trailer mileage was taken at one-half. On trips lost, fifty-seven roads reported allowances, and thirty-seven said no allowances were made in this regard. The question as to what constitutes a car-day produced some peculiar figures. Forty-eight companies reported that "cars operated per day" is not used by them as a basis for comparison of earnings. Forty-four companies do use this unit, but give it different values. Thirty-one of these companies call the car-day eighteen hours, four put it at fifteen hours, and three have it at seventeen hours, while four others, being a single instance, each gave the figures sixteen, seventeen and one-half, nineteen and twenty hours. Two companies reported on the basis of miles in place of hours, giving the figures eighty and 115 miles respectively. These statistics are interesting, if for no other reason, because they show wide diversity in point of view, as well as the differences that exist in current practice.

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Mr. Mackay's conclusion from his investigation and study of the subject was that such mileage carefully computed, all dead miles included, and with the trailer eliminated, there would be available a unit uniformly applicable to all electric systems and available as soon as the question of speed is adjusted. In his remarks he had dwelt upon the question of speed as between city service and interurban cars, showing that increase of speed does not materially increase the cost of operation, and demonstrating that in the case of interurban cars running from two to four times the speed of city lines, the cost per car-mile would be less, while the showing on the basis of passengers carried would be more, by reason of the longer haul. The new unit, Mr. Mackay called the "motor-car hour," meaning car-miles divided by the average rate of speed. This unit he advocated using for both earnings and expenses, and in closing his address pointed out how various suggested difficulties could be met and overcome. That the convention did not agree with the speaker in his conclusions in all respects became apparent as soon as discussion was commenced. It also became very evident that there were almost as many views as there were speakers, thus demonstrating over again just what Mr. Mackay's carefully gathered statistics had proven.

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Mr. Vreeland, of the Metropolitan Street Railway Company, New York, who opened the discussion of Mr. Mackay's paper, took a somewhat peculiar, but extremely interesting, course to show why and wherein he could not indorse the unit named for use upon the lines within his control. His opening remarks were slightly biographical. He briefly traced his own railway history, by way of explaining how and why he was tinctured with some of the views which prevail among the managers of the steam roads of the country, in the matter of records and units of comparison. He described the peculiar conditions under which street railways in New York are operated. He pointed out that as many as 5000 horses are yet at work in the street car systems of the metropolis, and that both cable and electric lines are in use. Congested traffic is the rule on all the down-town lines at certain hours of the day. When a car starts out it is uncertain whether it will make the entire trip or part of the trip, because of being turned back by an inspector at some point en route. Speeds differ not only as between different lines, but as between different sections of the same line, and as between different hours in the day on a given section of any of several lines. In view of all these perplexing conditions the speaker declared that he had found the "car-mile" the only satisfactory unit of comparison, or basis of statement of results. He mentioned that the unit in use in New York is also in use in Philadelphia and some other of the large Eastern cities. No trailers are used in New York. Mr. Vreeland said that at present cars of various lengths are in service, ranging from 18-ft. horse cars up to the long double-truck electric cars on some of the more recently equipped lines. He said, in answer to a question, that no attempt was made to take the element of speed into consideration in the statistical statements of his company, and pointed out that it would be impossible to do so for reasons already mentioned.

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The one remark dropped by Mr. Vreeland that attracted most attention, and that was referred to most frequently in the discussion in the convention, and also in the talk of the accountants as they rode together on the excursions, was that in which the operating expenses of a steam road in a mountainous section were compared with those of a road in a prairie country. The first, he said, might show operating expenses of 80 per cent, while the other was as low as 50 per cent. This demonstrated not that the first was poorly and inadequately managed, but that the cost of hauling freight and passengers up heavy grades was more than that of hauling them over a level road. Computations by percentages, he pointed out, were never satisfactory, because in percentage statements it is impossible to indicate the conditions under which the traffic is conducted and the physical condition of the road and its equipment. The comparison of mountain and plain was very quickly grasped, and the illustration was frequently employed in enforcing what many members contended is a fact, that no single unit is possible, taking all the street railways of the country into account. Differences in roadway and equipment are indisputable. Weather conditions, as between the extremes of North and South, are facts to be considered, and numerous other matters that will occur to the mind of every practical railway man are to be reckoned with.

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Mr. Wyman, of the New Orleans Traction Company, thought possibly the motor-car hour might overcome some

of the difficulties encountered with the car-mile unit. Mr. Duffy declared that the motor-car hour would help out a comparison between the road in the Rocky Mountains and one on the prairies of Illinois. Col. Heft, of the New York, New Haven & Hartford Road, declared that the question is one that is governed entirely by the conditions which exist upon the road that is being operated. He said the motor-car hour on the New York, New Haven & Hartford Road would be very misleading, because during certain portions of the day two trailers are used, while during other portions, three, four, or even five, are employed, while in still other cases the motor-car alone is enough for the traffic. The car-mile unit has been adopted by his company. He remarked further that all such questions as the unit of comparison or basis of statement of results must be settled in the light of the conditions that exist on each of the several lines, and that no fixed or stereotyped rule is possible. He would cordially welcome a rule universally applicable, to be used alike by all companies, but from present light such a consummation seems well nigh impossible.

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Mr. Wilson, referring to the Boston roads, said that over 300 routes per day were run, all of them being different lengths, and such cars running at different speeds. The conditions are such that no other unit than the car-mile would answer. He did not think it fair to compare city routes with interurban routes. Each class ought to have comparisons of its own. The same unit was not equally applicable to both. Mr. Ross remarked that the question of the car-mile and the motor-hour is entirely a local one. He believed the ratio of expense to earnings to be the only proper basis of comparison. He did not think it feasible to compare a large road with a small one, nor yet a road where there is no snow to one that is obliged to spend a large sum in removing snow every winter. When Mr. Mackay introduced his second diagram, in which were compared results of different months having different incomes or earnings, but with practically unvarying operating expenses, the discussion waxed warmer. The diagram showed earnings of $100,000, $120,000 and $150,000 for January, May and July, respectively, and $60,000 operating expenses for each. The percentage of the latter to earnings was shown to be 60, 50 and 40 for the three months respectively. The earnings per car-hour figured $1.67, $2 and $2.50 respectively, the motor-hours throughout being 60,000. In explaining this diagram, Mr. Mackay pointed out the evident unfairness of comparing different roads upon the basis of percentage of expenses to earnings. To say that the month of May showed operations 10 per cent cheaper than January, as above, when the operation expenses were the same for both months, the amount of traffic or earnings representing the sole difference, would be absurd. Mr. Ross then asked why not make it on a per mile basis, instead of a per hour basis. Continuing, he enforced the point already made that there are different conditions distinguishing every road that is examined. He declared he could not see how the car-hour basis would bring the correct result. Mr. Mackay then alluded to efficiency of service, saying that in winter, when less cars are required, less are run. Mr. Hibbs, with, perhaps, a suggestion of impatience in his tone, here inquired if, as a matter of fact, there is any satisfactory basis of comparing roads that operate under different conditions?

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J. K. Newman, president of the New Orleans & Carrollton Street Railway Company, after explaining that a president must necessarily interest himself in the accounts of the property in his charge, said: "You may establish any basis you please, whether it be car-hour or car-mile, but you cannot compare different roads operating under unlike conditions with each other." He declared himself in favor of the car-mile basis, and then explained how in his own office the car-mile, the car-hour and the percentage method were all used, each showing some fact not revealed by the others, and, taken collectively, giving the whole situation in a form to be available to the management. Mr. Mackay here interrupted to the extent of declaring that in the light of the speakers who had so far discussed the question it was apparent that nothing had been accomplished. Mr. Wilson, by way of pacification, said that he did not think that the work of the association would be thrown away, even though no basis was arrived at. Mr. Dimmock then inquired as to the comparison of mileage to be made between a long haul and a short haul, and whether with a long double-truck car the mileage would be counted the same as with a single-truck car, if both went only 1 mile? Mr. Mackay answered in effect that the small car would cost less than the large car, but that there would be less efficiency, and accordingly that the showing would be more particularly in the earnings. The expenses would not show in the large car as they should. Mr. Dimmock next inquired if both cars, long and short, run one hour or any other period of time, would be regarded as running the same. He said he knew of some roads where the short car was counted double the long car. Mr. Mackay replied that the comparison should be on the actual time the car was out, without regard to the length of the car.

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It was left to Mr. Ford, of New Orleans, to close the debate, and this he did by pertinent references to what is the rule with his company in these matters. He believed it impossible to find a rule that can be considered as applying to all street railways in the country as a basis of comparison. While using the car-mile, it is his rule also to submit an analysis of the monthly results upon a percentage basis. His statement also shows the earnings per car-day of eighteen hours, and likewise the expenses per car-day of eighteen hours. Both earnings and expenses are shown per car-mile. Continuing, after mentioning that trailers are used on one line, he said: "I can see that on almost any basis it would be hard for us to compare with another road that is not operating under the same conditions." His advice to the association was to show the managers what the figures really mean. Let them have the comparison of one month with another on the basis of motor-car hours, of car-miles, of car-days, the earning percentages, the expense percentages, and whatever else is possible and appropriate.

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In an account of this nature, written largely from memory after the final adjournment, it is sometimes difficult to discriminate between what was said in the meetings and what transpired relating to the same subjects as they were talked over in the hotel lobbies. Perhaps it is not necessary to try to do so. All that Mr. Ford had said was cordially indorsed by Mr. Duffy immediately after adjournment and before all the members had got their overcoats and hats on ready for departure. He said he had been in the habit of displaying results for the benefit of his managers in just as many different ways as possible, in the knowledge that what was not clearly indicated in one way would be brought out by another. Mr. Harder, of Kansas City, offered remarks of like import, as did also Mr. Simpson, of Augusta, Ga.

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In the hotel a president and two accountants continued

the discussion of a unit of comparison to be universally applicable. The street railway president, who is also an accountant, did most of the talking. "Why," said he, "the proposition of a single unit is preposterous. There must be taken into account a lot of things, among which are the weight of the car, the length of the car, the horse power of the motor, the efficiency of the motor, the grade of road, the character and physical condition of the track, and ever so many more. A comparison, to be of any real value, ought also to include in some way a reference to earning capacity. I can readily see how a conference might result in fixing a unit for the car, and one for the track, another for the power, and one for receipts, and still another for time and wages of the operation, and no doubt as many more as are necessary, but to get an expression that shall include all these in one, and be fair in all cases, seems to me not only impossible, but an absurdity on its face. The variations in the underlying conditions, impossible of expression, would render comparisons on such a basis of no value whatever. It is barely possible, if the railway accountant had all the receipts of the road and the contents of the National Treasury, in addition, to defray the expenses of his department, and a span of life ten or twenty times the usual average, a plan might be worked out for grading or judging street cars and their operation, after the general method that obtains with horsemen, bird fanciers, dog breeders, and others. The perfect car would have a hundred points. So many of them would apply to length, so many to weight, so many to the motor, and so on. Then any given car could be justly classed, and all the cars on the road could be graded collectively as being equal to 50 per cent, 75 per cent, or 90 per cent of the ideal, as the case might be. The physical condition of the track and the grade of track might be similarly indicated. The element of speed could come in on some similar basis. The earning capacity could be likewise shown, and so on to the end of the list of all the elements the street railway man has to deal with. In short, if we had money enough and time enough a plan might be worked out by which any two roads to be compared might be measured up, just as contesting yachts are measured, with the result declared that the boom of one is 2 ins. too long, and must be reduced; that the water-line of the other is 6 ins. short, and accordingly more ballast must be carried, and that when these adjustments are made, still, to be fair, it is necessary for one to allow the other ten seconds' advantage in the race. Everything is possible, if only the time and money necessary to the undertaking are conceded. President Calderwood cautioned the members of the association not to ride hobbies, but the question that has been trotted out for exhibition on this occasion may prove a hobby that will run away with all who venture to test the saddle which it carries. The fact is that each railway manager is up against special problems of his own. No two lines present the same conditions. Each man, therefore, must work out his own solutions, by which I mean very largely, establish units of his own. Everyone can learn something of his neighbor, but the universal unit, by which Montreal can be fairly compared with New Orleans, and New York with Chicago, is a will-o'-the-wisp that it will not pay to run after."

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The report of the committee on a standard system of street railway accounting was in the form of a pamphlet eighty pages in extent, supplemented by a special sheet devoted to a classification of materials and supplies. The pamphlet showed on every page the evidence of the careful and conscientious work which has been given by this committee from the beginning. The report first recounted the conference of representatives of the committee with committees of the Association of Railroad Commissioners, and of the Association of American Railway Accounting Officials, held in New York in July last, the particulars of which were published in these columns some time since. It then set forth the action of the eleventh annual convention of Railroad Commissioners, held in Denver, Aug. 10, last. This amounted to an indorsement and acceptance of the classification worked out by the Street Railway Accountants' Association, after being modified in minor particulars, as agreed by the committees in conference. These changes are essentially three in number. First, substituting the term "operation of cars" for "car service" in expense accounts Nos. 16 to 24. Second, transferring "stable expenses" from account No. 30 to account No. 8, namely, "maintenance of miscellaneous equipment," and, third, putting taxes back into the list of subtractions, that is, among "deductions from income." The report proper was supplemented by a revised classification of construction and equipment accounts, being the classification adopted at Boston by the association and recommended for use, with the changes above noted properly embodied therein.

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The reasons set forth in the report which induced the committee to agree to the treatment of taxes above named, and which it appeared had been a virtual concession to the preconceived idea of the committees of the other organizations which it met in conference, deserve special attention. The Inter-State Commerce Commission established this form of statement a long time since. The steam roads adhere to this rule. The various boards of railroad commissioners have followed the precedent of the Inter-State Commerce Commission, and, while in principle, from the accounting point of view it is not correct, still it is better to conform to established usage. The convention approved of the report of the committee, and therefore for the time being, at least, the mooted question of the place to put taxes is settled. All this brings to mind a little matter in connection with office work, an allusion to which will serve to make clear a thought that is pertinent. The first typewriter that gained a position of favor in the public mind has a key-board that in economy of use is perhaps as much as 30 per cent or 35 per cent below ideal conditions. By the time that a competing machine having a key-board that was ideal in arrangement of letters, and which was scientifically correct, had got on the market the typewriter operators of the country had become so accustomed to the pioneer machine that they measured every new-comer by it. A little detail like 30 per cent or 35 per cent saving in motion of fingers, hands and wrists in operating was not to be considered along side of their blind prejudices. They were wedded to what they knew, and were too narrow-pated to even investigate something else, no matter what its asserted merits might be. The new key-board accordingly was unconditionally condemned. It was doomed to failure from the outset. The facts are that it was ultimately replaced on the new machine by something equivalent to that with which the public had been made acquainted by the pioneer machine. Meanwhile the makers of the latter, in a masterful piece of enterprise, shouted, "standard," and so well have they continued to shout "standard" from that day to this that all the typewriters before the public use a key-board, not ideal in arrangement, but conforming to what was established by the mechanical limitations of the first machine. Unborn generations of typewriter operators, it would seem, therefore, are destined to waste 30 per cent to 35 per cent of the energy expended in their work simply because their predecessors did not know a good thing when they saw it.

The parallel is apparent. It has become "standard" to deduct taxes from income, and therefore it goes.

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The election to honorary membership in the association of H. A. Davies, of Cleveland, was one of the pleasing incidents of the convention, as well also as a deserving tribute to the good work which an able man has performed in the interest of standardized methods. Mr. Davies has recently severed his connection with the street railway industry to become secretary of the National Carbon Company. For two years he served on the committee on standard accounts, and, in a letter, which he recently wrote and which Mr. Duffy read before the convention, he expressed continued interest in the purposes and work of the organization. Mr. Duffy made the motion to include Mr. Davies in the select class, heretofore composed of H. H. Windsor and Edward E. Higgins exclusively, and the vote in support of the same was unanimous.

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Mr. Brockway's report as committee on blanks and forms was a model piece of painstaking work. No less a monument to his indefatigable industry and energy was the collection of blanks which he displayed. These were presented in some twelve or thirteen huge volumes of the scrap-book variety, while a cabinet of the general shape of a safe, shelved off to contain them, represented their resting place when not in use. The safe-cabinet, of wood, was mounted on heavy casters and provided with handles for convenience in moving. The door, hinged in place, was fitted with a good lock. The blanks and forms displayed were casually examined by almost everyone present, and several attempted to go through the collection in a systematic way. Mr. Brockway's comments and criticisms presented at the conclusion of his report were received in good part, and in several instances were applauded. The usefulness of this collection would seem to depend upon the circulating library feature, far more than upon the display at the stated conventions. How the duplicate set of blanks can be obtained for examination by the members was carefully set forth in the report.

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Not a few expressed serious disappointment that the promised paper by Mr. Barnaby was not forthcoming. It was evident that it had been a drawing card in the programme. Several members declared that to hear it and the discussion likely to follow was what brought them to the convention. There was manifested the disposition to discuss the question of "Store-Room Accounts," paper or no paper, but time did not permit. A number of questions were put and answered, among the most important of which was that by Mr. Newman. He inquired how many present kept store-room accounts, and how many did not. The show of hands in response to the president's suggestion of how the question should be answered indicated a nearly even division. This seemed to show that progress is being made in one direction, at least, for, as I recall it, a similar vote taken at Niagara Falls showed Mr. Ross, of Montreal, as almost the sole representative of store-room accounts at that time. It is true that the association is much larger now than at that date, and it is also true that the composition of the convention on the present occasion was more representative than on the former one.

The report of the nominating committee, to which had been entrusted the selection of a ticket to be balloted for, was accepted by a unanimous vote, and the secretary was instructed to cast a single ballot for the officers thus nominated. This vote placed C. N. Duffy in the presidential chair, thereby putting at the head of the organization the man whose capacity, industry and unselfish devotion to the cause he has had so sincerely at heart, have done much to bring the association to its present position of vantage and success. In the dual position of president of the organization and chairman of the committee on standardization of accounts, Mr. Duffy for the ensuing year is likely to find abundant opportunity for continuing the work for which he is so well qualified. The secretary-treasurership remains with Mr. Brockway, who has learned the ropes, and knows just how to discharge the duties of his office to the satisfaction of all concerned.

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The convention finally adjourned without, however, anything having been said about accounting applied to street railway operations. It is true, "accounting" as a term had been frequently employed in connection with various bookkeeping details. No one, however, had seemed to see the opportunity that exists for using what has been done by the association to date as the foundation of an accounting system, which by its analytical completeness shall give the management all those results which it wants, expressed in the simplest possible form, and which by the logical arrangement of its parts, established upon a correct scientific foundation, shall operate with the minimum of clerical labor. Ideas or methods that are in direct sequence to single entry principles predominated for the most part. The relation of the profit and loss statement to the balance sheet of a company was not once alluded to, although several questions that were broached, and which were left open, could have been easily and finally settled in the light of this fundamental principle. No one seemed to think of the importance of modern mechanical expedients and aids in the office—that is, labor-saving devices—and the possibility—much less, the necessity,—of adapting them to use in connection with a scientific accounting system for street railways, in order that the multitude of details existing in this work, evidenced by the classified list of expense accounts, may be handled at the smallest possible cost.

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Those mercantile and manufacturing establishments which have given attention to these problems, although, perhaps some of them are weak in the matters of co-ordinating their expense items, are, as a fact, in possession of far better and and more complete statements of the progress of affairs than are the average street railways of the land. They have the further advantage of accomplishing their results with relatively a very much smaller expenditure than the railways. Like results and like economies, however, are in the reach of the street railways if only they will seek them along the paths which accountants in other divisions of industry have discovered and have blazed for the guidance of their fellows.

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However, comparisons in general are odious, and criticisms of any sort at this time and in this place may seem unkind. Suffice it, therefore, to say, in conclusion, that it is evident, from the work done at Chicago, that the association is making progress. Its members, individually and collectively, entertain broader views at the present time of the work in which they are engaged than it was possible for them to have three years ago or before the association was formed. Altogether, there is hope for the future. The time will surely come when the association will be able to put aside the swaddling clothes of mere bookkeeping classifications, with which it is at present encumbered, and undertake the higher work of investigating and promoting scientific accounting and its economical application to the industry in which they are engaged.

PAPERS READ AT THE CONVENTIONS

Investments in Street Railways, How They Can Be Made Secure and Remunerative

BY CHARLES T. YERKES

The subject you have given me for consideration, namely: "Investments in Street Railways: How They Can Be Made Secure and Remunerative," is one in which I take great interest, and for a very good reason—about all the investments I have are in street railway securities. You can therefore see that my faith is great, for it is from our actions that we are judged.

My experience with street railway securities dates back to a period almost forty years ago, at which time street railways were in their infancy—in fact, you may say, in their swaddling clothes. It was in the early sixties, when the scientific operating of street railways was unknown, and, in fact, not dreamed of. In those days the men were worked from sixteen to seventeen hours out of the twenty-four, and they, as well as the officers of the companies, did not seem to be aware of the fact that this condition could be bettered. The roads themselves were of a cheap character, and, while intended to be permanent, they were far from it, but were equal to the demands of the public and requirements of street railway transportation. In those days even a car register was unknown. The street railways in each city were owned by a few influential persons, generally men of large means, and the stocks and securities of the companies were but little distributed. Few people knew of their value or cared to have much to do with them. To hypothecate street railway stock as collateral with banks was unknown, and it was not until ten years after, in the early seventies, that the banks would look at them. The dividends in the meantime were generally fair, particularly with companies doing a large business in the thickly populated part of the cities in which they were located. To my mind, the chief reason of their unpopularity was that the building of street railways in those days was always opposed by the people in the vicinity of the location, and particularly on the streets where the rails were to be laid. I remember very well the first track laid in the city of Philadelphia, where I then lived. It was the Fifth & Sixth Street line. The people tore up the track at night which the company had laid during the day, and it was not until after there had been several riots and the authorities had awakened to the fact that the law must be sustained, that the company was able to finish its road. The Chestnut & Walnut Street line in that same city was bitterly opposed by the citizens, and everything was done in the Legislature and in the courts to prevent the charter from being granted and the tracks from being laid; and this has been the experience in most all large cities. Consequently, the people who were promoting the laying of street railway tracks were looked on as a sort of "free booters," and their securities with much distrust. To some slight extent this feeling still exists, notwithstanding that there is scarcely a road which was laid years ago that could be taken up to-day without great objection being made on the part of the people.

It was not until the early eighties that street railway securities were seriously considered as popular investments, and since that time their popularity has continued to increase as time developed the great resources which lie within them. The quality of the street railway plants of those days consisted in the kind of track, the condition of the cars and the class of horses which were used. These differed most materially. On some roads it looked as though the cars were never repaired or painted, and the broken-down horses were very much in the majority. Added to that was the uneven rail, spiked to a string-piece, which almost made the rider seasick during a passage over it. Then again, there were other companies where the track was well laid and kept in good order, the cars in good state of repair and well painted, and the horses of the highest class for their work. These two conditions were almost invariably the result of the adversity or prosperity of the different companies, and while the latter class—that is, those that were prosperous—came to be sought as an investment sooner than the other, the anxiety of the public to so invest was never active. But about 1880, when consolidation of different roads came to be more in fashion and the economies produced thereby and also the studious consideration which was given as to how to operate roads, it was more a matter of reality. The attention of capitalists and the people generally was drawn to the stocks and securities of street railway companies, and this condition has been on the increase ever since that time. The fact that great improvements have been made after the horse was relegated to a past era has had much to do with this, and naturally so. The mechanical propulsion of street cars has attracted the attention of the whole civilized world, and the question naturally arose in the minds of those who witnessed these changes, and who had money to invest—"Isn't this a good place to invest our money, and isn't there profit in it?"

The change in the mode of propelling the cars and, in fact, the whole outfit of street railways, has created what might be safely termed a "revolution." To look into the history of all the street railways of twenty years ago and see the changes which have taken place is certainly wonderful. I can see before me a plant that was run with one-horse cars, a driver, no conductor and a pay-box in the front of the car, where the passenger was required to advance and deposit his fare. I see that line changed to two horses and obtaining the dignity of a conductor to collect fares from passengers. That was a great improvement, and then we had straw in the bottom of the cars in winter—not over clean, because we could not afford to put fresh straw in every day, but still this was a luxury,—an oil lamp at each end of the car, which supplied the double purpose of lighting the car and showing the signal on the outside. We went at the rapid rate of 6 miles an hour when we could make it keep on the track. The motion of the car was most agreeable to a person who desired to ride on the billowy waves. We see this changed so that the track was smooth, the straw was taken out, floor always clean, and a stove, giving comfortable warmth placed therein in winter time. This was advanced luxury. We were pleased with all this, except when the snow would come, or the days were hot in summer, when the horses were not able to pull us to our destination.

We see another change—the great power of electricity was brought into use, the horses were gone, and instead of making our 6 miles an hour we would go twice that rate. The oil lamps were removed and electric lamps put in their places. As like begets like, the condition of the cars was improved; cleanliness—always an adjunct of electricity—was substituted for uncleanliness. The districts of the city were expanded, lines were made in the suburbs, creating new towns, improving the property of the people, increasing the amount of the assessment on real estate, until we seemed as though we were living in another world. Aladdin's lamp did not produce any more wonderful changes, and this could not have been done had it not been that the attention of investors, both great and small, had been attracted to the street railways.

And what of the great benefits to the people. Instead of the slow, uncomfortable manner of travel, rapid and easy means are given. Points that could not be reached with the old system are brought within easy access. Everything is better and cheaper. While in days gone by it cost 5 cents to travel 3 miles, with the new improvement four times that distance can be traveled for the same money. Then it cost a person to ride about 2 cents a mile; now it costs ½ cent per mile. Why then, I ask, should not a continuance of this condition be encouraged?

And I now come to the second and most important part of my subject: "How Can They Be Made Secure and Remunerative?" To my mind, security is most to be considered. The remuneration must be brought about by hard and close attention to the corporation. We cannot do much to increase our receipts. They come from natural causes, but we can control our expenditures, and that really, together with knowing where and what to do, is the science of street railway management.

But in regard to making them secure, we must depend very much upon the justice of the people, and the fact that we, as managers, are willing to do what is fair with the public. There seems to be an idea in the minds of many legislators that a street railway is a very simple affair and of very little account. This feeling has been engendered by their knowledge of long ago, and that knowledge has not advanced with the change in street railways. In fact, these changes have come and been accepted as such a matter of course that little attention is given to their worth.

The most important matter in regard to the security of street railway securities is the length of charter under which they are operating. This question is of as much importance to the people as it is to the street railways themselves. The longer time that is given to a charter to run, the greater improvements and the more expensive plant can be operated by the companies. That is to say, it can be made more permanent than if the charter was of short duration, and naturally it would be. If a company has a charter with but a few years to run the improvements will be of a cheap

character commensurate with the length of that charter, and the better the improvements the better it is for the people. Not only for those who own property, but for those who ride and have no property. We see this exemplified daily. Let us ask the question: How many bridges of iron or stone would the steam roads have if their charters ran for only a few years? There would certainly be none, and the speed of trains would be greatly reduced. Years ago 30 miles an hour was considered rapid traveling, with 20 as an average. Now the rate has been run up to more than 80 miles, with 45 miles as an average on fast trains. This latter condition would never have existed if the steam roads had not had charters long to run. Why should not the charters of street railways be equal to those of steam railways? In fact, considering them all in all, they should be longer. The cost of a steam railroad of to-day is not nearly equal to the cost per mile of a street railway, even counting all the appurtenances that go with each. One hundred years has been the time granted in this State for a charter to a street railway, and the municipality grants an ordinance for twenty years. That this was wise or unwise at the time that period was designated, I will not argue, but considering that it was a proper time for what we had in street railways then—rails weighing 40 lbs. to the yard, laid on a wooden string-piece; this string-piece laid on sleepers 5 ft. apart, cars of a cheap class, a lot of horses, good ones, if you please, and a 5-acre lot in the suburbs, where the car-barns were erected,—this practically constituted their outfit. At the end of twenty years, if there was to be no renewal of the ordinance and the charter was allowed to lapse, what would be the loss? The track, considering that it had been kept in good order, would sell for, say 20 per cent of its cost; the cars for about 30 per cent of their cost, the horses for about 25 per cent of their cost, and the real estate, which had been bought by the company twenty years ago, and where in all probability a settlement had since gathered, would sell by the front foot, realizing without doubt twenty times as much as it had cost. There, you see, there would not be much loss if this road had to be given up. But what are the conditions to-day? The street car tracks are laid with heavier material than that used by the steam roads, the power-houses cost hundreds of thousands of dollars, where the old structure cost but a few thousand; the electric plant on the cars and in the power-houses and the wires and poles cost immense sums. So that it can truly be said that the electric plant cost more than ten times as much as the horse-car plant. If, therefore, it was right to give a horse-car plant a charter for twenty years, the electric plant should receive a charter for 200 years and city ordinances should correspond.

It has been argued that if grants were made extending over a long period of time, other means of transportation might come into existence and these charters would interfere with the adoption of these improved methods.

Let us suppose fifty years ago perpetual privileges had been given to operate exclusive omnibus lines in this city, or privileges of the same character had been given to operate ferries across the Chicago River. What would they be worth to-day? Long ago the charters would have been forfeited, simply for the reason that improved methods had rendered them worthless.

But while I feel that the Legislatures should treat the street railways fairly, I also feel that the street railway companies should treat the municipalities and States in the same spirit. I believe that a fair amount of the earnings of the companies should be given to the municipalities in which they are located. There is no doubt but that the street railways are of great benefit to these municipalities and to the people generally and to the property owners, but at the same time it is my opinion that a spirit of liberality should be engendered by the street railways toward the municipalities, for the reason that it is through the municipality that they are permitted to transact their business. It is a mutual benefit, with the burden on the corporation. There is no doubt but that the extending of the lines in a large city is a great hardship to the railway company. There is little money to be made out of them for years, and while the company is waiting, the property owners and people are being benefited. The very mention of the fact that a line is to be extended in a certain district causes advances in the value of real estate, and these advances are emphasized when the extensions are really made. There is nothing that has added so much to the health of the inhabitants of a city as the extension of street railway lines. In this city the tenement house district, which would have been a perfect pest-hole, is scarcely to be found. The prairies have been covered with street car tracks, which forces the opening of streets. Cheap lots and cheap homes for the working people and the poorer classes, as well as the well-to-do, are everywhere in evidence. While there may be efforts to influence the people against street railways, they cannot but see these conditions, which are so plainly visible to them, and seeing them, fail to properly appreciate them.

I believe in educating the people, of whom the legislators are the representatives. Every State wherein there are large cities, which necessarily have important street railways, should have a commission appointed to ascertain the condition and requirements of this industry. The commission should be appointed by the Governor of the State, and should be composed of intelligent business men of first-class standing, who are not interested in street railways. Under no condition should a person holding office, or who is ambitious to do so, be named. A man of this character is never to be trusted in any affair where courageous opinions are expected. The reports of such committees should have great weight with the legislators.

I believe that all corporations which receive their life from the commonwealth should be subservient to that commonwealth, that there is nothing in their formation or general business which should not be reported to the proper authorities and be subject to investigation. I believe that the law should provide that an intelligent commission be appointed by the Governor of the State, in the same manner as is now done in this State in regard to the commissioners of the park system. The duties of this commission would be to see that the laws concerning street railways are carried out and that the companies have the protection to which they are by law entitled. The commissioners should have terms of fifteen years, so as to insure their becoming experts, and receive such salaries as would enable them to live well and take care of their families in a good manner. They should understand, when appointed, something of the street railway business, and as years pass by their knowledge would increase, as also their worth. They should have the power to dictate to the railway companies where new roads should be laid, if at all, and also the kind of new improvements to be used when a railroad contemplated making any change in motive power. They should have the power to regulate the devices to be used for saving life and preventing accidents. With an intelligent, honest commission of that kind, street railway managers would be made more comfortable, the people would be benefited and the securities of the corporation would be more solid. The advice of these commissioners would be sought, and the advice of such men with the experience and knowledge they would naturally have, would be most valuable to any railway manager. Their reports would be explanatory, and much of the ignorance regarding street railways, which is fostered by our enemies particularly in this part of the country, would be done away with.

To make securities more secure we must have these different matters fully understood. We must do our business in a straightforward manner, with due consideration to the public, who are our patrons, continuing to increase facilities as opportunities offer, and adopting the most improved kinds of transportation which experience teaches are proper. And last, but by no means least, holding with the kindest regard our employees, who are faithful to us to the end, that there may be perfect harmony between them and the management, and seeing to it that our corporations are able to earn honestly a fair remuneration for the money, time, experience and labor that have been spent upon them.

Train Service and its Practical Application

BY IRA A. MCCORMACK

It is an unquestioned fact that a well arranged train service is as essential to the commercial success of a street railway enterprise as is expert management of the power-house and equipments, the use of economical machinery or any other vital detail, and it is perhaps one of the hardest problems that street railway managers have been called upon to solve.

In presenting this paper the writer would not wish to be understood by the members as presenting a sovereign solution, but rather as submitting methods which he has found to be useful in cases that have come under his observation. The conceded fact that all discussions must have a nucleus and that the experiences of no two persons are alike, whereby the natural law obtains, that one is certain to learn something from another, must be the apology for what follows.

In mapping out the train service of street railway systems in a large city the problem will be found very intricate. Some lines have continuous traffic at almost uniform proportions at all hours of the day; some have rush hours at morning or night or both; some have hours of over-crowding at more frequent intervals, and with some the traffic is exceedingly irregular. There is the passenger who rides but a few blocks; there is the through passenger and transfer passenger. The problem is further complicated by the location of parks, places of amusement, shopping or residential districts, branch lines, and the summer and winter seasons, and it is perfectly evident that no general methods can be laid down.

The problem naturally divides itself into two parts; first, the ascertaining of the conditions of traffic which are to be met, and second, the means for meeting these conditions in the best possible manner.

No matter what the character of the service may be, suburban, excursion, or local, there is one ideal condition to be aimed at, and that is that each car be full of passengers. If there be less than a full car the equipment is not run to best advantage, and fewer car miles would render the same service, while if the car is crowded, the traffic of those who dislike a crowded car may be lost and the management is likely to be criticised unfavorably by the public and press. It is important, therefore, to determine with as much accuracy as possible the traffic conditions, that is to say, how many of the public want to ride, where they want to ride, where they wish to take the car and where they wish to leave it.

For convenience in making specific illustrations and also to enable the discussion of different conditions as far as possible,

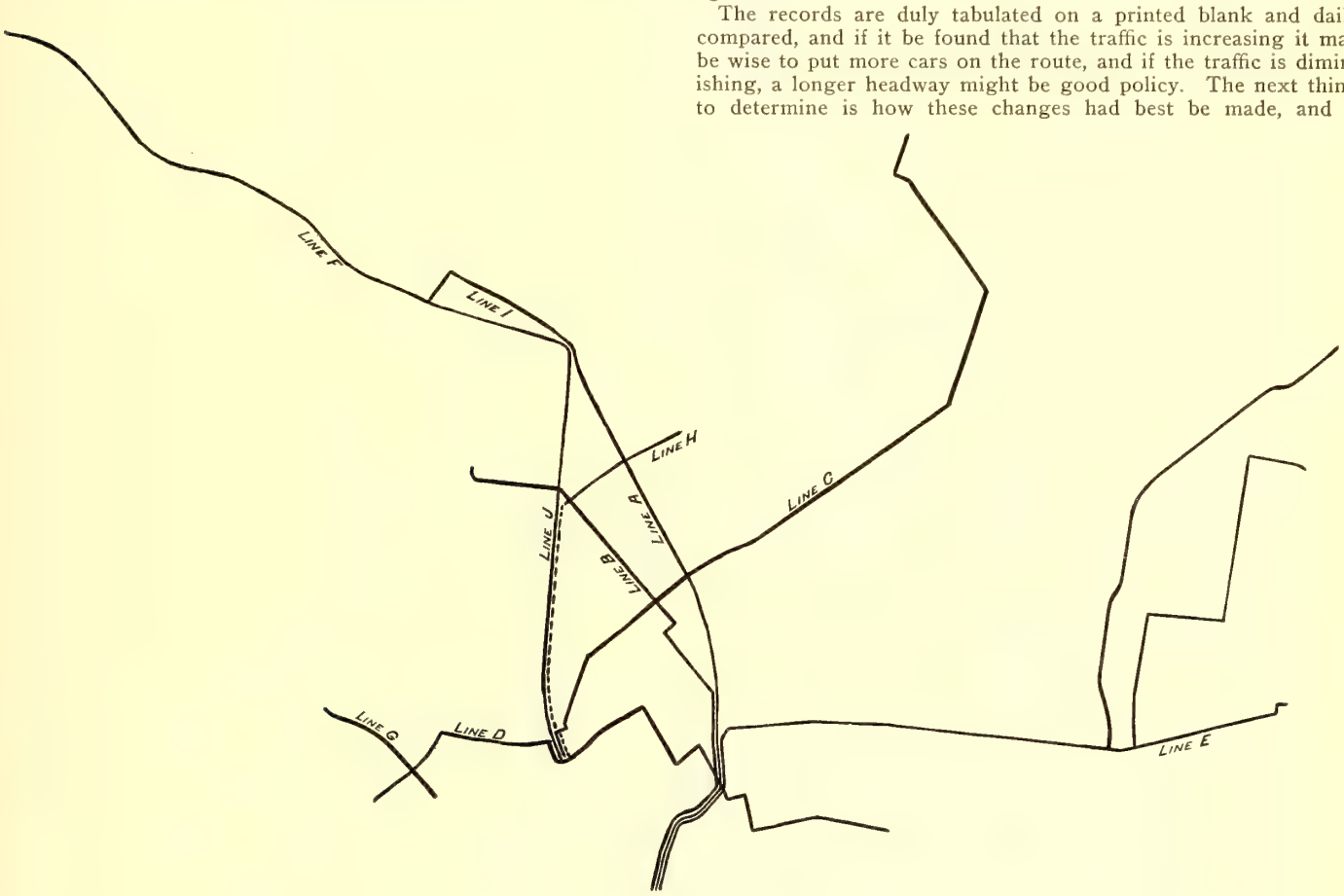


DIAGRAM OF LINES SERVED

the following different characters of service may be cited:

Line A.—A line of heavy traffic in shopping districts in close competition with elevated railroads.

Line B.—Doing a heavy traffic in residential districts without competition.

Line C.—A cross-town line serving as a transfer system to connect other lines together and add to their attractiveness.

Line D.—A cross-town line connecting with centers of transportation, such as railway stations, ferries and the like.

Line E.—An excursion line, half of which is residential, on which the excursion traffic varies with the season.

Line F.—A suburban line of considerable length and operated at moderately high speeds.

Line G.—A line not over remunerative and operated for such reasons as public or press opinion, or hope of its future value.

The conditions that will obtain on these various lines are obviously widely different. It will be first necessary to evolve a method of determining what these various conditions are.

At the start, the manager is as helpless as an outsider. He can merely generalize and deduce a time table which to his best knowledge of the system will fit the conditions, but having thus formed an existing time table the knowledge of how it operates and how it can be corrected is rapidly and easily acquired by the best of all methods, that of practical experience. In collecting the necessary data a method which the writer has found of value is to provide each car conductor with a blank which contains spaces on which the number of passengers carried on the car between the termini can be conveniently listed and totalized. This slip is conveniently arranged so that on it are registered the following data:

1. Name of operating line.
2. Run number as per time table.
3. The date.
4. The time due to leave terminal.
5. The actual time of leaving terminal.
6. Passengers carried on down trip.
7. Passengers carried on up trip.
8. Tôtals.

This slip, signed by the conductor, is turned into the proper office. This, of course, gives general information as to the traffic. It shows whether it is heavy or light, whether it is falling off or increasing, whether it is increasing on the down or up trip, and also gives a check on the register. This information is usually collected in one way or another by almost every street railway management.

The records are duly tabulated on a printed blank and daily compared, and if it be found that the traffic is increasing it may be wise to put more cars on the route, and if the traffic is diminishing, a longer headway might be good policy. The next thing to determine is how these changes had best be made, and if possible to ascertain the specific reason for the increase or loss in traffic. To do this the inspectors are provided with blanks and are sent out on the line. Various points are chosen, and at those points the passenger record is very carefully taken. This slip provides for the record of the following data:

1. The place of record.
2. The name of the line.
3. The date.
4. The observed headway.
5. The number of passengers on the cars at points of record.
6. The fares rung up on the register at record points.
7. The totals.
8. The general average of these quantities.

On the back of the slip the inspectors find the following instructions and queries to be answered:

Note. Inspectors will be careful to show correct count. Make report plain and clear, but use as few sheets as possible.

If record of but one line is being taken, show the name at top of page.

If record of several lines is being taken, indicate name of each line in blank space at head of column.

If conductors are found short, give conductor's badge number and state particulars.

Give any and all information of this report that will prove of value in permitting change of headway and condition of cars, etc., to improve the service.

Is the headway well maintained?.....

Is there enough or too much service at any hour?.....

Are cars running to proper terminals to accommodate the public?.....

General condition of cars.....

Conductor found short

Car No. Conductor No. Particulars.

It is sometimes instructive to plot the results in the form of

curves. Suitable section paper is selected and the number of passengers per hour are plotted as abscissae, and the hour of the day as ordinates. This gives opportunity to examine a large number of figures at a glance, and is sometimes useful in drawing general conclusions.

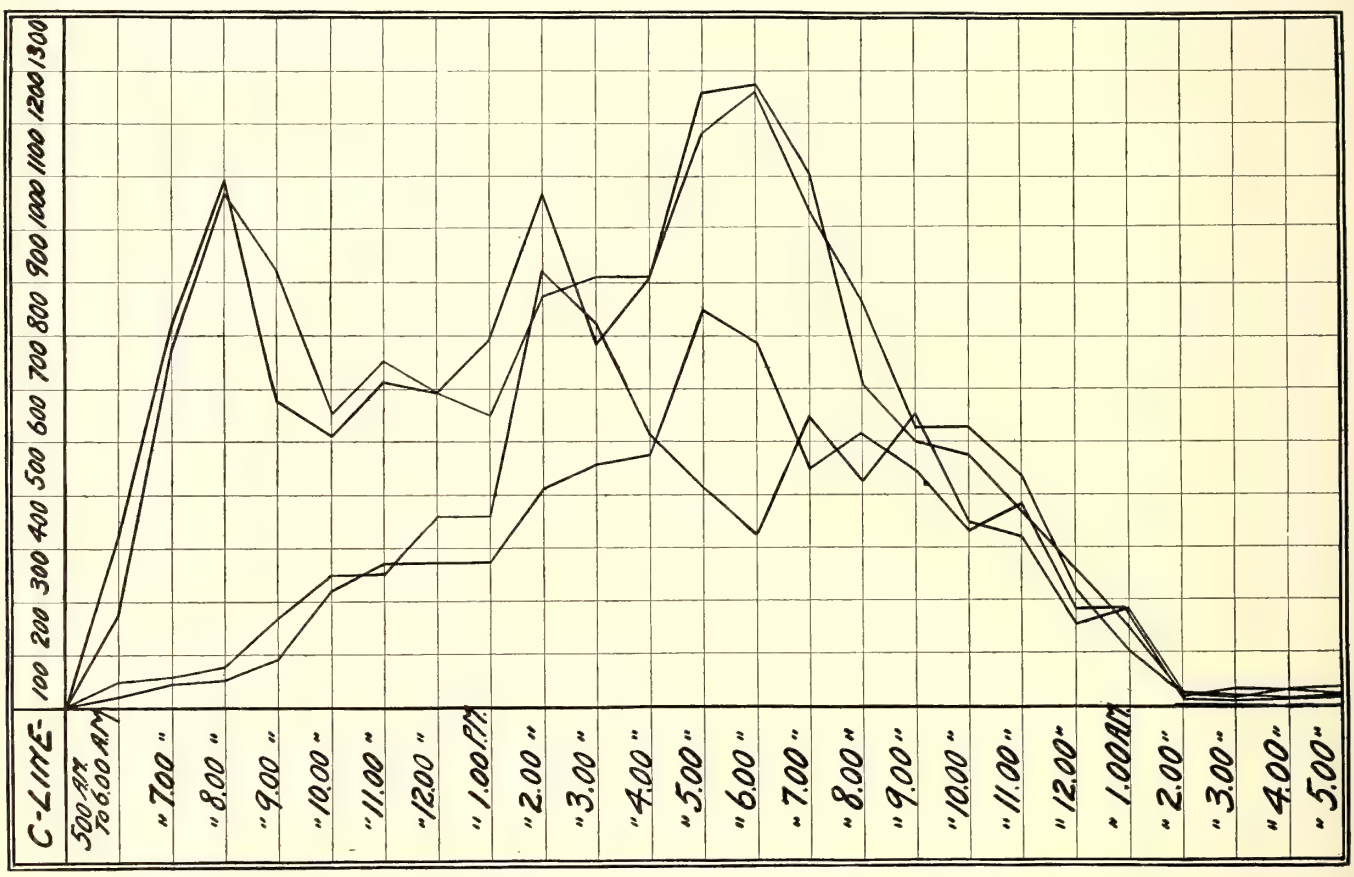
These reports give much valuable information. They show the average number of passengers on the cars at the point of record, thereby determining whether the cars are overcrowded or not. It gives the total number of passengers carried up to the point of record and an approximate idea of where they left the car. If the traffic on the line is irregular it shows in a measure where it is heavy and where it is light, according to how near together the points of observation are selected, and it further shows the exact time at which these traffic conditions obtain.

In order to obtain trustworthy results it will be necessary to take these records for some time, possibly for a week, for a single record might be completely misleading, because of condition of weather or a yearly Sunday school picnic or smilar flush of traffic not likely to be repeated. It remains to be said, however, that as a rule weekly records check very closely. Having certain rules, which long experience has shown are almost imperative. There are certain traffic conditions which are temporary, and others which are permanent. There are competition conditions, and in many ways there is much else besides these records to consider.

For instance, I have classified those who travel on street cars as follows:

1. The workers, who travel from 5 to 7.
2. The clerkers, who travel from 7 to 8.
3. The bankers, brokers and proprietors, who have sometimes been facetiously termed the "shirkers," who travel from 9 to 10:30.
4. The shoppers, who travel from 10 to 12.

The greater part of these people remain in the city, coming back in one grand rush hour, which begins between 4 and 5, and reaches its culmination point a little after 6, and sometimes lasts until after 7. Then the theater and places of amusement begin to influence the traffic, which swells in the direction of the metropolis till a little after 8, and outward again, from 10 to 12. The regular night hawks, who take care of the traffic



METHOD OF TABULATING RESULTS

obtained a fair average of the number of passengers to be carried between two points, the proper headway between these points can be computed, and the next question that obtains is how to get this headway.

It may be advisable actually to put on more cars, or again it may be that the increased traffic occurs between such points on the line when it would be advisable if possible to loop down upon this section a few more cars from some adjacent line. This would be desirable especially if at the corresponding section on the adjacent line the headway was found to be too short.

So far, the method seems to be a simple mechanical process in which the steps for remedy are as obvious as in a station test. It is unfortunate for the sake of simplicity that this is not the case. In making a station test the diagrams and curves obtained invariably show the condition of the machinery or apparatus tested. The curve traffic above described would show the condition of traffic were it not for the fact that the public and many local conditions, which would seriously effect the traffic, must be considered. As an instance of this, when the information is being gathered to plot out the curve traffic, a fair, festival or entertainment of some nature may be in progress, which would cause traffic to go in the direction of the entertainment. Therefore, the curve traffic without considering the local, and all traffic conditions, might lead to an erroneous conclusion. The maker of a new time table must know the lines, root and branch. There are of the city between 12 and the early hours of the morning, it is usually wise never to disturb.

It is sometimes possible to meet the traffic conditions on a line without increasing the car mileage, by simply changing the character of the cars which are running upon the line. Long cars with double trucks are advisable on through traffic, and it should be the aim of the manager to run them at the times when they will collect through passengers. Short cars should be run for the convenience of short riders, and if it be found on any line that at a certain hour of the day a large percentage of short riders take the cars between certain points, a little ingenuity in adjusting the long and short-car service may frequently accomplish a great deal.

On Sundays and holidays the traffic conditions change radically. On some lines the traffic falls off a great deal, and on others it becomes exceedingly heavy. On lines running to places of outdoor amusement, such as parks, beaches, race tracks and the like, it is well to watch the weather, for it is obvious that if the day is pleasant the traffic will be much heavier than otherwise.

The best men are picked out to run on the lines of heaviest traffic, in order to have the benefit of their experience in handling the public, knowing that they will be more safely handled and more convenient service given them than if a poor class of motormen and conductors are operating the lines of heaviest traffic. A street railway manager would—were it in his power—locate

amusements and entertainments upon the best built and best equipped lines, for it is on these lines that the best service to the public is given.

Of the last statement it may well be said that the duty of a superintendent may be divided into two equally important portions. First, the arrangement of the system for the good of the company and public, and second, for the good of the men. These duties are not all incompatible, although by some this has been thought to be the case. It is very important for the company to have a force of competent, well satisfied and not overworked men. I contend that a man earning $40 a month and who is satisfied with his surroundings and conditions is a better employee for any company or corporation than a man who is earning $500 a month and who is discontented and dissatisfied with the surroundings, and, on the other hand, it is important for the men that the company shall be prosperous, for otherwise there will be less regulars and more trippers.

It frequently happens that the time table of a road can be corrected to meet the conditions of traffic by delaying the cars at certain points and increasing their speed at others; thus, for instance, it has often been found beneficial to instruct the motormen to stop their cars at junction points and wait for the car on the cross road, in order to exchange transfer passengers, or perhaps to wait a stated time, say two minutes, and then to proceed. It is plainly to the advantage of the road to exhaust all such devices as this before actually running more cars to meet the increased conditions of traffic. If more cars are actually to be run the question should then be considered as to what kind of cars, that is to say, long cars or short cars, and if the road be a main artery receiving the traffic of several branches or cross lines, whether these cars should be main line or branch cars, and if branch cars, which branch.

From a practical knowledge of the conditions, and from the data as has been outlined, a new time table can be made up, but it is not to be expected that it will prove of lasting value. The traffic must be carefully watched; the conductors' reports carefully compared, and whenever an increase or decrease of traffic is shown, the advisability of sending out inspectors with passenger record slips should be at once considered.

Traffic may be increased temporarily, particularly in manufacturing districts, when some large manufacturer will put at work a large number of men, or may be decreased temporarily by the closing down of an industry, the workers of which industry were mostly patrons of the road. By the use of conductors' slips the superintendent will be at once advised of these changes.

These conditions show the necessity of an intimate knowledge of the entire system. The management, however, should not deceive itself in case mere adjustment is not successful. If the cars are still crowded, in spite of all manipulation of length of car and variation of headway, more cars should be put on.

However instructive it may be to make general remarks on these matters, specific cases and their solution are always interesting, and to provide this the writer has selected from his records a number of cases illustrative of different conditions which may be of interest to the members.

A practical condition that obtained recently was the case of a line, H, which formerly had its route down another line, J, to a ferry terminus. The inspector's report showed, first, that it was necessary to increase the service on a certain intersecting line, B, and second, that a great many passengers from line H transferred to line B, in fact, more than continued down line J. When these facts were known the solution was obvious. The traffic of line H was cut off from line J and sent down line B, thereby giving the desired service, avoiding the transfers, and only very slightly increasing the mileage and not at all increasing the number of trips or equipments.

Another interesting case may be cited of a line I, a short line running from the terminus of a main artery upward into the country. The traffic was found to be so great that it was necessary to diminish the headway. This was done by running some of the main artery cars over line I. This had the effect of slightly increasing the car mileage, but did not require any new equipments and gave through service from terminus of main artery to the further terminus of line I, which was beneficial.

Another interesting case is that of a cross-town line, C. This line carries through passengers to its terminus and also acts as feeder to the various lines which it crosses; therefore, in one portion of its length the traffic is exceedingly dense and the headway must be correspondingly short. This object is simply attained by running short lines which travel back and forth through the sections of heavy traffic, and the through service is run on a headway suited to fit the conditions of the more extended portion of the line, and also helps to diminish the headway in the more heavily patronized sections. Line D—the other character of cross-town line—is also very interesting. The line starts at a railroad terminal and distributes incoming passengers to their destinations. It passes through a large factory district and transfers a great many passengers to other lines crossing it at different intervals; it also traverses shipping districts and gives access to the docks. It is essentially a day line, and it has been found that in such a case the traffic has been met to best advantage by a practically uniform service. This is a unique exception in railway work. As a final illustration we may take a line, E, on which the traffic varies. The first section of this line is residential. The last is excursion. In the summer season the headway on the residential district has to be quite short to accommodate both classes of traffic. In the winter season the conditions are met by cutting the line in two and running a suitable headway through the residential district and a shuttle service of a few cars over the excursion section.

The street railway manager will easily see that these methods are typical, but by no means exhaustive. There are many methods of manipulation, and the opportunity for ingenuity on the part of the maker of the time table is exceptional.

Besides ascertaining the traffic conditions on the various lines it will be found necessary to pay strict attention to the actual management of the system, in order to obtain the train services that may be desirable.

In the first place, the power-houses must be located at such points as to conduce to equal distributions of voltage. Low voltage on any line means slow time, no matter how good the motorman or the equipment, and everything that may produce this trouble should be carefully avoided. Every precaution must be taken in the operation of the power-house to prevent shutting down. Power-house attendants often become careless and are slow in replacing a circuit breaker when it is blown out, not realizing that they may be wasting the time of as many as 1000 persons. The writer has known cases where the circuit breakers of two different lines were thrown at one time. The man who watched only noticed one of them, and, replacing that, failed to close the other, resulting in a most serious delay to the line which it supplied. It has been suggested that a switchboard should be equipped with an automatic device, which, in the event of a circuit breaker being thrown, would close a circuit and cause the ringing of a large gong, which would show to the switchboard tender or employees of the power station, whose duty it is to see that the circuit breakers are kept in, that there is some breaker or some line, which is not furnished with power. In this and in scores of other ways the station attendants are responsible for the accuracy of the train service in fitting it to an approved schedule.

There are also other cases which are incident to the power-house, and are in no way attributable to the men in direct charge. One of these which may be mentioned is false economy in purchasing a poor quality of coal, which, in spite of all that can be done, allows the steam pressure to drop and does not supply the engines with sufficient energy. Similarly, the use of poor oil may allow important bearings to become heated, which results in crippling the line or overloading other machinery, thereby causing a reduction in voltage, or it may be that the headway for the time will have to be lengthened, thereby departing entirely from the approved schedule. In short, everything must be done at the power-house to provide at all times sufficient current at a sustained voltage at the cars. Without this, any schedule however accurate and elaborate will fail in carrying out its object. The details of producing such service are so voluminous and have been so ably discussed by other writers that anything further than the statement of the condition would be superfluous here.

The track and overhead construction should be secure and serviceable. It is obvious that a good track is essential to good, comfortable riding, which will please patrons. Special work should be maintained in first-class shape and renewed promptly. It may be mentioned that it is not a wise practice to allow work of this nature to become worn to its last stages before steps are taken for its renewal. An order for special work of necessity cannot be filled promptly, and it may easily be that if there is delay in placing the order, the old frogs and crossings will become very much worn, cars will be derailed, axles bent or broken, motors dropped, and, aside from the actual expense of repairs and maintenance, the train service, which is the prime factor, will be interrupted.

The writer's experience has been that considerable trouble has been encountered in maintaining a train service by reason of the spread of the rails and consequent accidents and delays. Where the traffic is at all heavy this accident is very liable to occur unless the rails are bound with tie rods.

Both the track and the overhead construction should be of the very best. A broken trolley wire is even worse than a disabled truck, for it may tie up not only one car but a whole section, and anything which will minimize the liability of wires coming down is advisable. In order to preserve the train service the work of re-

pairing the overhead construction should be performed at such times as will least interfere with the service. This is usually at night.

In order that overhead maintenance can be performed to the best advantage, emergency stations should be located, each of which is assigned to certain territories. The station covering the heaviest travel should be able to reach its outer boundary in eight minutes, while in suburban districts the furthest limits should be reached in from fifteen to twenty minutes. The construction wagons should consist of an extension platform, from which the overhead work can be reached without standing the wagon in the trackway.

Track and overhead repair men should be impressed as strongly as possible with the fact that in making their repairs it should be done in such manner and at such times as will interfere least with the operation of the cars. The judgment of some track and overhead repair men cannot always be relied upon to carry out this injunction. Train service is often interrupted by track and linemen, in making repairs to the track and overhead system, by attempting to make too permanent repairs at a time when the service is heaviest and should be interrupted least, when a temporary repair would have done just as well until such a time as the service was light and permanent repairs could be made without interruption to the service.

The writer knows of one particular case where the ear of a double pull-off on a curve had become so bent and out of its proper position that when the trolley wheel was riding under it the trolley would come off and one of the arms of the pull-off and the bent ear would serve as the prongs of a boot-jack, the trolley harp and wheel catching in the arms of the pull-off and doing one of two things, pulling down the overhead work or pulling the trolley pole from out of its base.

It is a common fault to pay too little attention to the application of guy wires on curves, and serious delays due to failure of overhead construction on curves are very frequent. Sometimes the work is satisfactory for short cars, but on long cars the motion of the trolley, being somewhat different, is likely to throw the wheel off the wire. Frogs should be placed in the overhead work where the lines diverge at a point that will insure the trolley wheels following the desired route.

Another and exceedingly important feature of good train service is the selection of motormen and their instructions in running the cars. Many elaborate papers have been written on how to run a car to use minimum current and to produce minimum wear and tear on the equipment. These instructions, while ingenious and accurate from a technical point of view, and possibly of wise application in small country roads, are not at all suited to the heavy traffic conditions which obtain in large cities.

In such cases the most important duty of the motorman is to make schedule time, keep a sharp lookout for passengers and avoid accidents. It is interesting to note in this connection that the best motormen are often men who can neither read or write, and are found among teamsters, drivers of horse railways and the like. These men are accustomed to do implicitly as they are told. They are accustomed to watch the street carefully and keep good track of vehicles and persons, by which means they avoid accidents and secure passengers.

The semi-technical man, who is "learning the business," makes the worst motorman of all. His mind is more active, he is interested in the performance of his motors and equipment and neglectful of his primary duties as motorman. He is always on the lookout to take note of matters which, though they may be valuable to him in his personal advancement, are entirely foreign to his duties. More than that, he is a dissatisfied individual, looking for better employment in the near future, and for that reason he is not inclined to learn his business of motorman thoroughly, regarding it as scarcely worth his while.

Of course, it is necessary that the motorman have certain instructions with regard to managing the controller. He should know that it is not advisable to give the motors too many notches at once; that he should, wherever possible, allow the motor to gain speed on one notch before passing to the next; that he should run the car on certain notches as far as possible, and that he should not allow the controller handle to dwell on spaces between notches, but it is not at all necessary for him to know why the motors are more economical at full series or full parallel or just what misconnections are likely to obtain if the controller is run between notches. It is sufficient that certain things must be done and that certain other things must not be done.

It is, nevertheless, a fact that a good motorman will run a car with less energy than a poor one and still maintain schedule time. A good deal of this may be ascribed to the careful use of the brake. It is necessary in making a fast schedule with many stops to shut off the power and use the brake almost before the car has gained headway. This frequent use of the brake is a temptation to many motormen to keep the slack of the chain taken up, so that a slight pressure on the brake handle will put the brakes on hard. This keeps the shoes in contact with the brakes at all times, giving excessive friction and loss of power. A good motorman will coast his car as much as possible when the schedule will permit it. It is certainly advisable to keep accurate record of the way the motorman manages his equipment, but inferences must not be drawn too hastily from such records. If a motorman in charge of an equipment wears out his brake shoes rapidly and comes in with the regulating resistances sizzling hot, the schedule on which he has been running must be considered. If he has been on a fast schedule with many stops, and has followed it closely, the condition of his car signifies very much less than would be the case if he had an easier run and had failed to make schedule time. In forming an estimate of the qualities of motormen, train inspectors, conductors, and particularly of officials having men in charge, the writer has found first impressions to be exceedingly valuable. The well-known saying that the sober second thought is seldom wrong is not always correct. Judgment should, of course, be suspended until the second thought has been well considered, but the first thought may be right after all. It certainly has the advantage that it usually represents the only impression that the majority of people will consider, and hence may be the popular impression, which in street railway work at least must be catered to.

After all has been said and done with reference to the manipulation of train service it is interesting to know what results may be expected from good work in this department, and to exemplify these matters, the writer again cites from his records cases which he ventures to think will justify the statement that the matter of train service is of great importance.

It is not always easy to record the income of a line; for instance, a passenger may take line A, and ride on it for 100 yds. and pay in his fare simply and solely because he can obtain a transfer on line D. Line A gets the credit on the books and line D, which actually performed the transportation, carries the debit side of the account. There is nothing on the transfer to show whether the passenger rode a longer distance on line A than on line D or vice versa. To be strictly accurate, the fare and the expense should be charged to each line in proportion to the distance the passenger was carried on each, and while attempts may be made to equalize the accounts, in this respect absolute accuracy cannot be hoped for. The results are therefore submitted subject to this criticism and are the best that can be obtained under the circumstances. The following examples are taken from monthly comparison sheets. These sheets are made up from the reports of the conductors, the inspectors and the books of the company, and comprise the following data:

1. Receipts.
2. Total passengers.
3. Mileage.
4. Receipts per car mile.
5. Number of trips.
6. Receipts per trip.
7. Average length of trip.
8. Average number of cars per day.
9. Average mileage per car per day.
10. Time table cost.
11. Columns for the record of increase or decrease of these quantities over the same month in the previous year.

If the comparison sheet shows increased receipts, diminished mileage, diminished number of trips and diminished time table cost, the result must be ascribed in a large degree to the management of the train service. I may cite as examples the following:

From a monthly sheet on a certain line the increase in gross receipts was $3,586, the decrease in mileage was 18,920 miles, due to the substitution of short lines for longer ones. The decrease in time table cost was $1,612, representing an actual increase in revenue to the road of $5,198. This amount as a monthly incentive for ingenious manipulation of the train service is certainly attractive. On another line almost as large the increase in gross receipts was $13,765. It was, however, accompanied by an increase in time table cost of $1,902, representing a net gain of $11,867, certainly a wise investment for the added expense. The large gain in gross receipts was due to changing of the terminus to a better center of distribution. This manoeuver not only filled up the empty cars that were running formerly, but necessitated the running of additional equipments.

Another case may be cited in which the gross receipts showed a loss of $7,087 and the time table cost a decrease of $2,814, representing in total a loss of $4,273, as compared with the same month of the previous year. This, while not so pleasant for directors' contemplation, is very important to know. The reason for this was found in the fact that a number of large factories on the line had been shut down. It might have been due to local conditions or that the train service could be improved.

In like manner a yearly comparison sheet can also be drawn

and careful management can often in a well established road increase gross receipts or largely diminish time table cost. From such a sheet involving a yearly total from thirty-seven different lines may be cited an increase of more than 10 per cent in gross receipts and a little over 1 per cent in time table cost. The receipts per car mile showed an increase of 5.8 per cent. The receipts per trip were increased 16.5 per cent. The average mileage per car increased 15½ per cent, whereby about 144,000 trips and the incident expenses were saved.

Such figures as these on a system in which the building of new lines had been relatively small can hardly be ascribed to growth and extension, and could scarcely be obtained except by running the cars longer distances and by suiting the public taste, whereby larger loads of passengers were carried, or briefly and in other words, by improved train management.

Construction and Maintenance of Street Railway Tracks

BY EDWARD BUTTS

The construction and maintenance of street railways involves two words, construction and maintenance, which are inseparable in considering a street railway enterprise in its relation to capital.

Is the street railway to be built for temporary purposes? Is it to be built simply to float on the market or to turn over to our successors and assigns, or are we to build a street railway to endure to the extremity of the present advanced stage of science, speaking particularly of the use and durability of materials? The latter view will be accepted in preparing this paper.

In street railway construction, the first thing to do is to consider carefully all the local influences which may become factors in maintenance, or involve future changes, and so considering the subject from this fundamental position, the question naturally divides itself into urban and interurban street railway construction.

It is desirable in all cases to construct the street railway in such a manner that when it becomes necessary to reconstruct the interurban portion the termini shall need the same attention at the same time, and as a general proposition it may be said that the urban end of a line is the governing factor when durability is considered. The reason for this is, of course, because of the concentrated travel there.

For the present, then, we will consider urban roads from a standpoint created by practical experience and expenditure of capital.

The rails should be not less than 6 ins. in depth, with a width of base equal to the exposed upper surface. Where streets are paved with asphalt and a stone toothing course placed adjacent to the rails, the rails must be at least 9 ins. in depth, in order that the base may be securely imbedded in the concrete below. Rails should be center bearing, rolled in 60-ft. lengths and so handled that they will be perfectly straight when placed in final location.

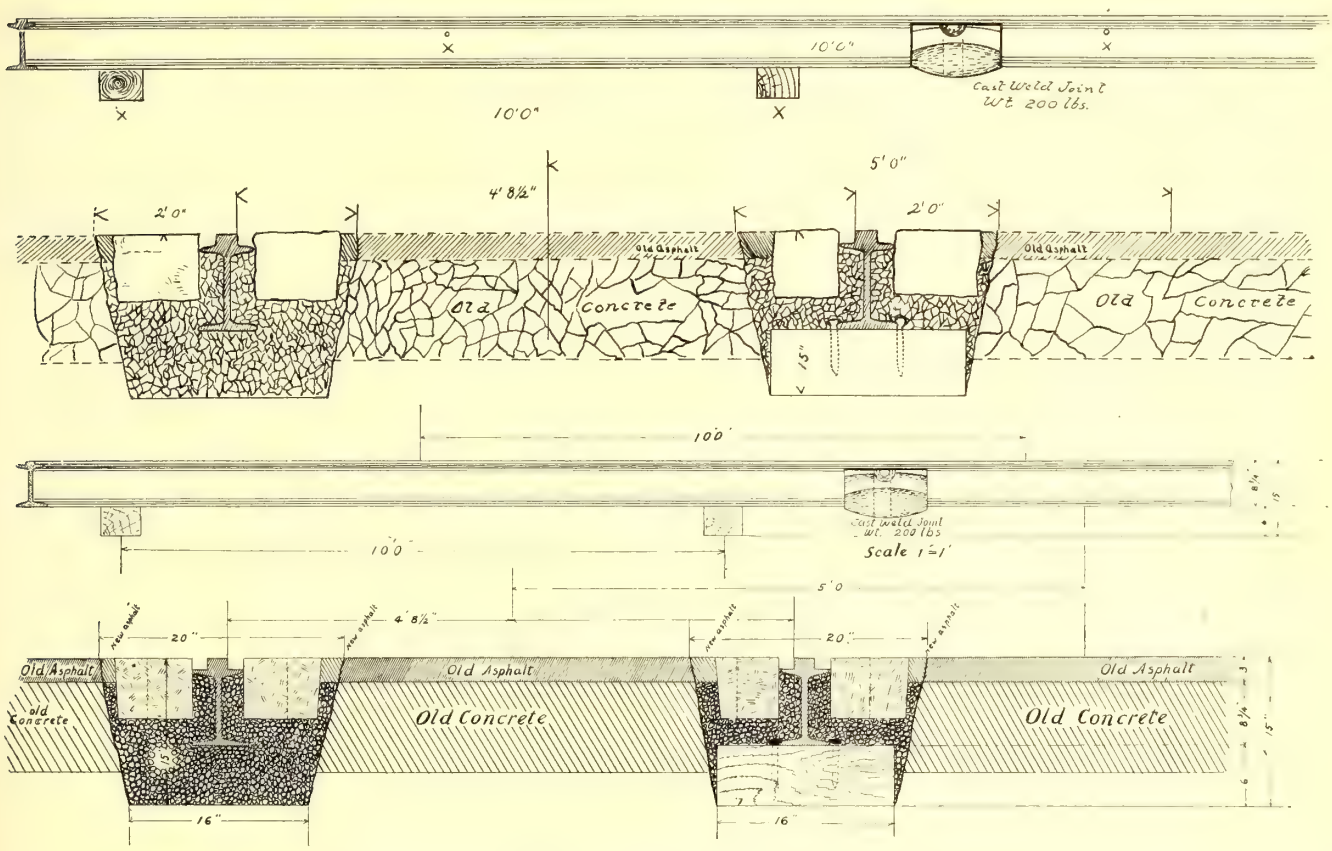
Tie-rods 1 in. in diameter should be placed 6 ft., center to center, along the line and supplied with hexagon nuts, which, when in place, should clamp the rails securely on both sides. The tie-rod threads should extend far enough from the rod ends to allow the rod to be put in place without bending it. The theory of this rigid tie-rod is that the street traffic and pressure on the outside of the rails should be provided against, as well as the car thrusts on the inside. The top of the tie-rod should be placed half way between the top and base of rails to better accommodate the paving, especially if the wearing surface is brick or stone.

For rail foundations a trench should be dug, 20 ins wide on top, 16 ins. wide on bottom, and deep enough to be 6 ins. below the rails when the latter are at the established grade. In this trench, at 10-ft. intervals, should be placed wooden blocks, 8 ins. x 10 ins. x 16 ins., to which the rails can be securely spiked. These blocks serve to hold the rails in position while they are being laid and tamped to surface, the joints being held in position by temporary splices.

After nicely gaging, aligning and surfacing the track, the trenches should be filled with concrete, bedding the base of the rails up to the bottom of the proposed paving. The concrete, which is placed in the trenches around the rails, should be composed of crushed stone, measuring not more than ½ in. in greatest dimension, with Portland and domestic cement, and sand, mixed as follows: Two parts sand, one-half part Portland cement, one-half part domestic cement and five parts crushed rock, all by measure. Great care should be taken to get the mortar flushed close against the rails and to bring it full up under rail trams. The concrete in the trenches should be allowed to set about six days; this time, however, depends upon the condition of the atmosphere, as the concrete will set much more rapidly in warm than in cold or chilly weather.

The concrete for paving foundation may also be composed of one part domestic cement, two parts sand and four parts broken stone, by measure, the broken stone to be not larger than 2½ ins. in the greatest dimension. All concrete should be thoroughly tamped until the mortar flushes to surface.

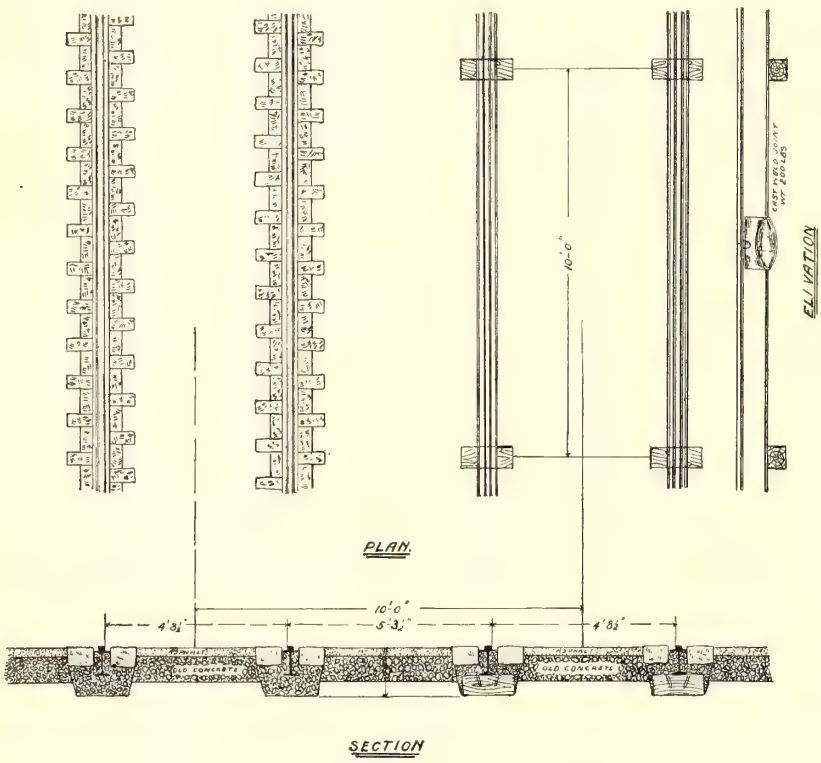
After the concrete has set, cast-weld joints should be poured at all joints, including those of the special work which may be needed.



ELEVATIONS AND SECTIONS OF TRACK CONSTRUCTION, KANSAS CITY

The cast-weld joint on 80-lb. rails should weigh 150 lbs, and on 100-lb. rails, 200 lbs., the metal cast about the joint should be composed two-thirds of pig iron and one-third common scrap iron. The metal should be heated to a bright yellow temperature and each joint formed with one pouring. The depressing clamps should remain in place for at least one hour after the pouring, and the surface of the rails finally dressed smooth, so that the passing of the car will be the same as on a continuous rail. In preparing the joint better results as to smoothness are obtained by inserting a thin shim between the rails, than by placing the rails too close to admit of such a shim. These cast-welded joints should be so formed as to present the least amount of interference with the wearing surface of the pavement.

In general, the wearing surface of the paving between the rails should not be of better material or smoother than the balance of the street, otherwise there will be an undue amount of vehicle travel on the street railway tracks and consequently more frequent accidents will occur. Attention should be paid at all times to drainage, and at street crossings where the established grade is level, the surface of the tracks on one side should be elevated several inches to prevent the retention of water pools. At all changes of grade the rails should be bent to form vertical curves, and these vertical curves should contain no joints, as otherwise it would be almost impracticable to secure uniformity in curvature without resort to shop work.



ELEVATION, SECTION AND PLAN, DOUBLE TRACK CONSTRUCTION, KANSAS CITY

There is no economy in trying to construct a railway hastily, as in so doing the work is often slighted in some particulars, and this involves future expense.

The special work, turnouts, crossings and cross-overs should be of cast steel construction, except at steam railway crossings, where the best built-up work located on foundations should be used. The tongue of turn-out switches should be placed on the high or super-elevated rail of the curves, otherwise the guard rail of the mate should extend the full length of casting on which the tongue is located. All curves with a radius of less than 300 ft. should be provided with a guard rail, and curves of less than 50-ft. radius should be double guarded.

A very important matter in the construction of street railways is that of drawing up the specifications and final contracts. Great care should be taken that these cover all the material and labor necessary to complete the entire line. Neglect of this precaution often entails serious trouble and is expensive.

When a line is constructed as herein provided its maintenance is a question almost entirely of car equipment, involving the wheel base, double or single trucks, diameter of wheels, properly applied springs and weight of cars. The longer the wheel base the less durable the curve. Single trucks will batter out frogs, switches and joints more rapidly than double trucks.

The Care of Car Equipment

BY J. H. VANDER VEER

In giving the writer's views as to the proper care of car equipments he expects them to be thoroughly criticised, though it should be borne in mind that different conditions obtain in different cities.

On the railway with which the writer was first connected, all the cars owned were kept in service except from 8 P. M. to 6 A. M., during which time all inspections were made and all possible overhauling done. If a car broke down during the day every one possible, including the motorman and conductor, was put to work on it. As the motormen in those days carried kits of tools with them and inspected the motors at the end of each round trip, they were very helpful when it came to overhauling. That period, however, has passed away, together with the double reduction motor.

In the maintenance of motor equipments to-day, where almost continuous service is demanded and high mileage made, only those equipments which are fitted with both oil and grease boxes will safely run over forty days without a thorough overhauling. This overhauling, on a large road, must be done at a number of different points, at each of which it is advisable to have extra trucks mounted with motors, all in first-class order, ready to run under a car body whose equipment needs inspection. To properly lift the body from the trucks four duplex chain hoists, or air jacks, conveniently located, together with two cross timbers and four stirrup irons, form as good a combination as can be found, and will do the work with the least possible injury to the car body. When the car body is lifted, the truck to be overhauled is run out and the good truck substituted, the car lowered, connected up and turned over to the operating department. The operation takes about one hour, and for that length of time only is the use of the car body lost. A suitable crane, properly located and equipped with a carriage and a second duplex or air hoist, will also be found of great convenience. Such a crane can be readily made in any blacksmith shop and for the arm a piece of old rail can be used. When the motor is opened, the armature should be lifted out and placed on a suitable rack, where the commutator can be cleaned and armature tested for insulation. The fields should also be tested for drop in voltage, and where there is a drop those fields and armatures should be used in motors by themselves, keeping new and rewound fields and armatures in motors by themselves. This prolongs the life of the equipment and reduces the number of crippled cars taken off the road. The motor shell should be thoroughly cleaned out, either by compressed air or by washing with kerosene. The grease in the grease boxes should be taken out and put in the gear case and the grease boxes thoroughly washed out with kerosene. The brush holders should also be taken out and thoroughly inspected and cleaned.

The writer has found that the work described cannot be properly done in the pit, with the car body on the truck and the bottom half of motor dropped. He recommends, therefore, the removal of the car body, as described, a step which also saves tying up a complete equipment while the motor inspection is being done.

In general, a car, starting in perfect order, will safely run five days before requiring inspection.

The force required to inspect from twenty to twenty-five cars per day would be about as follows: One man can be responsible for the proper inspection of all trolleys, including the taking out and replacing of any defective poles, wheels or springs, and the straightening of all bent poles. Another man should be responsible for the proper inspection of all circuits, together with hood switches, fuse boxes and lightning arresters. Another should give his whole attention to controllers. A fourth, with an assistant, should be able to keep all brakes in good shape and replace all worn out shoes. This force should keep the truck and motor equipment in good shape, if the night men take equally as good care. The writer recommends doing as little work as possible at night. At a car house operating say one hundred cars, three men should be able to grease motors, inspect brushes and make any small trolley repairs. Car cleaning should come directly under the operating department. The night car cleaning should be limited to sweeping out, cleaning windows and dusting cars, and all washing should be done in the day time while the car swings or is on the stand, if the car house is at one end of the line. If the cars are

of the closed type, the seat risers, drop sash and the space under the seat should be cleaned once a week, as the traveling public has a tendency to drop newspapers, apple cores, etc., behind the seat back, not to mention the bits of lunch the motormen and conductors drop there if their runs compel them to eat on the car. The best way to avoid this and to also save the annoyance of a rattling sash, is to make the sash stationary and cover over the space between the top of the seat back and sash rail. This, of course, does away with blinds and compels the use of curtains. The cost of maintenance is less with curtains, however, than with blinds.

A car house from which one hundred cars are operated should have, among its employees, a good carpenter to make small running repairs and to take care of bell cords and register ringing devices. Any car that has been in a collision and damaged so badly that it cannot be repaired in one day should be sent to the general repair shop. All cars should be taken to the general repair shop once a year, the body put in thorough repair and the car varnished or burnt off and painted anew, as the case may demand. While the car is in the carpenter's hands the wiring should be gone over carefully and put in shape. If the car goes to the shop with its regular truck and motors, the former should be run out and gone over thoroughly. In case it is a built up truck, all rivets and bolts should be carefully inspected and renewed where necessary. In the case of a solid side frame truck, it should be carefully squared to see that it has not sprung. The brake rigging should be taken apart at this time and if it is a truck with brake beams working in slides the beams should have what are termed "Dutchmen" jumped into the ends to bring the wearing parts back to their original thickness, as the beams will probably be found to have worn wedge shaped. If the brake beams are hung by links, these should be renewed if they show signs of wear. At this repair shop should be concentrated all classes of repair work, not only repairs to bodies and trucks but all electrical repairs. The writer believes it pays all railway companies to make their own repairs to electrical apparatus, including the making of armature coils and renewing of commutators.

In connection with the latter the writer has found that hard drawn copper makes the best commutator. This is bought in lengths and the bars sawed off with an ordinary metal saw. It will be found that the same bar will often do for several types of commutators. In making commutators it is well to increase the diameter over those turned out by the factories as much as can safely be placed between the brush holders. Drop forged bars can also be purchased for any width of commutators desired.

As regards controllers, hood switches, etc., most roads will find it cheaper to buy the ordinary repair parts and then assemble them, themselves.

In conclusion, the writer has found it is advisable to make car body repairs, rewind armatures, make commutators, armature coils, field spools, etc., by piece work. If good inspection is provided and the prices honestly watched, both the company and its employees are gainers by this method. The writer has in mind a case in point. A shop was operated by day work and the regular carpenters' wages were $2.25 per day of ten hours. Cars that were being remodeled were costing $120. This was changed to piece work and the same results secured by paying four men $110 per car. It was found that the men could do the work easily for this and make about $6 over their regular wages. They soon became so expert at this line of work that the price was gradually cut to $80 per car. Cars are being turned out at this price now, and the men are averaging $2.50 per day. Close inspection, however, is a necessity.

Car Mileage

BY H. C. MACKAY

One of the greatest problems affecting the street railway interests is an equitable and standard unit for comparing results, and the subject assigned will be treated in its general relation to accounting as such.

Car mileage has been adopted by practically every road in the country as the unit of comparison, but a study of the methods used in computing the mileage made by the different systems will convince anyone that under the present conditions it is misleading and unreliable. It makes but little difference what is used as a basis, as long as its purpose is simply to show if the earnings or expenses are proportionately above or below that of a similar period; but to make a comparison with another system, whose speed, length of day operated, size of cars, etc., are different, or where the physical conditions are dissimilar, it is absolutely necessary that the unit be identical.

It is not practical to make general comparisons of any given expense item as to the amount in dollars and cents, for the reason that there are so many factors to be considered which have a direct bearing on the cost; hence, it is necessary to reduce same to a basis alike to all systems. When this has been accomplished, the result of the operations of the various systems will establish an average for each division or item of expense, which will be an accurate guide to the manager; an indicator showing all expense items in which reductions should be made. Here is where the greatest value in a standard unit lies; the cause of an abnormal expense is at once detected and the energies otherwise wasted in an endeavor to locate the trouble can be applied in the correction of it.

The principal objection to "car mileage" is the variation in speed. Between city and suburban lines there is a difference of from 8 miles to 30 miles, or even more, per hour. The increase in speed does not materially affect the cost of operation. The liability of accidents due to increased speed are more than offset by the difference in density of population of district traversed, while the principal items of expense, such as "wages of conductors, motormen, car-house employees, etc.," are the same in either case; hence, the suburban or interurban line would show from two to four times the number of miles run, at only a slightly increased cost as compared with a city system. The question may be asked, why the interurban line should not be entitled to the credit of operating at a less cost (as the object of a standard unit is not to make expenses uniform, but to show the actual conditions). I will answer the above by saying that while the cost "per car mile" would be less, on the basis of passengers carried, it would be more, by reason of the longer haul, thus indicating that its expenses are not proportionately less except upon a basis favorable to itself.

Another disturbing element is the "trailer." Where trailers are used regularly and to any considerable extent, they are considered as a separate car mileage, being computed for both motor and trailer in nearly every case. Theoretically, a system whose equipment is exactly adapted to its needs, would assign to runs cars of just sufficient capacity; the trailers being abandoned, and in the place of, say a 22-ft. motor and 18-ft. trailer, a 40-ft. motor car would be run, thus eliminating the expense of one conductor, as well as the extra maintenance charges.

New cars are rarely purchased for use as trailers on electric systems. Those in use are either relics of horse-car days or an indication of an extraordinary growth of the city, and consequently of the system; an indication that the capacity of the car is not equal to its requirements while it is still in good condition and too valuable to be consigned to the scrap pile or even to be sold at forced sale, so its motors are placed under a longer car body and it is transformed into a trailer, to be brought out and used as an attachment or extension wherever the motor car's capacity is liable to be overtaxed.

Surely, no one will contend that it is cheaper to operate a motor and trailer, whose combined length is 40 ft., than a motor car of the same length. If it were true, the same rule must apply to a 24-ft. car, and we would be substituting a 12-ft. motor and 12-ft. trailer in its stead, yet the method of computing both motor and trailer mileage attempts to show just this result. To better illustrate, we will take for example two roads, one using 40-ft. motor cars, the other a motor and trailer whose combined length is 40 ft. They are operated at the same speed, headway, etc., yet the first shows a cost of, say 12 cents per car mile; the other, by reason of the double mileage, a little more than one-half of 12 cents, though with the additional expense of an extra conductor. My contention is, that a road using trailers is naturally handicapped and should not be expected to produce as good results as one whose equipment is nearer adapted to its needs, and that the trailer is but an extension of the motor car and the extra expense of running it should show as the result of unfavorable conditions.

To secure data, the writer sent to most of the railways of the United States and Canada a circular letter, requesting answers to the following questions, viz.:

1. Is your mileage computed from conductor's trip reports? If not, how? Answers were received from 103 roads, and were as follows:

Conductor's or motormen's reports	73
Foremen, dispatcher or switchmen's reports	15
Time tables	4
Unanswered	11
	103

From the above we see that over 70 per cent of the total number and still greater per cent of the answered reports arrive at mileage from the trainmen's reports. Some few companies have adopted a system whereby the conductor reports his route run by numbered points, each switch, cross-over, etc., being given a

number, permitting the accounting department to accurately trace the car. It requires, however, a careful examination of each trip sheet, which, to a large system, means the expenditure of considerable time. I suggest that the trainmen be required to report only the exceptions to their regular trips, either lost trips or extras made, thus, instead of going over all the trips made during the day, only the deviations from the regular schedule would be examined and computed. This result may then be added to or subtracted from the regular schedule. The method adopted would depend upon a conclusion as to the following question:

2. Do you keep record of mileage made by each car? Answers:

Affirmative	51
Negative	46
Unanswered	6
	103

Of the above fifty-one roads that keep such records, twenty-six are in cities of less than 50,000; ten are in cities of 50,000 to 100,000, and fifteen are in large cities.

Neither of above questions has any bearing on "car mileage" as a unit, except so far as accuracy is concerned. A great amount of data is usually prepared by the accounting department to which reference is seldom made. Mileage by cars is valuable and necessary to determine the life of wheels, gears, pinions, etc., but these tests are of a semi-occasional nature, and special records can be kept in such cases at a less expenditure of time and money.

3. What method have you of verifying above figures?

Answers:

None but care in computing	45
Time tables	28
Dispatcher's reports	8
Pay rolls	4
Foremen's reports	4
Motormen's reports	3
Trip receipt returns	1
Unanswered	10
	103

It would seem that the simplest method of verifying the results would be by a report from the foremen showing deviations from the regular schedule, and this result checked by trainmen's reports.

4. Do you include dead mileage, i. e., from station to where car strikes regular route?

Answers:

Negative	50
Affirmative	36
Have none	11
Unanswered	6
	103

The reason assigned why dead mileage should not be included is that the car is not earning revenue, and that it would be unjust to decrease its earnings per car mile. Nevertheless, the mileage had to be run before it could earn revenue; the expenses were the same as when on regular service, and I consider it legitimate mileage. Thus, the systems whose stations are advantageously situated would receive whatever benefit there was due to that fact.

5. Do you include full trailer mileage? If not, what proportion, and give reasons why full mileage is not used?

Answers:

Trailers not used	46
Affirmative (of which number only 50 per cent use trailers regularly)	37
Negative	11
Unanswered	8
One-half	1
	103

The percentage of roads using trailers regularly, as shown above, is only about 20. As stated before, the trailers should not be computed for general use.

6. Is any allowance made for partial trips lost?

Answers:

Affirmative	57
Negative	37
Unanswered	9
	103

This question is covered under No. 4. Allowance should be made for partial trips lost, or, in other words, mileage used should be the actual mileage made by motor cars.

7. What is your average motor mileage per day? Trailer?

8. What clerical help is required for mileage work and approximate cost per month for same?

9. How long does it take to ascertain the total mileage for the day?

The object of the preceeding questions was to determine the relative cost and adaptability of method used, but, owing to the different construction placed upon question No. 7 (answers covering average motor miles per day per motor and total miles per day) no conclusion can be drawn except that the speed varies, so that the average motor miles per day per motor ranges from 65 miles to 300 miles.

10. Do you use "cars operated per day" as a basis for comparison of earnings? If so, what constitutes your car day?

Answers:

Affirmative	44
Car day of 20 hours	1
" 19 hours	1
" 18 hours	31
" 17½ hours	1
" 17 hours	3
" 16 hours	1
" 15 hours	4
" 115 miles	1
" 80 miles	1
	44
Negative	48
Unanswered	11
	103

Car days, especially in the larger cities, are gradually lengthening, and will no doubt reach the maximum of twenty-four hours.

The adoption of the "passenger mile" (being the passenger trip distances divided by the number of passengers carried) is precluded, owing to the impracticability of obtaining the length of the separate passenger trips.

This applies to the "ton mile" as well, if the element of "passenger weight" is taken into consideration. If the "ton mileage" is based upon the dead load hauled, I do not consider it complete. In fact, the showing made on the basis of "ton mile" would have a tendency to mislead the management. For example: One system operating "20-ton motor cars," with a corresponding large ton mileage, would show a small cost per ton mile. Another system, operating "10-ton motor cars," would show nearly double the cost per ton mile, when as a matter of fact the lighter car may be the more economical; but, with the mileage computed carefully, all dead miles included, and the elimination of the trailer, we have a unit which will be uniform and applicable to all electric systems as soon as the question of speed is adjusted; hence, we have but to divide the above figures by the average rate of speed and this result, verified by the motormen's time, will be a standard unit. This is equivalent to a "motor-car hour."

To illustrate the method of ascertaining and verifying the "motor-car hours," at the same time showing the effect that speed has upon car mileage as a unit, I submit the following exhibit:

TRAFFIC SHEET

	A. B. Ry. Co. Operating City Line	C. D. Ry. Co. Operating Interurban Line
Number of cars operated	3	3
Speed per hour (miles)	8	24
Length of trip	24	24
Number of trips per day (regular)	18	54
Extra trips made	2	6
Trips lost	½, 1½, 19½,	1½, 4½, 58½
Miles per day	19½, x 24, 468,	58½ x 24, 1404
Motor car hours	468 ÷ 8, 58½,	1,404 ÷ 24, 58½

PAY ROLLS

Motormen's Time		
Regular trips	18	54
Extra trips	1½	4½
Total trips	19½	58½
Motor car hours	19½ x 3, 58½,	58½ x 1, 58½
Assuming the cost of operating above cars at $60 per day, the cost per car mile would be	$ .12.82	$ .04.27
The cost per hour would be	1.02.56	1.02.56

From the foregoing exhibit we see that the time table of the city system shows eighteen regular trips per day. From the conductors' and foremen's reports we find two additional trips were

made and a half trip lost, a net addition of 1½ trips, or a total of 19½ trips, amounting to 468 miles. This amount, divided by the speed, equals 58½ motor-car hours. This figure is verified by the pay roll. Time allowed:

Eighteen trips, at three hours (regular)	54 hours
One and one-half trips, at three hours (extra)	4½ hours
Total	58½ hours

For the purpose of comparison, the interurban line is based upon the same conditions, excepting speed, which is increased from 8 miles to 24 miles, thus increasing the mileage without changing the car hours.

It will thus be seen that on exactly the same cost the city system would show 12.82 cents "per car mile," as compared with 4.27 cents, while on a basis of "motor car hours" the cost is the same.

It has been contended that the unit for earnings should be the "motor car hour," and that operating expenses should be based upon the percentage of earnings.

The car hour certainly applies to earnings just as well as it does to expenses, but I do not think that a percentage of earnings is the correct basis. For a standard unit it is too fluctuating. If a road's equipment was always taxed to the limit, its earnings and expenses might be held at a fairly uniform basis, but these conditions would never exist for any length of time, and could not become general. Any large convention or carnival would swell the earnings abnormally, and while the expenses would increase at the same time, they should not in the same ratio; hence a comparison of the month's result under such circumstances with another system under normal conditions would be unfair.

Again, the geographical location would disturb fair comparisons, as the time of the year when expenses would be proportionately low in a Northern city would undoubtedly be just the reverse in New Orleans or other similarly situated places.

It has also been suggested that the sub-divisions of "general expenses" are not consistently covered by the "motor car hours," and that such items as "advertising and attractions" and "insurance" are not affected by the number of car hours run. So far as such accounts as these are concerned, the same may be said of any basis. Good management will always keep its car hours as near the point where profit and loss separate as is possible, whether on a large or small system, and while such accounts may not be affected by the car hours, nevertheless, the said hours being the index as to the management, the amount of such expenditures is proportionately and correctly shown.

Before concluding I wish to briefly refer to an article on the cost of electric power for street railways at switchboard, by R. W. Conant, read at the last convention of the American Street Railway Association; quoting therefrom: "The car-mile basis is not a fixed standard. A car, up hill, takes a great deal of power, while a car down hill should take none, and may be made a source of power." This is undoubtedly correct, as all grades and loads affect speed, and without this adjusted, mileage is not a fixed standard, but with the speed taken into consideration it would be practically the same as on a road without grades.

Report of the Department of Blanks and Forms

BY W. B. BROCKWAY

When the call was issued for the meeting which organized this association, it also included the suggestion that the companies represented at that meeting should bring samples of their blanks and forms in order that helpful and suggestive comparisons could be made. The idea was so well received that a long table was necessary to display the collection. As a means of exhibition the blanks of each road were placed in a pile by themselves, but the contents could only be ascertained by a detailed search of the pile. The popularity of the exhibit was attested by the constant attention it received and by the packages of exchanged blanks most of the members carried home with them.

At the first annual meeting held in Niagara Falls, Oct. 1897, the plan was again tried, but for various reasons it was not so successful as the previous experience at Cleveland. However, a committee was appointed to arrange the blanks presented, and their work was as well done as the blanks and room would permit.

In view of the accepted importance of the idea, it was decided for the convention at Boston, in 1898, that a special effort should be made to have the exhibit of the size and bear the results it deserved. Therefore, a committee of arrangements was appointed from among the gentlemen contiguous to Boston, who issued a special circular and those attending that convention are familiar with the thoroughness and popularity of their work.

It was really the object lesson given by the orderly display of the blanks of the Montreal Street Railway, at Niagara Falls, in 1897, and the classified collection exhibited by the committee at Boston in 1898, which called forth the resolutions establishing the Department of Blanks and Forms and making it a permanent part and feature of the advantages of membership in the association.

The blanks as they are exhibited this year are mounted in thirteen large books 20 ins. x 30 ins. and one 30 ins. x 30 ins. These books are bound in canvas and are made from special 120-lb. manila paper, which will assure the wearing qualities needed for exhibition year after year. For the convenience and safety in transporting these many heavy books, there has been provided an oaken box with a shelf for each book, securely locked. And that there may be no reason for heavy handling, end over end, it is mounted on heavy castors that it may be readily moved.

In the whole physical make-up of the department, care has been taken to make the wearing quality as good and permanent as possible. And the assistance authorized at Boston and engaged by the secretary has been of high order rather than cheap, feeling confident that the result would be well worth the care and expense. The exhibition, it is hoped, will bear out the soundness of that reasoning.

As a foundation for the blanks preserved there was taken those exhibited at Boston, which, it will be remembered, amounted to several thousand; to this already fine collection there have been added the private collection of the secretary and the complete sets of very many other companies, so that at the present time there are complete or semi-complete sets of upward of eighty companies, many of which are the representative companies of the continent.

The secretary takes this opportunity to thank most sincerely the companies contributing for their cordiality and promptness in granting original and the many special requests made for additional copies of blanks, that duplicate and triplicate filing might be made where the construction of the blank demanded it. This co-operation has materially lessened the burden of preparation.

Many methods of classifying were considered, but there were but three which seemed feasible for so large a collection of diversified blanks as this one, viz.:

1. *By companies*, whereby the blanks of each company would be placed together in rotation.
2. *According to the standard classification*, in which those blanks relating to each account of that classification are filed under the different headings.
3. *Logically*, by which is meant the arrangement into classes all blanks of all companies intended for a similar use.

The last plan was adopted for the reasons that if the arrangement by companies had been followed it would still have been necessary to have followed some general classification of each company's blanks. But in the practical use of such a filing, a company satisfied with its entire form list, except this or that blank, would be unable to obtain a comparison without searching through every book in the collection, and even then to compare any two blanks on file, possession would have to be had of two or more books, which, according to the law of average, would be perpetually in use by some one else, which objection would make the annual exhibition a difficult one to make use of.

And in considering the arrangement according to the standard classification of accounts it was found that there were many blanks which applied to more than half the accounts which, to make the filing complete for each account would frequently require the possession of as many as forty copies of a blank that the face and back could be shown. This is illustrated in the blanks relating to labor, it being obvious that there are few of the thirty-eight accounts in which labor does not form a prominent part. This difficulty seemed so insurmountable that this plan could not be followed.

In view of the difficulties and objections found in other plans which, to make the filing understandable, had to be omitted in the plan adopted, it seemed to be better to make certain classes to contain blanks of all companies. This will permit the closest comparisons in each class and will at the same time include in one book all blanks of all companies which will in any way relate to that class. It is true this plan has broken up the continuity of the blanks in use by the individual company, but we have substituted a continuity in which all the companies join, for there is a certain channel through which the business of a company must run in its performance and the various changes in the direction of that channel have been followed as closely as was possible. For instance, in the books containing income it will be noticed that book A, starts with the first record of income, viz.: conductors' reports; these are followed at once by the report envelopes, the receipts of the receivers, the reports and records of the counting and verifying clerks, etc. Thus there has been a natural sequence kept in mind, but it is one in which all the railroads join for the benefits of a prompt and efficient comparison. It is sincerely hoped that the

reasoning by which this plan of filing has been adopted is sound for the amount of study and time involved is considerable.

The three fundamental divisions into which the collection has been separated are:

1. Income.
2. Expenses.
3. Records and reports.

These are separated further into classes which can be best shown by the following description of the contents of each book.

Book No. 1. Income A, consisting solely of those books relating to the handling, reporting, verifying and depositing the actual cash income, and the daily, weekly and monthly reports of earnings only.

Book No. 2. Income B, contains tickets and transfers, their records of received, used and on hand, and physical records of registers.

Book No. 3. Labor A, includes the application, investigation, hiring, disciplining and discharging of employees.

Book No. 4. Labor B, covers all the various steps of paying the employees, from the time reports to the comparison of pay rolls.

Book No. 5. Materials, is for those blanks for material only, from the request for, through the purchasing, receipt and issuance to inventory.

Book No. 6. Maintenance, consists of the reporting of work done outside of and in the shops. The records of wheels and axles, and other blanks not strictly labor or material, but rather the result of their combination.

Book No. 7. Power-house, this book contains everything relating to the power-house—labor, maintenance, operation and efficiency. All blanks of each company are filed in this book by themselves.

Book No. 8. Transportation A, covers the actual operation of the cars from time tables through the various steps of dispatching and running.

Book No. 9. Transportation B, is the miscellaneous needs and results of the operation of cars, as instruction to trainmen, secret inspection, lost and found articles, cleaning snow and ice, car mileage, stables, benefit association, etc.

Book No. 10. Injuries and damages, takes the accident from the original report of to the settlement and records, and summaries.

Book No. 11. Vouchers, etc., is for the vouchers, bills, journal entries and various office stationery.

Book No. 12, contains monthly and annual reports and comparative statements of earnings and expenses.

Book No. 13. Records, includes voucher, accounts receivable, check, cash and other general records.

Book No. 14. Electric lighting, consists of all blanks relating to electric lighting as a business of itself.

To make the books useful for ready reference a system of cross indexing has been provided for each book, by the use of which a company intent upon only the conductor's reports of the X. Y. & Z. Railway can readily turn to it without searching for it until found. These indexes will be found inside the first cover of each book and will explain themselves, and as a means of assistance to the casual looker-on, each page has been labeled at the top to show what form that page contains, so that in the rush of convention hours " he who runs may read." Small figures in green will also be found in some corner of each blank to show the date of the original filing. This is done that an intelligent idea may be formed of the changes from year to year.

In many instances it has been important to make a duplicate and sometimes a triplicate filing. This is caused by the combining in one blank the information covered by two or more of the divisions into which the collection is separated. It was thought better to file as many times as necessary so that the specialist intent upon but one form will still find the collection as complete as possible within the limits of the blanks filed.

In all cases where a blank contains a form upon both sides, each side has been shown and an explanatory stamp has been impressed upon it, showing that it is the "front of" or the "back of" the form to which a hand points. This will save confusion. It is expected that errors of omission and commission will be found both in the classes selected and in filing, and it will be of great assistance if a memorandum be made of each error and handed to the secretary that attention may be given to the correction.

As to the practical working of the department there is to report that the books comprising the official file and annual exhibit are intended to remain in the office of the secretary for continual additions, and they will only be moved to make their annual appearances at the succeeding conventions. For the use of members there has been provided a reserve set, unmounted, which are at all times subject to the request of those entitled thereto. A letter of request is an application and the secretary makes a selection from this reserve set and forwards it to the applicant. Accompanying them is sent a blank giving such information needed to make clear the length of time they may be kept and the cost (which is always nominal) to the applicant.

This reserve set is treated on a library basis and selections should be returned upon the date allowed (usually thirty days), as it sometimes happens there are other roads awaiting their return to get the set which is in use somewhere else. It will be of interest to say that this occurs oftener with those blanks relating to materials and supplies than to any other.

In a circular, No. 9, issued from the secretary's office, attention was called to the many requests for sample blanks which every company received. It may be well to repeat the suggestion made, that all such requests be referred to the secretary, who will gladly fill the request, if the company making it is a member of the association, or will courteously decline if not. By this action considerable trouble and expense is saved the individual company, and new members will be gained to the association.

While I do not feel qualified to make any extended criticism of the size, shape or other characteristics of the blanks on file, there are found in working over and studying so large a mass of blanks and forms, certain little kinks or tricks of practice which have become almost a habit and, while they are harmless and unnoticeable while by themselves in use on the roads where they originate, yet when included in a collection the size of this the comparison is more or less marked, and I cannot refrain from making a brief reference to some of them.

The most prominent of these is the omission of the name of the road. It is not a bad guess I am sure, to say that of the thousands of blanks filed, 30 per cent are without any mark of personality. Very many and devious were the schemes tried to locate blanks, of which another copy was necessary, for duplicate filing. For instance, one very important blank was recognized only when the water mark in the paper was compared with other blanks till one was found of the same kind, and from this blank we were enabled to find the issuing company. In another case an explanatory note was written on the face of a blank, of which we again needed additional copies, and in this instance no less than twelve different blanks were found with an explanation in the same handwriting, but not one had an identifying mark. The company was only found by comparing the handwriting with the correspondence on file in the secretary's office. It was absolutely necessary to the value of the collection that these two cited should be duplicated, hence the efforts made to locate them.

If there can be any second choice in the shortcomings now being referred to, it is perhaps best covered by the term "ambiguous." A number of these are of undoubted importance to the companies making use of them, yet in the hands of one unfamiliar with the ins and outs of the particular roads by which they are used, they become almost meaningless and many were the inquiries sent out by the secretary where a few words printed at the head of the blank would have made the use clear.

In the next thought the other extreme is brought out, and I can think of no better term with which to describe it than "persistent information," meaning thereby the repetition of information in two or three blanks. The persistency of some forms reminds one forcibly of the annual report required of the steam railroads by the Interstate Commerce Commission, wherein questions are asked in so many ways as to be almost bewildering at times. This class of blanks made their filing very difficult, requiring many times a duplicate or triplicate filing to properly care for the various information, most of which was contained in other blanks already on file.

While not the most important, perhaps the most prominent feature of the whole department is the tremendous lack of uniformity in the shapes and sizes of blanks intended for the same service by different roads. One of the largest city companies in the United States has a report measuring 2½ ins. x 4 ins., while another road of about the same size requires a sheet 8 ins. x 12 ins. for but little more information. In another case one company uses two pages (meaning cross-pages) for a book of record, where another has precisely the same columns and headings and needs but one page, and that smaller, the difference being in the space allowed for the columns. The larger one has a date column of 3 ins. in width, and the number of reports from which the record is made has room enough to run up into the millions with still room to spare. These are extreme cases, but the principle is unchanged.

Careless press work and ridiculous selection of type make in some instances a jarring effect upon the other extreme, often found in that of beautiful and artistic work on the part of the printer, because he knows nothing but that kind of work will be accepted, and is governed accordingly. In this connection there is another practice, about which much pro and con can be said. I refer to the paper used. There is a vast difference in the cost of "cheap yellow" and ledger linen, but you will find forms intended for similar uses thus dissimilarly made. There is an average where ser-

viceability and economy can and do meet, but it requires an exacting—not petty—management of this branch of the expenses of a railway property.

Further suggestions can properly be made to the desirability and usefulness of form numbers, whether to make them continuous or to have a set for each department as applied to a small road or a large one. And again to the multiplicity of blanks burdening a small road as compared to a large one with not enough to properly attend to its volume of business, both external and internal. Other suggestions readily occur to one while examining the collection, but I will call your attention to but one other to which I have applied the title "Confusion," or perhaps a better one would be "Lack of Care in Arranging." By this I mean the jumbling together of all kinds of information upon one large sheet, and further, the placing on both sides of that the information intended for the busy financial or operating man who depends upon your statistics for various information, and has literally to search for what he wants. This, it seems to me, is caused by a desire to utilize every inch of space of a larger sheet, rather than to cut it into smaller ones with information of a similar nature grouped together.

On the other hand, as compared with these few criticisms, there will be found very much to commend, admire and use in the mass of blanks brought together. There is in many an evidence of careful thought and artistic sense, which shows itself in the composition of the blanks of this or that road. There is as much need of genius in the building of blanks and forms, as much a demand for brains and foresight in the logical arrangement of columns and statistics upon paper, as there is in the management of an office, for on one side is "Stationery and Printing and Office Expenses," and on the other "Surplus from Operation."

Fuel Economy of Railroad Engines*

BY PROFESSOR R. C. CARPENTER

In the following papers are given the results of thirty-five tests of electric railroad power stations, which have been made during the past eight years under my supervision, by especially trained students in advanced work in Cornell University.

The tests which are cited were made under the ordinary conditions of operation peculiar to the system referred to. In every case the results were doubtless affected by the machinery employed, the method of operating the station and by the varying and continually changing load produced by irregularities in loading and moving of cars.

The tests show the fuel consumption of several classes of engines, operating under the usual condition of power-house work. There is shown a variation in the fuel economy by engines of the same class, operating in different stations, which in some instances is of considerable amount. This is probably to be expected, for it is well known that the economy is affected to a great extent by variation in load, since an engine fully loaded is in general much more economical than one partly loaded; no duty throws on an engine a more variable load than street railway work. A certain amount of the variation in coal per horse power, as shown by the tests, may be accounted for by individual differences due to poor or good firing; this may, and often does, make 20 per cent or more difference in fuel economy, and this condition affects the uniformity of the results in about the same proportion. The effect of employing different classes of engines is also well marked. The fuel consumption of different classes of engines is doubtless the most interesting and practical part of the investigation. If we can learn from the tests the probable fuel consumption of each class of engine, we can draw conclusions as to the saving which might be produced by change of power, and we can also predict with certainty the fuel charges for different classes of stations.

TESTS OF THE SIMPLE NON-CONDENSING ENGINE. SLIDE VALVE AUTOMATIC

The summary of the tests of the simple non-condensing engine shows on the whole an economy of steam and coal nearly equal to that usually attained with engines of this class in any work. The most probable values indicate an average consumption of 34.3 lbs. of steam and 4.63 lbs. of actual coal per i.h.p. per hour.

In tests made by the writer with an engne of this class operating with a steady load, the best results at the normal load corresponding to about one-quarter cut-off, was slightly over 27 lbs. of steam per i.h.p. per hour, the steam consumption was greater either with a lighter or heavier load. As an illustration, the diagram on page 802 exhibits the results of a series of tests made on an automatic slide valve engine running non-condensing. Each test was continued sufficiently long at a given load to obtain the water consumption for that condition. The results are shown in the accompanying diagram, by employing horizontal distances to represent horse power, and vertical distances to represent steam used per horse power per hour. The scale on the left corresponds to the curves showing steam; that on the right, to curve showing total steam per hour.

The curves show graphically how the steam used changes with change in load. When the load is light the steam per horse power per hour is very great; when the load is normal, the steam consumption is lowest; when very high, the steam consumption per i.h.p. is increased. The total steam per hour increases faster than increase of load. The curve indicating steam per i.h.p. per hour shows slightly over 27 lbs. at 120 h.p.; nearly 30 lbs. at 150 h.p., 44 lbs. at 60 h.p., and 64.3 lbs. at 40 h.p.

Thus it is seen that a comparison of the results of the test of the automatic simple non-condensing engines in actual power-house work with those obtained under best conditions is in many respects favorable. The average results of all the tests show a steam consumption only about 25 per cent higher than obtained with this class of engine working under most favorable conditions.

This corresponds by the diagram to the results obtained with the engine tested at about 80 h.p., or at two-thirds its rated capacity. The average load as compared with the capacity of the engines in the various power-house tests was 54.2 per cent, which would correspond by the diagram to a steam consumption of 41 lbs. per horse power.

The following shows in tabular form the results of the tests of simple engines in a power house:

TABLE I

SUMMARY OF TESTS OF SIMPLE NON-CONDENSING SLIDE VALVE ENGINES

No.	H.p. of Engine	Steam per i.h.p. Hour	Actual Coal per i.h.p. Hour	Mean Observed i.h.p.	Per Cent Observed h.p. to Capacity	Boiler Evaporation per lb. Combustible from and at 212°	Kind of Coal
6	200	34.8	4.47	110	55	11.50	Pea A
1	405	34.5	(a) 6.54	257	63.4	(a) 9.11	Culm, East Ohio
7	1,975	35.7	4.60	862	51	9.46	Bit. W. Pa.
11	300	37.3	4 49	90	44	12.20	Bit.
11	300	34 3	4.72	95	46.7	10 20	Bit. Ill.
24	1,000	31.8	(b) 5.38	717	71.7	(b) 9 15	Bit.
31(c)	270	41.5	(c) 5.50	126	47.5	(c) 10 60	Ant. Buck.
33	270	31.6	4.61	147	54.5	10.70	Ant. Pea
Average		35.1	5.07	....	54.2	10.24	
Average neglecting (c)		34.3	....	....	....	....	
Average neglecting (a b c)		....	4.63	....	....	....	

Remarks.—Engine in test (31) in bad condition. Probable average coal per i.h.p. hour, when using anthracite or eastern bituminous, 4.63 lbs.; anthracite culm. 6.54; western bituminous, 5.38. Coal per kw. output averages 50 per cent higher, or 6.94, 9.81 and 8.07 respectively. Probable error for any given case not over 10 per cent Steam pressure, 90 lbs. to 120 lbs.

TESTS OF NON-CONDENSING SIMPLE CORLISS ENGINE. (SEE TABLE II)

Three stations only were tested which were using non-condensing simple Corliss engines. These three stations show fairly uniform results both as to steam and coal consumption, and, as was the case with the simple slide valve engine, the results closely approximate the best results to be obtained with that class of engine. Thus, while this class of engines might produce a horse power under favorable conditions of loading for an expenditure of 23 lbs. to 25 lbs. of steam used, the tests show an average steam

TABLE II

SUMMARY OF RESULTS OF TESTS OF SIMPLE NON-CONDENSING CORLISS ENGINE

No.	H.p. of Engine	Steam per i.h.p. Hour	Coal per i.h.p. Hour	Mean Observed i.h.p.	Per Cent Observed h.p. to Capacity	Boiler Evaporation per lb. Combustible	Kind of Coal
17	300	30.1	3.09	139	46	11.45	Clearfield Bit.
19	150	26.9	3.5	90	60	9.73	Ant. Buck.
22	350	28	3.77	153	44.7	8.55	Ohio Bit.
Average		28.3	3.45	....	50.3	....	

* This paper was to have been presented at the meeting of the New York State Street Railway Association, September 12-13. It was omitted on account of the unavoidable absence of Prof. Carpenter, but has been made part of the proceedings.

consumption of 28.3 lbs. of steam per i.h.p. per hour, the average load being slightly over one-half of the rated capacity.

The coal per i.h.p. per hour averaged 3.45 lbs.; the evaporation per pound of combustible varied considerably, which was due in part to the variation in calorific value of the coal used. The summary of the results of the test is shown in Table II. on the preceding page.

THE NON-CONDENSING COMPOUND ENGINE. (SEE TABLE III)

The data obtained relating to this class of engine is limited, and is probably insufficient to draw any general conclusion; four tests of power stations were made, in which such engines were used; these tests are numbered respectively 2, 4, 21 and 24.

The power-house tests No. 2 and No. 4 were made when both simple and compound engines were running; the results do not differ essentially from those obtained with simple engines and previously recorded.

Tests No. 21 and No. 24 were made on non-condensing compound engines, working under fairly favorable conditions. Test No. 21 does not show better coal or steam consumption than many of the tests recorded for simple non-condensing engines; compared with No. 24 it shows a better coal record, due principally to the fact that in test No. 21 the coal used was from Western Pennsylvania, while that used in test No. 24 was from Illinois. The difference was due principally to the quality of fuel used.

It would hardly be safe to draw a general conclusion from the results in the table regarding the compound non-condensing, as compared with the simple non-condensing engine for railroad purposes, but such conclusion as could be deduced would be but slightly in favor of the compound non-condensing engine.

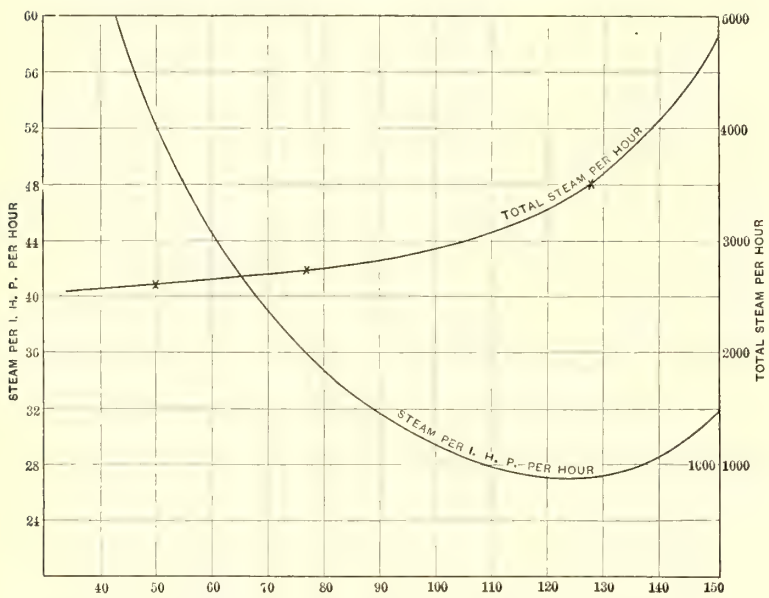
We have seen that the simple non-condensing engine performs its work in a railroad power-house under conditions of varying load with an average steam consumption only about 25 per cent higher than the best average record for its class of engines with a steady load. The compound non-condensing engine requires, on the other hand, however, nearly 40 per cent more steam than when working under best conditions with a steady load. From this

TABLE III

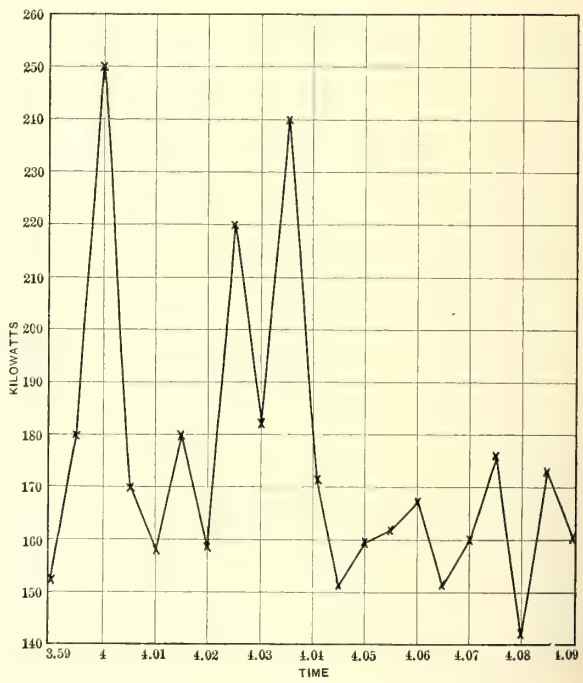
SUMMARY OF RESULTS OF TESTS OF COMPOUND NON-CONDENSING ENGINE

No.	H.p. of Engine	Steam per i.h.p. per Hour	Coal per i.h.p. Hour	Mean Observed i.h.p.	Per Cent Observed h.p. to Capacity	Boiler Evaporation Lbs.	Kind of Coal
2	1,000	30.5	4.22	603.5	60.3	9.03	Bit , 3 parts Ant.
4	1,250	36.8	4.33	674	53.8	9.92	Culm. 1 part. Bit. slack
21	400	34.20	4.17	203	51.	10.23	Bit. Penn.
24	1,200	30.37	4.93	754	62.7	9.01	Bit. Ill.
Aver. 21 and 24.		32.28	4.55	----	----	----	

Remarks.—Test No. 2 was made on three simple engines 150 h.p., one cross compound 250 h.p. and one triple 300 h p. Test No. 4 was made on three simple engines 250 h.p. each, and one compound of 500 h.p. Steam pressure, 100 to 125 lbs.



TEST OF SIMPLE NON-CONDENSING 14-IN. X 16-IN. ENGINE, 120 LBS. STEAM PRESSURE, 120 WATER H.P. 210 R.P.M.



CURVE SHOWING VARIATION IN LOAD OF RAILWAY ENGINES. HALF-MINUTE READINGS OF OUTPUT WITH FIVE CARS

Some additional information was obtained on this question by test (24) which was made on both simple and non-condensing compound engines, each kind being tested separately, and so as to give an opportunity of comparison. The test on three simple engines showed an ave age steam consumption of 31.8 lbs. of steam per i.h.p. per hour, and a fuel consumption of 5.38 lbs. of coal. The test on one compound non-condensing engine (24 in. x 48 in. x 48 in.) 1200 h.p. showed a steam consumption of 30.37 lbs. of steam and a fuel consumption of 4.93 lbs. of coal per i.h.p. per hour. The actual evaporation per pound of combustible from and at 212 degs. F. being in the test of compound 7.75 lbs., and in the test of the simple engines 7.83 lbs. of steam. Reducing the results for uniform evaporation, the two tests would indcate that the compound, as compared with the simple non-condensing, was 9.4 per cent more economical in use of coal, and about 5.5 per cent more economical in use of steam.

The compound non-condensing engine is much less economical, as shown by these tests, when employed in power-house work, where the load is variable, than when used for a steady load. Thus I have tested a compound non-condensing engine of this class working with a steady load and with about the same steam pressure as in the cases cited, and found a steam consumption under the best conditions of loading of 22 lbs. to 23 lbs. of steam per i.h.p. per hour, which is nearly 33 per cent better than shown by the same class of engines in power-house work.

limited data it would appear that the compound non-condensing engine is only slightly better than the simple non-condensing, and except under extreme conditions not sufficiently better to warrant its use.

No stations were tested using Corliss non-condensing compound engines, neither were any tested using simple condensing engines, and no engines of this class are known to the writer to be in use in railroad power stations.

THE COMPOUND CONDENSING SLIDE VALVE OR HIGH-SPEED AUTOMATIC ENGINE

The average results of the tests which were made in power stations using automatic engines of the slide valve type show a steam consumption of 23.96 lbs. and a coal consumption of 3.41 lbs. per i.h.p. per hour. If we reject the three highest values as given in tests 3 (a), 18 and 21, and the lowest result, as given in test 8 (b) we shall have for the average 22.7 lbs. of steam and 3.25 lbs. of coal per horse power per hour, which can doubtless be assumed to be most probably correct for this class of engine.

Most of the makers of engines of this class will guarantee them to produce a horse power per hour for a consumption of 18 lbs. of steam under favorable conditions of loading, and engines of this class have in several instances produced a horse power for less than 15 lbs. of steam. It will be noted that the best results with engines of this class was 16.7 lbs. of steam per i.h.p. per hour, and

2.4 lbs. coal per horse power, which was obtained with an engine of 400 h.p. of the four-valve type.

The effect of the variable load and other conditions due to railroad work is to affect the economy adversely by 30 per cent to 40 per cent, as compared with the best results with a steady load.

TABLE IV.

SUMMARY OF TESTS OF COMPOUND CONDENSING SLIDE VALVE OR HIGH SPEED AUTOMATIC ENGINE

No.	H p. of Engine	Steam per i.h.p. Hour	Coal per i.h.p. Hour	Mean Observed h.p.	Per Cent of Mean h.p. to Capacity	Boiler Evaporation, lbs.	Kind of Coal
3a	600	29.4	4.43	174	29	10.38	3 parts A; 1 pt. Bit.
3	600	23.2	3.50	190	32	9 93	1 part Bit.
8	400	20.2	3.14	154	38	8.29	Ohio Bit.
8b	400	16.7	2.40	180	45	7.75	Ohio Bit.
13	250	24.6	2.95	86	34.5	10.51	Bit. Penn.
16	350	22.7	3.41	164	47	9.50	Ant. Pea
18	1,200	25.6	3.61	904	75	10.58	Pea Penn.
21	400	29.3	3 81	188	47	10.23	Bit.
Average		23.96	3.41	....	....	9.64	
Average except 3a and 8b		24.26	3.40	....	....	9.82	
Av'r'ge omitting 3a, 18, 21 & 8b		22.7	3 25	....	....	....	

Steam pressure, 100 lbs. to 130 lbs.

COMPOUND CONDENSING ENGINES, CORLISS, GREENE, MCINTOSH & SEYMOUR TYPES

The average results of the tests made on the compound condensing Corliss engines and other engines with similar valve gear, including McIntosh & Seymour and Greene, show a steam consumption of 18.8 lbs. and a coal consumption of 2.6 lbs. per i.h.p. per hour. Omitting test No. 10, for the reason that the coal was of a poor quality and the evaporation low, the average becomes 18.25 lbs. of steam and 2.36 lbs. of coal per i.h.p. per hour. The steam consumption of this class of engines working with a good load can safely be taken as 15 lbs. or less per i.h.p. per hour, in which case the actual results in power-house practice exceed the results when the load is steady by slightly over 20 per cent.

A study of these latter tests shows a higher evaporation per pound of coal than was obtained in power-houses using the cheaper grade of engines. This is probably to be explained by the fact that a better grade of engineers and firemen are employed to operate stations of this class, as compared with those using cheaper machinery, although it may possibly be an accidental variation due to the fact that only a limited number of stations were tested in each class.

The average evaporation from and at 212 degs. per pound of combustible was found to be as follows: for stations using the simple non-condensing engine, 10.26 lbs; for stations using the compound condensing slide valve engines, 9.82 lbs.; for stations using Corliss compound condensing engines, 10.54 lbs. of steam. It is not easy to explain why the evaporation is better from stations using simple engines than from those using compound engines of the same class, as the average grade of employees is rather better in the stations using compound than simple engines; probably the variation is an accidental one due to the limited number of stations of each class tested. The average range in the variation of results of the evaporation tests for the stations employing the three classes of engines does not exceed 7 per cent, and whether it can be accounted for or not it will not seriously affect the conclusions.

TABLE V

SUMMARY OF RESULTS OF TESTS OF COMPOUND CONDENSING, CORLISS, GREENE, MCINTOSH & SEYMOUR, AND SIMILAR VALVE MOTIONS

No.	H.p. of Engine	Steam per i.h.p. per Hour	Coal per i.h.p. Hour	Mean Observed h p.	Per Cent of Mean h.p. to Capacity	Boiler Evaporation, lbs.	Kind of Coal
10	825	22.7	4.05	482	58 2	8.29	½ Bit slack. ½ A Culm.
14	1,000	21.9	2.56	277	27.7	10.96	Bit.
14	1,000	20.0	....	314	31.4	10.96	----------
28	350	16.64	2.10	182	52.2	11.80	Bit.
27	500	16.90	2.61	290	58	9.36	Bit.
30	2,000	14.50	1.80	814	40.7	10.70	Bit.
34	200	17.30	2.91	145	72	11.14	Bit.
35	1,600	20.50	2.18	....	....	11.14	Bit.
Average		18.8	2.60	....	....	10.54	

Evapo ation, 7.25 to 1 of coal.

Av'r'ge omitting No. 10		18.25	2.36	....	....	....	

Evaporation, 7.78 to 1 of coal.

SUMMARY OF RESULTS

A summary of the average results of these various tests is given in Table VI., in such manner that the various classes of engines may be readily compared. The best results with each class of engine when sufficiently well marked are also given.

A column giving the proportional value of the engine on the basis of coal consumption with a Corliss compound condensing engine placed at 100 is also given. A column giving the probable coal consumption per kw. hour is also appended.

TABLE VI

SUMMARY OF AVERAGE RESULTS

Class of Engines	Steam per i.h.p. Lbs.	Coal per i.h.p. Lbs.	Steam per i.h.p. Lbs. Best Load	Proportional Value of Engine	Probable Coal per kw., lbs.
(A) Non-condensing					
Slide valve simple, average	34 3	4.63	30	53.1	6.90
Best result	31.6	4 61	..	....	....
Corliss simple, average	28 3	3.45	25	64.5	5.65
Best result	26.9	3.01	..	....	....
Slide vaive, compound, average	30.37	4.17	22	60.2	6.12
(B) Condensing					
Slide valve, compound average	22.7	3.25	16	80.5	4.57
Best result	16 7	2 40	..	....	3.60
Corliss, compound average	18.2	2.36	15	100	3.64
Best result	14 5	1.80	..	....	2.70

RELATIVE ECONOMY OF VARIOUS TYPES OF ENGINES

Assuming that the results of the tests which have been cited give average and best results for engines of the different classes tested when working under the conditions of street railroad work, it is easy to compute the probable yearly cost of each class of engine, and by this means determine the relative value from a financial standpoint.

From the table last given it will be noted that the steam consumption per i.h.p. per hour varies from 34.3 lbs. to 14.5 lbs. A boiler horse power under the conditions of steam pressure supposed to exist would be about 30.4 lbs. of steam, although this amount would vary slightly, depending upon the temperature of feed water and upon the steam pressure. This computation would show that 1.13 boiler horse power would be required in case a simple slide valve non-condensing engine were used, while 0.6 of a boiler horse power only would be required for furnishing steam for the compound Corliss engine or engines of its type in order to supply them with the same relative amount of steam. This indicates that a considerably less amount of boiler power would be needed for the more economical engine than for the more wasteful one, and this fact tends to equalize the cost of a power station on employing the different classes of engines.

From actual prices which have been quoted within the last six months the writer feels very certain that an engine of 500-h.p. capacity, of good quality in its respective class, can be purchased and, under ordinary conditions, can be erected complete on foundations for the figures which are given in the following table. A boiler horse power is considered as worth $12 when erected for each class of engines. In view of the recent rise in prices this may be somewhat low, but the results are comparatively true for each class of engine. The figures in the table do not consider real estate, building or chimneys, which would vary largely with different conditions. Despite the fact that engines,

TABLE VII

COST PER HORSE-POWER OF 500-H.P. PLANT

	Boiler h.p. per Engine h.p.	Cost per h.p. in dollars					Cost for 500-h.p. Plant
		Engine	Boiler	Pumps and Heaters	Piping etc	Total per i.h.p.	
Non-condensing Engines							
Simple slide valve	1 135	8 00	13.60	2.00	5.00	28.60	14,300.00
Simple Corliss	0.933	12.00	11.20	2.00	5.00	30.20	15,100.00
Compound slide valve	1.00	11 00	12.00	2.00	5.00	30.00	15,000.00
Condensing Engines							
Compound slide valve	0.75	11.00	9.00	4.00	6.00	30 00	15,000.00
Compound Corliss	0.602	16 00	7.25	4.00	6.00	33.25	16,625.00

pumps, heaters and piping will cost more per horse power for the condensing engines than for the non-condensing engines, the total cost per horse power does not differ greatly for the various classes of engines employed; this is due largely to the fact that a smaller boiler plant is needed with the more economical engine.

Table VII. shows the cost per horse power and also the total cost of the machinery for a power plant of 500-h.p. capacity. It may be remarked that the cost of engines of larger units would be somewhat less per horse power and the cost of those with smaller units somewhat greater per horse power than the results shown in the table.

Taking the fuel consumption as shown by the average results and also the best results in the various tests mentioned, we can compute the yearly requirements in tons per horse power for each class of engine. This has been done in the following table, which is arranged to show the number of tons of 2000 lbs. each required per horse power per day for a day of twelve hours, of eighteen hours and of twenty-four hours. The fuel cost at $2 per ton per horse power year for a day of eighteen hours is taken as a basis of comparison of fuel costs of the various engines which have been tested. A day of eighteen hours is believed to represent fairly well the average length of time which railroad engines are required to operate. It is also believed that $2 per ton is not far from the average price paid for coal by railroad stations in this State. If anything, it is rather below than above the average price, and consequently lessens rather than exaggerates the proportional saving made by the most economical engine.

To the fuel cost of each engine must be added fixed charges of sufficient amount to cover interest and repairs, and this has been assumed to be in each case 8 per cent of the cost. No account is taken of that portion of the operating expense chargeable to employees and oil, for the reason that there is no known reason why such charges should be essentially different for the best or for the poorest engine. The following table shows these various quantities computed for the different classes of engines. The last column in the table shows the sum of fuel costs and fixed charges, and is one which may be taken to represent the proportional yearly cost of each class of engine.

By a study of the results in the latter column some interesting conclusions may be deduced.

First, as to the saving due to condensing water; we have only two results which can be compared to show the value of the condenser; these results are the cost of the compound slide valve non-condensing compared with the average value for the compound slide valve condensing. The results are respectively, $29.54 and $23.76; the saving due to condenser is $5.78, which is 19.5 per cent of the cost of running a non-condensing engine, and 24.4 per cent of the cost of running a condensing engine. The saving would seem to be nearly 20 per cent, for reasons which have been already mentioned, would probably be more.

Second, the average yearly cost of engines of the compound condensing type with the Corliss, McIntosh and Seymour, or Greene valve gear as compared with the simple slide valve engines, show a yearly saving of $14.69 per horse power.

The difference in costs of the power plants considered is $4.65, which is the excess in cost of the compound condensing Corliss type over the simple slide valve non-condensing. The saving in fuel and fixed charges is thus seen to be sufficient in a single year to pay 3.15 times the difference in cost between the cheapest and best power plant. Comparing in the same way the average yearly costs of fuel and fixed charges for the compound slide-valve condensing engine and the compound Corliss condensing type, we find a yearly saving of 5.64 in favor of the better grade of engine. The difference in costs of the two plants is 3.25 in favor of the compound condensing slide-valve engine. Thus, in a single year the saving on the fuel and fixed charges of the better engine as compared with the poorer will pay 1.73 times the difference in costs.

Third, these figures would show that no station can afford to purchase and operate the simple non-condensing engine of any type as compared with the compound condensing engine, and, fourth, that the compound condensing engine of the best type and with improved valve gear such as the Corliss, McIntosh & Seymour and Greene, and one or two other makes, although costing somewhat more, is so much more economical to operate that, taking all things into consideration, it gives much better financial returns than an engine of any other class. These financial returns are so much in their favor that unless other conditions are exceedingly unfavorable these latter engines are the only ones which should be considered in purchasing machinery for power-house work. This general conclusion, that the compound condensing engine of slow rotative speed and with the improved valve gear is much more economical to use than any other type for power-house work, even when fixed charges are considered, is certainly the only one which can be adopted from the average results of the tests which I have quoted. This conclusion is noticeable from the fact that in a comparison of costs of different types of railway engines made by Dr. Charles E. Emery, he concluded that the compound condensing engine of the slide valve type and with cylinders arranged in tandem was, when fixed charges were considered, the more economical engine to use. The tests which I have referred to point to a different conclusion, and indicate that the saving of the better type of engine will many times repay the extra expenditure of costs. In brief, the tests indicate that the engines of the best class are much the better investment.

TABLE VIII

FUEL AND INTEREST CHARGES FOR THE DIFFERENT CLASSES OF ENGINES

	Coal per i.h.p., lbs.	TONS PER H.P. PER YEAR			Fuel Cost per Year. 18 Hours per Day. $2 per ton	Interest and Depreciation 8 Per Cent	Total Cost per Year per h.p.
		Day 12 Hours	Day 18 Hours	Day 24 Hours			
Non-condensing Engines							
Simple slide valve, average	4.63	10.4	15.21	20.28	30.42	2.29	32.71
" " " best	4.60	10.7	15.10	20.14	30.20	2.29	32.49
Simple Corliss, average	3.45	7.55	11.33	15.10	22.66	2.42	25.08
" " best	3.01	6.59	9.89	13.18	19.78	2.42	22.20
Compound slide valve	4.17	9.05	13.57	18.10	27.14	2.40	29.54
Condensing Engines							
Compound slide valve, average	3.25	7.12	10.68	14.24	21.36	2.40	23.76
" " " best	2.40	5.25	7.88	10.51	15.76	2.40	18.16
Compound Corliss, average	2.36	5.17	7.74	10.33	15.48	2.64	18.12
" " best	1.80	3.94	5.91	7.88	11.82	2.64	14.46

Address of the President of the Street Railway Accountants' Association

BY J. F. CALDERWOOD

Gentlemen of the Association: "Know Thyself," that simple injunction carved over the entrance to a temple of ancient Greece—so old that no one knows who wrote it—is a motto which has impressed me as ideally appropriate for this organization, the newest branch of a business, which is at once the effect and the cause in what might be called the latest phase of modern civilization—rapid transit.

The executive head of one of the larger street railway systems of America said recently that the industry had not developed beyond 20 per cent of what might reasonably be expected as the ultimate future of street railway business in America; in other words, that there still remains four times as much to do as has been accomplished in the perfection of the art of carrying the public. If this be true, no small part of the future development must be due to the work of the men who, by analysis of accounts, establish the data for future advancement. Managers are continually balked by new problems, and while the operating department is usually able to answer satisfactorily the question: can this or that be done? it is for the accountant to go further and ascertain what can and what cannot be done profitably; for, in the end, the wisdom of every policy must pass the ordeal of ultimate cost.

Andrew Carnegie, the captain-general of the iron and steel industry, paid this tribute to the calling here represented: "There is not a science or class of men on whom the business of the world is more dependent than the science of accounts and accounting." It is an axiom of modern business on which its success depends—I will go further and say, upon which its very life depends, that of having within it a well-devised system of accounting which will show at all times (with the least labor and the greatest accuracy) its true condition. In the idiom of the street, show me the management of any company, mercantile, manufacturing or transportation, that does not recognize this principle and act upon it, and time will show you its "finish."

More, perhaps, than any other, does the street railway business depend upon, and involve diverse and extraneous conditions, rendering it doubly necessary that a successful management, in order to secure the greatest revenue with a minimum of expense, should be prepared for prompt action and unerring judgment, by careful analysis and minute comparison of the various items of revenue and expense through its accounting department.

Pursuant to a general desire on the part of those who had struggled single-handed and alone through the maze of unsystematic street car bookkeeping in a desperate effort to supply these much needed data, a few accountants met in Cleveland, March 24, 1897, for the purpose of promoting an organization which would bring together, for exchange of ideas, those engaged in the ac-

counting departments of street railways. Many of you will remember that paper, fruitful of discussion, read by C. N. Duffy, upon the "Standardization of Street Railway Accounts," which, by common consent, became the chief subject of discussion at that meeting, as it has been ever since the foundation of the chief work of this association.

For the purpose of preserving the continuity of the developments I will remind you briefly of the appointment of a committee upon this subject consisting of Mr. Duffy, chairman; W. F. Ham, of Brooklyn, and myself, which reported at the convention held at Niagara Falls in October, 1897. The report of the committee was approved, but the question arose as to the probable action of the railroad commissioners of the various States, since these commissioners in many States, prescribe what system of classification shall be used by the street railway companies reporting to them. As a result of the debate it was decided to continue the committee permanently, its membership being increased by the addition of H. L. Wilson, of Boston, and H. J. Davies, of Cleveland. The permanent committee endeavored during the following year to have meet with it the railroad commissioners of the States which exercise any control over the accounts of street railways, but arrangements could not be made previous to the convention, which met in Boston. A full and complete report covering the matter of uniform accounting was presented at the Boston convention by the committee, and adopted, notwithstanding their inability on account of lack of time to secure the approval of the railroad commissioners.

You will have presented to you, at this meeting, a full report from the committee covering its conference with representatives of the State railroad commissioners, and also of the American Railway Accountants' Association. At this conference Mr. Duffy and Mr. Ham acted for our committee. I take pride in calling your attention to the recognition there accorded the action of our association in the adoption by the conference of the entire system of classification (with a very few minor changes) as prepared and promulgated by our organization. This tribute to our committee is admirably expressed in the language of William O. Seymour, chairman of the committee which reported to the railroad commissioners at their meeting at Denver, Aug. 10 last. Mr. Seymour, in his report, said:

"It was found that the form prepared by the street railway accountants was so much more advanced in its preparation, so complete and full in its details, and so well adapted for its purpose, owing to the familiarity of those who prepared it with street railway accounting, that we deemed it wise to abandon the work which we had commenced, and advise the indorsement and adoption of the form prepared by them."

The recommendation of their committee was adopted by the convention of railroad commissioners, and we have every reason to believe that the same action will be taken by the American Railway Accountants' Association, since its representatives at the conference concurred in the action then and there taken. We have thus established, through our committee, a recognized standard classification of the various items which enter into the three chief elements of street railway accounting, namely: the revenue, the cost of operation and the cost of construction.

This important feature is now substantially fixed, subject, of course, to slight modifications from time to time as new and varying conditions make it necessary to modify slightly the present established classification, and to that end I would recommend the continuance of this permanent committee on the standard system of classification.

While our association has accomplished much by the practical establishment of a permanent classification of accounts, we are far from having concluded the work necessary for a complete system of accounting, such as would be available for purposes of comparison. What we now need and must have before we shall have fulfilled our mission, is the establishment of a unit of comparison. We may have properly classified the cost of maintenance of way, transportation and general expense, and severally and collectively determined the amounts of each for a certain period as compared with another similar period; the comparison of the totals of one period with another may be in the aggregate more or less. This means nothing in itself, unless we can reduce these several sums to a unit of comparison. Now, whether this unit shall be the ratio which each item of expense shall bear to the total revenue, or whether it shall be so much per car-mile, per motor-mile, per motor-hour or ton-mile, is the next great and important question for the association to consider and to settle. To H. C. Mackay has been assigned a paper bearing upon this subject, which will be read at this convention, and we trust he will suggest a solution of this most perplexing proposition. I would recommend the appointment of a committee on the establishment of a unit of comparison. When this is done I shall feel that we are nearing our goal. With the classification and the unit established, the next important feature is a statement blank that will enable the accountants to present, in a uniform, simple and concise manner, the various results and comparisons.

We have established a department of blanks and forms, and to our energetic and persevering secretary, W. B. Brockway, the association is indebted for a remarkable exhibit of the blanks and forms of various street railway companies. These he has arranged and will present with his report, the first important feature, as well as one of the most interesting on the programme for Thursday's session.

I cannot conclude this task without yielding to a duty which I feel to be incumbent upon me at this time. I desire to remind the members of this association that the enthusiastic accountant, charmed with the possibilities for analysis and classification which lie within apparently meaningless statistics, is frequently tempted to indulge in hobbies, which, while pretty enough from the accountant's standpoint, and frequently necessary in part, are worse than useless so far as giving practical information to the management. The ideal accountant wastes no energy upon unnecessary labor. His aim should be to prepare and present to the management only such salient facts as will enable the man in command to make instant comparison upon the three fundamental elements of street railway operation, namely: the revenue, the labor cost and the material cost; all else is subsidiary.

The revenue statement should show, by hours or otherwise, the number of passengers carried, so that the management may be enabled to secure the largest revenue with the least expenditure.

The labor statement should show, in a systematic and comparative manner, the number of men employed and the amount of wages paid in each department, that the management may compare with corresponding periods, and be able to control labor expenditure and keep within a fixed ratio.

The material statement, by showing the kinds, quantity and cost of materials bought and the consumption of the same, enables the management at all times to regulate the stock of material on hand.

I shall be pleased if what I have just said, fragmentary and brief as it must needs be in an address of this character, will create a discussion; if not at this meeting, at some subsequent meeting of our association. I believe we get more out of the "experience-meeting" feature of our gatherings than from the set papers, valuable as they are.

In ending my term as president, I wish to express my especial appreciation of the good work of C. N. Duffy, that perfect type of an aggressive, progressive and intelligent all-around master of accounting and business man, who laid at Cleveland the corner-stone of this structure, and to his worthy associate, W. F. Ham. To these two gentlemen this association is indebted for the larger part of the great work which it has accomplished since its birth, and I hope that this association has only begun in a field of usefulness which broadens as we advance. Purely practical and limited in scope though it be, it has afforded us a vehicle for good fellowship which I have enjoyed quite as much as the professional stimalus and suggestion. I look forward to future meetings with pleasure, and I thank you all for uniform courtesy extended to me since I have had the honor to preside over your deliberations.

Report of the Secretary and Treasurer of the Street Railway Accountants' Association

BY W. B. BROCKWAY

The past year has been an exceptionally busy one in the secretary's office, not alone in the regular work falling to such an office, but to the preparation of the department of blanks and forms, which is explained in the report of that department, to be made Thursday.

Thirty-four companies have been admitted to membership since the last meeting, as follows:

Tiffin, Fostoria & Eastern Railway Company, Tiffin, Ohio.
Omaha Street Railway Company, Omaha, Neb.
Stamford Street Railway Company, Stamford, Conn.
Cleveland City Railway Company, Cleveland, Ohio.
Citizens' Rapid Transit Company, Nashville, Tenn.
Ottawa Electric Railway, Ottowa, Ontario, Canada.
City Electric Railway, Port Huron, Mich.
Fair Haven & Westville Railroad Company, New Haven, Conn.
Milwaukee, Racine & Kenosha Electric Railway Company, Racine, Wis.
North Hudson County Railroad, Hoboken, N. J.
Metropolitan Street Railway Company, New York, N. Y.
Norfolk Street Railway Company, Norfolk, Va.
Tri-City Railway, Davenport, Iowa.
Metropolitan Street Railway, Kansas City, Mo.
Syracuse Rapid Transit Company, Syracuse, N. Y.
Quebec, Montmorenci & Charlevoix Railway, Quebec, Canada.
Union Traction Company, Philadelphia, Pa.
Vicksburg Railroad, Power & Manufacturing Company, Vicksburg, Miss.
North Chicago Street Railway Company, Chicago, Ill.
Savannah, Thunderbolt & Isle of Hope Railway Company, Savannah, Ga.
San Diego Electric Railway Company, San Diego, Cal.

Duluth Street Railway Company, Duluth, Minn.
Glasgow Corporation Tramways, Glasgow, Scotland, England.
Calumet Electric Street Railway, Chicago, Ill.
Brightwood Railroad, Washington, D. C.
Mobile Light & Railway Company, Mobile, Ala.
Butte Consolidated Street Railway Company, Butte, Mon.
Schenectady Railway Company, Schenectady, N. Y.
Central London Railway, London, England.
Third Avenue Railroad Company, New York, N. Y.
The American Railways Company, Philadelphia, Pa.
Alton Railway, Gas & Electric Company, Alton, Ill.
Kansas City & Leavenworth Railway Company, Leavenworth, Kan.
The Albany Railway, Albany, N. Y.

And but two have resigned:

Birmingham Railway & Electric Company, Birmingham, Ala.
Manchester Street Railway Company, Manchester, N. H.

A statement of the growth of the association is as follows:

Companies forming the Association at Cleveland, March, 1897	25
New members reported at Niagara Falls, October, 1897	12
New members reported at Boston, September, 1898	32
New members reported at Chicago, October, 1899	34
Total	103
Withdrawn	3
Total members to be reported Oct. 17, 1899	100

But a new problem of consolidation is confronting us, a problem which is having a tremendous effect upon the whole street railway world, and I would commend to your earnest consideration the suggestions made in the report of your executive committee.

The finances to be reported are:

Balance from Sept. 9, 1899	$51.84	
Received from applications for membership	340.00	
Received from 1899 dues	730.00	
Received from 1898 dues	60.00	
Received from department of blanks	3.91	
Received from bills payable	225.00	
Received from interest on deposits	.27	
		$1,411.02
Expended for salary of the secretary	$200.00	
Expenses of the secretary's office	83.24	
Printing circulars and stationery	96.65	
Postage for reports, circulars, etc	79.03	
Executive committee meetings	46.05	
Stenographer for Boston meeting	105.00	
Printing report of the Boston meeting	224.67	
Printing 1898 report of the standardization committee	74.49	
1898 expenses of the standarization committee	68.50	
Secretary's traveling expenses	156.90	
Department of blanks and forms	157.21	
Bills payable	100.00	
Cash in Home Savings Bank, Toledo, Ohio	19.28	
		$1,411.02

Bills payable		$125.00
Cash in bank	$19.28	
Unpaid dues	30.00	49.28
Deficit		$75.72

Thus, I cannot report the association as having been a dividend payer, but I am sure the results of the work of the committee on a standard system of accounts and the department of blanks and forms, which now has something tangible to offer, will well repay any reasonable stringency which we may encounter. The circulars sent out from the secretary's office to explain the benefits of membership have all resulted in the increase of applications. We seem to have almost accomplished most of the expensive work made necessary by the creation of the departments of standardization and blanks, and eventually we will sail on the smoother waters of "well-to-do."

It is again my bounden duty to express my doubly grateful thanks to all who have in so many ways assisted in the performance of the work of the association. It has all been so cheerful that the thanks are the more heartfelt, and in all true sincerity I say, thank you.

Report of the Standardization Committee of the Street Railway Accountants' Association

The report to the convention of 1899 of the committee on a standard system of street railway accounting consisted of a final draft of the classification and equipment accounts for overhead, underground, third-rail, storage battery and surface contact electric railways, this draft including the amendments agreed upon by the committees on standardization of the Street Railway Accountants' Association, the Association of American Railway Accounting Officers, and the National Association of Railroad Commissioners. This final draft is the same as that printed in the Street Railway Journal for October, 1898, pages 632 to 638, with the corrections embodied in the following report of Chairman C. N. Duffy, presented to the 1899 convention in Chicago.

Chicago, Oct. 18, 1899.

To the Members of the Street Railway Accountants' Association of America:

Gentlemen.—In response to the invitation of William O. Seymour, of the Board of Railroad Commissioners of the State of Connecticut, to attend a meeting at the Manhattan hotel, New York City, on July 11, 1899, to confer with the committee representing the Convention of Railroad Commissioners and the committee representing the Association of American Railway Accounting Officers, for a general discussion upon the subject of a classification of construction and operating expenses of electric roads, your committee begs leave to report that two of the members attended the meeting.

The following gentlemen were present at the meeting: Wm. O. Seymour, member of Board of Railroad Commissioners of the State of Connecticut and chairman of committee on classification of construction and operating expenses for electric roads; Ashley W. Cole, chairman Board of Railroad Commissioners of State of New York and a member of Mr. Seymour's committee; H. M. Kochersperger, Comptroller New York, New Haven & Hartford Railroad Company and a member of committee representing Association of American Railway Accounting Officers; J. D. Green, auditor of disbursements Pennsylvania Railroad Company and a member of committee representing Association of American Railway Accounting Officers; Wm. F. Ham, representing the Street Railway Accountants' Association of America; C. N. Duffy, representing the Street Railway Accountants' Association of America; H. T. Billings, clerk Board of Railroad Commissioners, State of Connecticut.

After a morning and afternoon session, in which the report of the committee on a standard system of street railway accounting, covering the classification of construction and equipment accounts, classification of operating expense accounts, and forms of monthly and annual reports made to the Street Railway Accountants' Association of America, at its second annual convention, held in Boston, Sept. 6-9, 1898, was fully discussed, the following modifications and changes were unanimously agreed to by all the gentlemen present:

1st.—The title of the sub-heading, "Car Service," which includes operating expense accounts numbers 16 to 24, both inclusive, the second sub-heading under the main heading, "Transportation," was changed from "Car Service" to "Operation of Cars."

2d.—The cost of replacing horses lost by death or worn out in service, and the depreciation in the value of horses, was transferred from account No. 30, "Stable Expenses," to account No. 8, "Maintenance of Miscellaneous Equipment."

3d.—The number of operating expense accounts was changed to 38, numbers 1 to 38, inclusive, account No. 39, "Taxes," being eliminated from operating expense accounts, and classified as a "Deduction from Income."

4th.—In monthly report, under "Deductions from Income," the first item is to be "Taxes."

5th.—In annual reports, under "Deductions from Income," the first item is to be "Taxes."

In explanation of the modifications and changes that were agreed to, we beg leave to submit the following:

1st.—Changing the title of the sub-heading, "Car Service," from "Car Service" to "Operation of Cars." It was stated that the title "Car Service" would conflict with a technical term used in the operation of steam railroads, and with an account that steam railroads carry on their books. In addition, it was suggested that the title of the sub-heading, "Operation of Cars," was preferable to "Car Service," and was in uniformity with the title of the first sub-heading under "Transportation," "Operation of Power Plant." Your committee readily agreed to this suggestion, as we both considered not only the objection to the old title founded, but the name of the new title an improvement over the old.

2d.—Transferring from account No. 30, "Stable Expenses," to account No. 8, "Maintenance of Miscellaneous Equipment," the cost of replacing horses lost by death or worn out in service, and the depreciation in the value of horses. The gentlemen criticised the action of your committee in classifying this item under account No. 30, "Stable Expenses," a "General Expense" account, for the reason that they thought that the cost of maintaining horses was a maintenance charge, and should be classified under the same account that carried the cost of maintaining the wagons and harness. They pointed out that the wagons, harness and horses were one, in the sense that the wagons and harness were useless without the horses, and that in their opinion account No. 8 should carry the cost of maintaining wagons, harness and horses, in order to have the classification consistent. In this, your committee thought they were correct.

3d.—Eliminating account No. 39, "Taxes," from operating expense accounts and classifying same as a "Deduction from Income." In view of the fact that under the Inter-State Commerce classification of accounts, the universal standard followed by steam railroads and the position taken by all boards of railroad commissioners throughout the United States who exercise any supervision over the books and accounts of street railways, that "Taxes" are considered a "Deduction from Income" and not an "Operating

Expense Account," and for the sake of bringing about a uniformity of methods and secure the co-operation of the convention of State Railroad Commissioners and the Association of American Railway Accounting Officers, all of the gentlemen representing these two associations being unanimously of the same opinion as to the disposition of "Taxes," and in addition being firmly fixed in their opinion that "Taxes" should not be a part of the operating expenses of a road, your committee agreed to change the classification of operating expense accounts, taking therefrom account No. 39, "Taxes," and treat "Taxes" as a "Deduction from Income," making it the first item under that heading in monthly reports and annual reports.

At the eleventh annual convention of Railroad Commissioners, held in the city of Denver, Aug. 10, 1899, Mr. Seymour, chairman of committee on classification of construction and operating expenses of electric railways, presented his report, in which he reviewed the work of his committee, referred to the meeting with this committee, spoke in the highest terms of the form of classification of accounts adopted by this association, advised its indorsement and adoption by his association, and submitted verbatim the printed report this committee made to the Boston convention, Sept. 6-9, 1898, with the changes and modifications as agreed upon at the meeting held in New York City July 11, 1899, embodied in the printed report.

The Convention of Railroad Commissioners unanimously adopted Mr. Seymour's report, commending it most highly.

Mr. Seymour's report proper has been made a part of this report.

The committee representing the Association of American Railway Accounting Officers, who were present at the meeting held in New York City July 11, 1899, stated that they would report to their association, at its next annual convention, to be held in May, 1900, the result of the conference with the committees from the Convention of Railroad Commissioners and the Street Railway Accountants' Association of America, and that as a committee they would recommend the adoption and use of the standard system of street railway accounting adopted by the Street Railway Accountants' Association of America, with the modifications and changes as agreed upon embodied into the system.

Your committee desire to take advantage of this opportunity to express their appreciation of the hearty co-operation extended to them by the gentlemen representing the Convention of Railroad Commissioners and the Association of American Railway Accounting Officers, for Mr. Seymour's kind words and strong indorsement of the work of this association, as expressed in his report to the Convention of Railroad Commissioners, and also to the members of that association, for their action in unanimously adopting Mr. Seymour's report as presented.

Through the co-operation of the Convention of Railroad Commissioners and the Association of American Railway Accounting Officers, with this association, and in view of what this association has already accomplished, the standard system of street railway accounting adopted by the Street Railway Accountants' Association of America will undoubtedly be used by all street railway companies, thereby securing a uniformity of methods, which has been so much desired and for which we have so earnestly labored.

The classification of accounts accompanying this report embodies all the modifications and changes as agreed upon at the meeting held in New York City, July 11, 1899, and as adopted by the Convention of Railroad Commissioners, at the meeting held in Denver, Aug. 10, 1899. Your committee asks this association to indorse and approve what they have done by ratifying and confirming their action and adopting this report as presented.

Respectfully submitted for the committee,

C. N. DUFFY, Chairman.

Supplementary Report of Committee on a Standard System of Street Railway Accounting

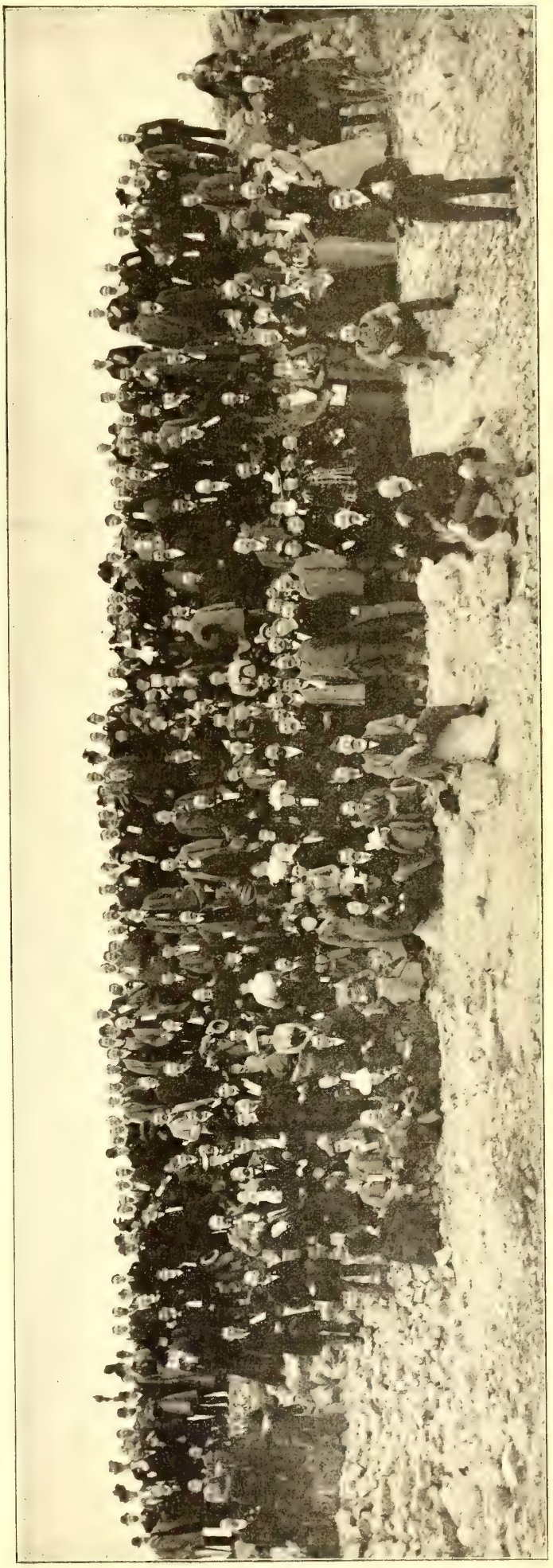
Mr. Duffy also presented a supplementary report in the convention as follows:

CHICAGO, Oct. 18, 1899.

To the Members of the Street Railway Accountants' Association of America:

Gentlemen—In addition to the printed report made by your committee and presented to this convention, we desire to present for your consideration other questions in connection with the standard system of accounting, not touched upon in the printed report.

First—Construction and Equipment Account—"H"—"Investment Real Estate." The instructions classifying this account read, "Charge to this account all expenditures for land and buildings not used in operation of road."



GROUP OF DELEGATES AT CHICAGO CONVENTION, TAKEN WHILE VISITING DRAINAGE CANAL

The committee want it understood that this refers to land and buildings purchased in connection with securing right of way, and real estate used in operation of road, but not a part of either, although incident to the construction and equipment of the road. This does *not* refer to the purchase of land and buildings bought for the purpose of investing surplus funds of the company, which should be charged to a special account; for example, "Surplus Investments." It having been suggested to your committee that the instructions concerning this account were not sufficiently clear or explicit, and that "Investment Real Estate" was not a construction and equipment account, we submit the above for your information.

Second—Monthly Reports—Debiting and crediting the month's proportion of each item under "Income From Other Sources," "Deductions From Income," and "Deductions From Net Income," currently, each month, and charging to accounts Nos. 36 and 37, respectively, the month's proportion of the total annual charge of these accounts, estimating such debits, credits or charges, if the exact amount per month is not known.

The instructions regarding these questions appear to be complete and sufficiently clear and explicit. As far as your committee know, they are fully understood, but they are not always properly carried out. The debits, credits or charges referred to, should be estimated and apportioned monthly, as closely as possible, from the best information obtainable, and the amounts taken up each month by journal entry, so that they would appear on the books. In many instances, these amounts are pro-rated on the monthly report, without having been put on the books at all.

Third—Classification of Material and Supplies—A classification of material and supplies is submitted, because your committee consider it of the greatest importance in connection with the use of the standard system of accounting adopted by this association. Material and supplies have been classified under thirteen departments, A to M, inclusive. The items properly classified under each department, should be alphabetically arranged as they are under each account. In addition, the items should be indexed, showing the department or departments that each item properly belongs to. This detail would have been carried out by your committee, if sufficient time were at our disposal to do the work.

This supplementary report is presented for your careful consideration. We hope that the questions referred to will meet with full discussion, and we will be glad to have the report subjected to any criticism that you may see fit to make.

Respectfully submitted for the committee,

C. N. Duffy, Chairman.

CLASSIFICATION OF MATERIAL AND SUPPLIES.

Department.

A. Material and Supplies for Maintenance of Track and Roadway.
   All material and supplies as classified under Account No. 1, that properly belong *only* to Track and Roadway.

B. Material and Supplies for Maintenance of Electric Line.
   All material and supplies as classified under Account No. 2, that properly belong *only* to Electric Line.

C. Material and Supplies for Maintenance of Buildings and Fixtures.
   All material and supplies as classified under Account No. 3, that properly belong *only* to Buildings and Fixtures.

D. Material and Supplies for Maintenance of Steam Plant.
   All material and supplies as classified under Account No. 4, that properly belong *only* to Steam Plant.

E. Material and supplies for Maintenance of Electric Plant.
   All material and supplies as classified under Account No. 5, that properly belong *only* to Electric Plant.

F. Material and Supplies for Maintenance of Cars.
   All materials and supplies as classified under Account No. 6, that properly belong *only* to Cars.

G. Material and Supplies for Maintenance of Electric Equipment of Cars.
   All material and supplies as classified under Account No. 7, that properly belong *only* to Electric Equipment of Cars.

H. Material and supplies for Maintenance of Miscellaneous Equipment.
   All material and supplies as classified under Account No. 8, that properly belong *only* to Miscellaneous Equipment.

I. Material and Supplies for Shop.
   All material and supplies as classified under Account No. 9, that properly belong *only* to Shop.

J. Fuel (Coal, Coke, Charcoal, Kindling).
   All coal, coke, charcoal and kindling, including coke for welded joints, charcoal for electric line; charcoal, coal and coke for shop; fuel for power; charcoal, coal, coke and kindling for heating cars; coal or coke for heating buildings, and fuel for drying sand.

K. Lubricants and Waste (Oil, Grease, Waste, Rags).
   All oil, grease or other lubricants, and all waste or rags used with lubricants, for shop, power plant, cars, track, wagons, etc.

L. Printing and Stationery.
   All printing and stationery of every description, including tickets, transfers, legal papers, signs, posters and other advertising matter.

M. Miscellaneous Material and Supplies.
   All material and supplies as classified under Accounts Nos. 14, 21, 22, 23, 24, 28, 29 and 30, that properly belong *only* to those accounts, and all material and supplies *not* classified specifically under Departments A, B, C, D, E, F, G, H, I, J, K or L.

The following is a list of some of the items that it is proper to classify under Department "M."

Arc lights and fixtures.
Babbitt (metals).
Badges (employees').
Batteries (for car bells).
Bedding (stable).
Bell cord.
Belting.
Blankets (stable).
Bolts.
Brass (metals).
Brick.
Brooms.
Brushes (car washing).
Brushes (flue).
Brushes (generators).
Brushes (horse).
Brushes (motors).
Brushes (scrubbing).
Buckets.
Carbons (arc light).
Cement.
Chamois skins.
Conductor's books.
Conductor's punches.
Copper (metals).
Cotters.
Curry combs.
Emery cloth.
Feather dusters.
Feed (stable).
Fire buckets.
Fire extinguishers.
Fuses (cars).
Garnet paper.
Globes (arc light).
Horse shoeing supplies.
Hose.
Iron.
Lamps (incandescent).
Light { (lanterns, oil, wick, torches, candles, incandescent lamps).
Lumber.
Matches.
Medicine (stable).
Metals (babbitt, brass, copper, etc.).
Mops.
Nails.
Nuts (for bolts).
Oil cans.
Packing (for engines).
Painting material { (linseed oil, turpentine, varnish, white lead, painter's brushes and supplies).
Paving material.
Pokers (car stoves).
Polish.
Portable registers.
Rags.
Rivets.
Salt.
Sand.
Sandpaper.
Screws.
Shakers (car stoves).
Shovels (car stoves).
Soap.
Spikes.
Sponges.
Sprinkling cans.
Steel.
Stone.
Stove blacking (car stoves).
Tape (insulating).
Tools (hand).
Towels.
Trolley rope.
Uniforms.
Washers (iron).
Washers (car washers).
Waste cans.
Water gauge glasses.
Wire.

Respectfully submitted to the Street Railway Accountant's Association of America, by committee on a standard system of street railway accounting. C. N. Duffy, Chairman.

Annual Convention of the Pennsylvania Street Railway Association

The regular annual convention of the Pennsylvania Street Railway Association was held at the Stevens House, Lancaster, Oct. 11 and 12. In the absence of President Silliman, Vice-President W. B. Given introduced Simon Schissler, Mayor of Lancaster. Mr. Schissler welcomed the delegates to the city, and the response to his address was delivered by J. H. Stedman, in behalf of the association.

The roll-call followed, showing the following active members of the association were represented: Altoona & Logan Valley Traction Company, Harrisburg Traction Company, Lebanon Valley Traction Company, Pennsylvania Traction Company, The Scranton Railway Company, Schuylkill Traction Company, United Traction Company (Reading), Union Traction Company (Philadelphia), Wilkesbarre & Wyoming Valley Traction Company, Williamsport Passenger Railway Company, York Street Railway Company.

The associate members and others in attendance represented the following: J. G. Brill Company, Philadelphia; General Electric Company, Philadelphia; Pennsylvania Steel Company, Steelton; Lobdell Car Wheel Company, Wilmington; Westinghouse Electric & Manufacturing Company, Philadelphia; McKee, Fuller & Company, Catasqua; Philadelphia Car Wheel Company, Philadelphia; Pittsburgh Car Wheel Company, Pittsburgh; Pennsylvania Car Wheel Company, Pittsburgh; Providence Engineering Works, Providence; Street Railway Journal, New York; Smith, Wallace & Bonta, Buffalo; Jackson & Sharp Company, Wilmington; Lykens & Williams Valley Street Railway, Lykens; J. H. Stedman, transfer expert, Rochester; York Car Brake Company, York.

Three papers were read, one on "Street Railway Trucks." by W. H. Heulings, Jr., of the J. G. Brill Company; one on the "Railway Engine of To-day, a Combination of the Principles of High

Speed and Corliss Practice," by W. P. MacKenzie, assistant manager of the Harrisburg Foundry & Machine Works, and one on "Track Construction," by Frank Silliman, Jr., general manager of the Scranton Traction Company.

MR. HEULINGS' PAPER

Mr. Heulings dwelt upon the necessity of good trucks and stated that even comparatively light car bodies, if mounted upon rough riding trucks, will pound to pieces the best roadbed and twist and bend the heaviest rails more or less out of shape within a surprisingly short length of time. He said that this result had been reached within two or two and a half years on roads within his knowledge, where only moderate speeds were used, and where the car bodies were quite small. The first electric truck introduced upon street railways was of the four wheel non-pivotal type and was a natural development of the old horse car running gear. He described what he considered the proper construction which included a solid side frame, preferably forged, making each wheel piece a single bar, and with the two wheel pieces connected by heavy end irons. This makes the truck a self-contained motor vehicle with sufficient strength to support the machinery and haul the trailer if necessary. The springs are an important feature and the writer recommends the use of eight journal box springs, and placing the car springs on the solid frame. Of the latter springs, the outer springs should be half elliptics, those on each side of the jaw, spiral. Although numerous attempts have been made to secure equalizing four-wheel trucks, the speaker thought that these attempts had been unsuccessful. He also said that most of the destruction of street railway tracks comes from badly constructed trucks and not from any heavy trucking which goes over them. He doubted whether four-wheel cars are suitable for any service on modern street railways and strongly recommended double truck cars, claiming the cost of propulsion by steam or electricity varies according to the number of units rather than their size, and is practically independent of the load carried. Moreover, the four-wheel truck, whether of large size or small, should not be run at a high speed because its destructive power increases in proportion to the square of the speed.

Mr. Heulings then discussed the maximum traction truck and stated that a maximum traction car requires no more power for its operation than a four-wheel car. To fortify this assertion he cited the case of the New Orleans Traction Company, which, in 1894, contracted with the Louisiana Electric Light Company to purchase power for its cars at a given rate per car per day. The fact of the traction company introducing maximum traction truck cars was the foundation for litigation brought by the light company, which claimed more compensation to cover the increased consumption of electricity. The traction company's engineer, B. Willard, and the light company's engineer, J. B. Craven, with Walter H. Knight, then of the General Electric Company, conducted a series of tests. Their report was: "We cannot find that the 22-ft. cars on maximum traction trucks consume any more power than the ordinary 18-ft. car bodies on single four-wheeled trucks, such as used on some of the New Orleans Traction Company's lines." Experiments by the Consolidated Traction Company, of Jersey City, showed that the repairs to motors and trucks varied directly as the number of motors and was independent of their size, that the eight-wheel car had a repair account practically twice as large as that of the four-wheel cars. The maximum traction truck permits the use of two motors to the car. It carries a longer and heavier car body and without increasing the weight on the driving wheels over the weight on the wheels of a four-wheeled car, allows the whole weight of the car body to be increased by 33 1/3 per cent.

Ample traction is secured with this truck for the most rapid running, as shown on the Washington, Alexandria & Mt. Vernon Railway, where maximum traction trucks are running at a speed of 40 miles an hour. Another advantage of these trucks over those with four wheels of equal size, is that the car can be brought so low that a single step of usual height gives access to the platform. For high speed service he recommended the Brill "perfect" truck, which has been described in these columns.

From this truck the company has developed the No. 27-G truck, especially for city and suburban use. The No. 27-G truck has four motors, an inside brake and so short a wheel base that it can be used on cars which have to pass short city curves. The swing of the wheels is so short as to make it possible to use them under cars of ordinary width without unduly raising the car body. The equalizer is replaced by long half elliptic springs which also take the place of the elliptics on the spring plank. The four motors employed give the car the greatest possible tractive force and fit it for running at any desired speed. For certain purposes it is possible to modify this truck in such a way as to make it perform many of the functions of the maximum traction, using only one motor per truck. In this case the motor is carried outside the axle, thus bringing a considerable increase of weight upon the driving wheel while the center bearing and center radiation is retained. The spring links, the swing motion and the perfect equalization, three sets of springs, together with journal springs of ample size are features which are retained and which together are the reason for its exceptionally easy motion. The "perfect" truck has shown itself capable of meeting a surprisingly large variety of conditions. At all times it retains its characteristic ease of riding.

While Mr. Heulings had no figures to present relative to the diminished flange wear of wheels in these trucks, he stated that owing to the softening of the side motion by the spring links, little pressure is brought upon the flanges. The truck may be forced violently from side to side by the irregularities of the track, yet so perfectly is the body hung that it only follows the truck slowly or allows the truck to move without itself moving at all. Incidentally in the construction of this type of truck great gain was made in strength. Instead of transmitting the weight of the car body through the transoms to the center of the wheel piece and then from the wheel piece out toward the spring pockets, a considerable distance, in the present case the weight where the spring links throw it upon the wheel piece is but a short distance from the jaws. The wheel pieces are consequently subjected to very little strain and the truck is much stronger in consequence. In fact, getting out of square from the strains set up in running ought to be and is practically unheard of.

MR. MACKENZIE'S PAPER

Mr. MacKenzie objected to the prevalent designation of engines as "high speed" and "low speed," and prefers the terms "short stroke" and "long stroke," for the short stroke engine is often a low speed engine, having a less piston travel per minute, although the rotative speed is higher. In the short stroke engine the steam is admitted to the cylinder much oftener than in the long stroke; there is therefore less opportunity for the cylinder walls to cool, and consequently less cylinder condensation occurs. The economy of this, however, is somewhat offset by the usual higher temperature of exhaust and greater clearance space necessary. These last, in turn, however, became of less importance when a condenser is used or when the exhaust steam is utilized for heating, which are conditions very generally found to-day.

The usual type of governor employed with this engine is an automatic shaft governor.

Corliss or long stroke engines have, in the matter of steam distribution, undoubted advantages, and in their sphere give satisfactory results, although this sphere is limited. As built to-day, they are practically the same in the arrangement of their mechanism as the original one from which they derive their name. The old vacuum dash pots and tripping device remain, and it is not considered practical to speed the engine much over 90 r.p.m., or at the most 100 r.p.m. The old style Corliss engine also takes up more space and is more noisy than the modern short stroke engine. With the high rotative speed of the latter, smaller diameter fly wheels are possible, and with the same rim velocity the danger of bursting wheels is reduced, as it is easier to make the smaller castings perfect. The short stroke engines also regulate closer on account of their use of an inertia shaft governor. Compared with the long stroke engine, however, they are usually less economical in coal consumption per i.h.p.

The writer then stated that three or four styles of combination engines designed to embody the advantages of both the short stroke and Corliss engine had been placed on the market, and of these described that manufactured by the Harrisburg Foundry & Machine Company.

Probably the most novel feature in this engine is the steam accelerated valve gear, so-called because of auxiliary steam cylinders, so arranged as to give a most positive and instantaneous cut-off to the steam admission valves. The engine is provided with two eccentrics, each having unvarying motion, being fixed to the shaft. That eccentric which operates the mechanism controlling the steam valves is connected to a rocker arm on the side of the engine frame, and from this point a connecting rod transmits the motion to two levers, which are pivoted to the valve stem brackets. On the outside of these levers protrudes a small steel shaft, at the end of which is a multiple sided steel block made with renewable wearing surfaces. To the outer end of each valve stem is securely keyed another lever, through which passes a small rod. To the lower end of this is attached a hardened steel toe-piece, with a face to correspond and engage with the multiple sided steel block above alluded to. This toe-piece is actuated by a cam by means of a shaft and lever; the cam is pivoted upon the valve stem bracket, and receives its motion from a rod connecting through a bell crank to a centrally balanced centrifugal inertia governor. By a connecting link the cams are made to operate in unison. The governor is mounted upon a heavy bracket shaft, securely fastened to the side of the engine frame and is driven by a belt from a pulley keyed to

the engine shaft. From the mechanism above described it will be apparent that if no auxiliary motion were provided, the cut-off of steam in the cylinder would occur in a hesitating manner, due to the slow travel of the eccentric through its arc of motion. It is this difficulty that the steam acceleration overcomes, as a brief description will make evident. Attached to the heaviest portion of the valve stem bracket is a frame having two small cylinders, one intended for air and the other for steam. The piston rod common to both connects at a central point by a sliding block to a lever, extending upwards and keyed to the valve stem. The auxiliary steam cylinder is supplied by steam direct from the boiler. This auxiliary cylinder has no piston but the piston rod common to both cylinders passes into the steam end by means of the ordinary stuffing box, and thus presents only the end sectional area to the pressure therein. No new steam is required nor exhaust necessary, hence no losses from this source are possible. The constant pressure in the auxiliary steam cylinder compels contact of the toe-piece and multiple faced block, which continues until released at a position determined automatically by the centrifugal inertia governor. The steam pressure then instantly impels the steam valve to positive cut-off, instead of allowing the more leisurely action of the eccentric alone. This steam accelerated motion of the cut-off device is arrested by the compression of air in the cylinder provided for that purpose, forming a cushion which prevents all jar, vibration or damage.

The exhaust valves of the engine are controlled by a motion beginning at the outer eccentric, which, as already stated, is fixed to the crank shaft and has therefore a constant motion. Through the medium of a rocker arm and two connecting rods, this motion is directed to the long arm of a bell crank attached to the valve stem bracket a little to one side of its center. To the short arm of this bell crank is attached a link, which transmits the motion to a lever keyed to the valve stem; the valve being thus oscillated by the compounding of the angularity of the several levers gains a greatly to be desired quickness of motion at the points of release and closure. The forward exhaust valve is connected to the other by a common link so that they work in harmony with one another.

The governor is of the centrifugal inertia type and is centrally balanced, which balance is maintained in all positions of cut-off, the governor operating with equal ease and isochronism from zero to 75 per cent cut-off. The rotative speed of the governor is about three times greater than that of the engine, insuring unusual sensitiveness. The variation in speed by the use of this style of governor, no matter how sudden or great the change of load may be, can be easily kept within the very close bounds of 1 per cent, and under exceptional circumstances, where the service demands it, the range can be reduced as low as ½ per cent.

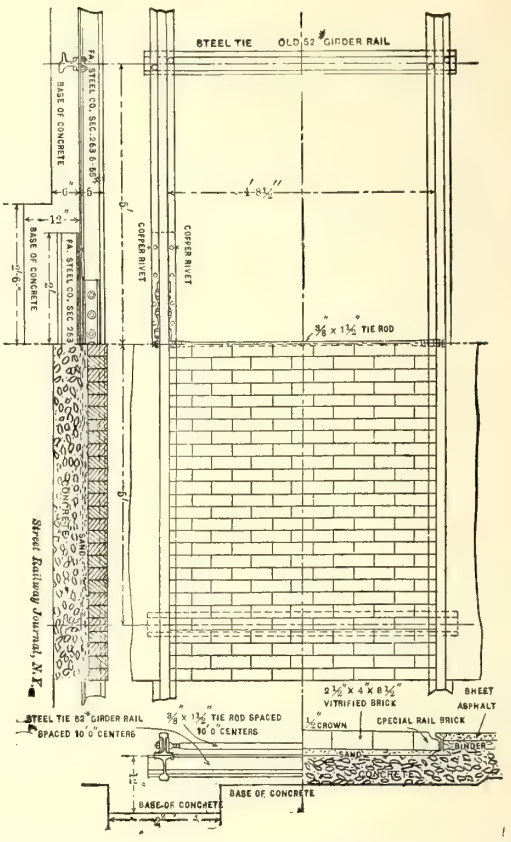
The form of valve used is similar to Corliss practice, being a multi-ported rotary valve, by the adoption of which the clearance spaces are very much reduced, over those usually found in high speed practice, thus resulting in improved economy.

In summary, Mr. MacKenzie claimed for the type of engine described, the following combination of virtues: Compactness, simplicity, ease of access, quiet running, great range of speed, smaller diameter fly-wheels possible, when direct-connected lower first cost of generators as rotative speed can be comparatively high, low friction losses, almost perfect regulation, and economy equal to the best known practice.

MR. SILLIMAN'S PAPER

In the design of a construction of track that has been used in Scranton on the lines of the Scranton Railway Company, to a considerable extent during 1899, the two main points sought were a rigid joint without the use of unduly heavy rail between the joints and the employment only of such materials as are practically imperishable

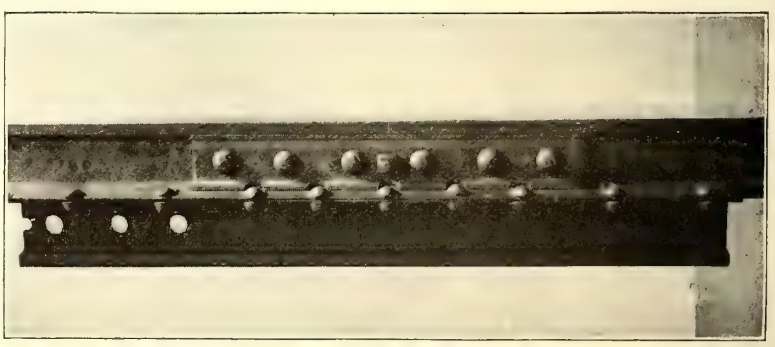
The rail used has been a 5-in. high T-rail, having a base of width equal to the height of the rail, and weighing 57 lbs. per yard, with a stem ⅜ in. thick, and having parallel sides. The joint consists of the ordinary six-bolt joint that has been heretofore furnished with such rail, except that it has been rolled to a little heavier weight. Entirely in addition to this joint, is what is claimed to be a novel feature of it, and that is, a 4 ft. long piece of the same section of rail, inverted and placed under the joint, and secured to it by eighteen ¾ in. rivets, which are driven by a pneumatic bridge riveter in the field. Four of these rivets are of copper, and constitute bonds of the joint. As long as the rivets hold tight, this makes a rail at the joint, that is 10 ins. in depth, securing a girder as deep as the heaviest sections of rail that are rolled. In between the joints, it is, of course, not necessary that the rails should be as heavy, and the great waste in the ordinary 9-in. or 10-in. rail track construction, is owing to the fact that there is so much of this great weight of rail used in between the joints, in order that the joints themselves may be of the necessary stiffness and rigidity. The rails being in 60-ft. lengths, make the economy of this construction still greater, due to this feature. Through the middle of each joint is a tie-rod, and every 10 ft. of track contains a tie-rod. Ten feet apart and intermediate between the tie-rods are ties, which are made, in the case of the Scranton company, of a 52-lb. girder section that has been taken up from old track. Almost any rail section may be used for these that has a sufficient width of base to allow the bolt holes to be drilled in it. The ties are bolted to the rails, and not riveted. The tie-rods are the same as



SECTION AND PLAN OF TRACK CONSTRUCTION, SCRANTON

those that have been in use for many years, being flat bars, so as to interfere as little as possible with the pavement.

This metal part of the construction having been assembled, as heretofore described, and surfaced and lined on blocks on a bed prepared by grading and by rolling with a 10-ton roller, is filled under with a sub-structure of concrete, having a uniform thickness of 6 ins., except at the joints and at the ties, where the thickness of the concrete is increased to 1 ft. The work of concreting



SIDE VIEW OF RIVETED JOINT EMPLOYED IN SCRANTON

having been completed, the whole is allowed to stand for a week if possible, and for at least five days, before any traffic is allowed on the rails. The top of the concrete is the bottom of the rail, of course, and this leaves a height of 5 ins. from the top of the concrete to the level of the surface of the street.

The pavement between the rails is made of brick, which are 4 ins. in width, and this leaves 1 in. for sand on top of the concrete. The brick next to the rail are of special form, made so that the surface of the pavement is the same as the surface of the head of the rail, with the exception of a groove for the flange along the

inside of the rail. On the outside of the rail, plain brick are used, which come up against the head of the rail, and the space between the head and the base, out to a line flush with the head of the rail, is filled with cement mortar. The whole brick pavement is grouted with cement grout, and rolled to a level surface and uniform crown by a 5-ton roller, running on the rails of the track.

The work of construction is very much facilitated by the machinery used and the uniformity of the work is, no doubt, very much greater than in the case of hand work. The concrete mixer is mounted on a low car, and driven by a No. 3 Westinghouse street car motor, while the pneumatic riveter is mounted on a car having on it a derrick for handling the riveter, and a motor-driven air compressor for furnishing the air.



VIEW OF BALLAST CAR



VIEW OF COMPLETED STREET



DUMPING BALLAST FROM CAR



RIVETING RAIL JOINTS BY PNEUMATIC POWER

This construction has given a great deal of satisfaction to the authorities of the city, and seems to be very popular with those who have to drive on streets where tracks are located. More can be said of the durability of this construction in the course of a few years time, but it being entirely free from such perishable material as wood, should last a long time. The lightness of the rail is compensated by the fact that it is supported under every inch of it. Additional width to the base of the rail would still further improve the construction.

OFFICERS

Officers for the ensuing year were then elected as follows: President, W. B. Given, Pennsylvania Traction Company, Lancaster; first vice-president, E. C. Felton, Harrisburg Traction Company, Harrisburg; second vice-president, E. H. Davis, Williamsport Passenger Street Railway Company, Williamsport; treasurer, W. H. Lanius, York Street Railway Company, York; secretary, S. P. Light, Lebanon Valley Traction Company, Lebanon. Executive committee—W. B. Given, Frank Silliman, Jr., S. P. Light, W. H. Lanius, John Rigg.

The place selected for the next meeting was Pittsburgh, Pa., and the time the third Wednesday in September, 1900.

The Exibit of Street Railway Apparatus at the National Export Exposition

The National Export Exposition, which opened in Philadelphia, Sept. 14, and closes Nov. 30, is being utilized by many manufacturers of mechanical appliances for the exploitation of their products in foreign lands. Leaders, as we have been, in the field of mechanical traction, devices and materials for use in this field are on the foremost wave of the rush of export business that seems to have set in since the Spanish-American war. Many companies do not exhibit, for the reason that the home demand is at present so great and the price of raw materials so high that efforts to obtain export orders are discouraged, but others, realizing that this is a temporary condition, are making extensive exhibits, some of which are described below.

In the line of electrical apparatus the most general exhibit is that of the General Electric Company, of which company the foreign department has fitted out an extensive booth in the Exposition. The apparatus shown is largely for central-station service or general supplies, there being no street railway material proper in the exhibit.

The Standard Underground Cable Company, of Pittsburgh, has a number of show-cases, one of which contains samples of its products especially manufactured for street railway work. Among these are its cables, cable terminals, Conner junction boxes, etc.



EXHIBIT OF GENERAL ELECTRIC CO. AT PHILADELPHIA

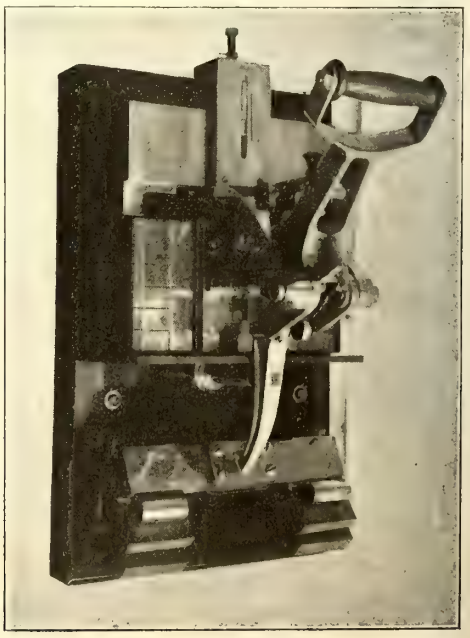
Another exhibit of wires and cables is that of the John A. Roebling's Sons' Company, whose booth at the Export Exposition is fitted out with the same apparatus and in the same general style as was its exhibit at the New York Electrical Show, this apparatus having become a sort of permanent exhibit, which is sent from exhibition to exhibition. One new feature of the collection is the samples of work done at the company's new rubber mills, which were recently started in Trenton, these mills already consuming 1000 lbs. of Para rubber per day. As usual, the company's rail bonds are well represented.

The Reconstructed Granite Company, of New York, has an attractive exhibit of all its various lines of manufacture. In the Street Railway Journal for May, some particulars were given of this remarkable material, especially with reference to its use for third-rail insulators. Since then the company has largely extended its manufactures, so as to cover a great variety of uses for electric railways, such as rheostat blocks, arc deflectors, fuse boxes, cut-outs, etc., for controllers and motors, to be used in place of porcelain and vulcabeston, and claims for it not only the highest insulating properties and great durability, combined with low cost, but also that copper will not deposit upon the surfaces, and that it cannot be injured by fire, frost or sudden changes of voltage or temperature. The company is having considerable success in introducing this material upon various street railway systems. In addition to showing reconstructed granite in these various forms, the company exhibited a line of glass-lined electrical conduits and chemical ware, which attracted much attention. A panel of the company's exhibit of reconstructed granite is illustrated in this connection.

The Cutter Company, of Philadelphia, has a large display board, on which is mounted one circuit breaker of each different type manufactured by the company, including even some freak combinations. The most interesting breaker of the collection is a mammoth one of the new laminated-wedge type, specially designed for street railway service. This particular one is the largest yet made by the company, and is rated at 4000 amps., its range of operation being from 2000 amps. to 5000 amps. This breaker has a main contact with finely laminated leaves wedged between oblique contact blocks by a toggle joint operated by the handle. The force required to close this breaker is much less than that



THE NEW BRILL CONVERTIBLE CAR



CUTTER 4000 AMPERE BREAKER

necessary for the older types of knife and jaw breakers of much smaller capacities. Incidentally, too, the weight of the breaker is greatly reduced by the more compact arrangement and the greater number of points of contact over a given area of contact surface. The carrying capacity of the breaker is so much improved by the new principle involved that it runs cooler than do the older types, in spite of the reduced area for radiation of heat. The main contact of this breaker is shunted by a secondary copper contact, designed to form a better short circuit around the main contact than would ordinary carbon contacts, and this secondary copper contact is in turn protected by a tertiary carbon contact of ample size for for the enormous current the breaker is desired to carry.

In the line of materials and supplies, the Ajax Metal Company, of Philadelphia, has a booth made entirely of bars of babbitt metal and containing samples of the trolley wheels and harps, journal brasses, steet car fittings, etc., turned out by this company. A similar exhibit is that of Merchant & Company, of Philadelphia, containing, as it does, samples of the firm's extensive line of solder, babbitt and other alloys. In addition, the booth is covered with a roof fitted with the firm's Star ventilator, over which there is arranged an artificial rainfall. The interior of the ventilator is illuminated with incandescent lamps, designed to show that no water comes through. Another exhibit of materials valuable in street railway work, although not mechanical in character, is that of the Joseph Dixon Crucible Company, which, as usual, makes an extensive showing of its graphite products. As this material does not adapt itself to very extensive exhibit decoration, the space occupied is elaborately fitted out with handsome furniture, palms, etc. Prominent in the exhibit is one lump of Ceylon graphite exactly as mined, weighing 270 lbs. This is said to be the largest single piece of graphite in this country.

Of track materials and accessories there are many interesting lines shown. The Continuous Rail Joint Company, of Newark, has on exhibition its product consisting of an extended angle or tie-plate carried down below the foot flange of the rail, forming a base-plate and girder. The samples shown at the Exposition were made by the Illinos Steel Company, and rolled nine times, giving them a high tenacity, which is forcibly illustrated by pieces twisted and bent when cold to fantastic distortions. The Diamond State Steel Company also makes an exhibit of its rails, tie-plates, angles, foot-plates and other special street railway steel work. Another exhibit in that line is made by the firm of Wm. Wharton, Jr., & Company, of Philadelphia, who show their specialties in the line of street railway switches, frogs and crossings with manganese steel points. Much of the work shown in this company's exhibit is cast-welded, the various parts of a diagonal cross-over being shown cast-welded together. The firm also shows sections of the various types of rails which it handles, as well as models of derailing and unbroken main-line switches for street railway work.

The Philadelphia Railway Track Equipment Company makes its exhibit, which has become a familiar one to visitors to railway conventions. The exhibit shows the special points of the company's system, the series of under and over-lapping half sections, the rail-head being rolled separate from the foot flange, with staggered joints and tie-bars, which lock the whole together.

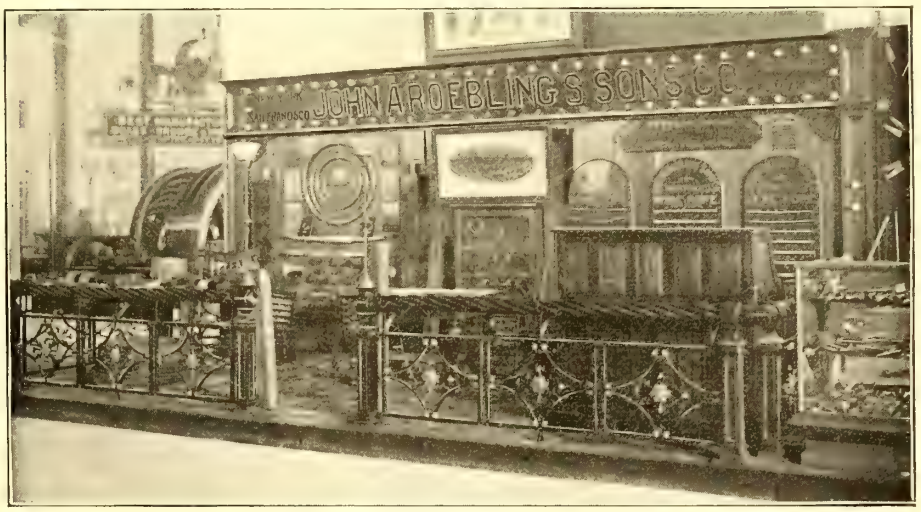


EXHIBIT OF THE ROEBLING CO.

Of cars and trucks, the most extensive exhibit is that of the J. G. Brill Company, in the Transportation Building. The most conspicuous feature of this exhibit is Brill's convertible car. In the form shown at the Exposition, this car differs somewhat from its predecessors in having movable panels at its sides covered with an oxidized copper sheet, the panels being finished inside with wood veneer. The rest of the exhibit consists of Brill's sprinkler and trucks of four different styles, the Perfect, the Universal, the Eureka Maximum Traction Pivotal and No. 21-E. The convertible car is fitted with a Providence fender. The Consolidated Car Fender Company has also an exhibit in the main building, consisting of its handsomely-finished full-sized brass model of fender of the 1900 style. Another duplex car is also shown in the Transportation Building, made by the Duplex Car Company, a description of which is hardly necessary in these pages.

Of car wheels, there are two interesting exhibits, one that of the New York Car Wheel Works, of Buffalo, and the other the Whitney Car Wheel Works, of Philadelphia.



EXHIBIT OF THE STANDARD UNDERGROUND CABLE CO.



EXHIBIT OF THE RECONSTRUCTED GRANITE CO.

STREET RAILWAY MEN AT THE CONVENTION

Representatives of Member Companies

Alton, Ill.—George D. Rosenthal, electrical engineer, Alton Railway, Gas & Electric Company.

Anderson, Ind.—Charles L. Henry, general manager; Charles Berry, superintendent; Albert S. Richey, electrical engineer; W. C. Simpson, director, and Frank H. Schlater, chief bookkeeper, Union Traction Company.

Atlanta, Ga.—E. Woodruff, president; J. R. Gordon, engineer, Atlanta Consolidated Street Railway Company. E. Woodruff, president, and J. P. Smedden, engineer, Atlanta Railway Company.

Augusta, Ga.—C. O. Simpson, secretary, Augusta Railway & Electric Company.

Aurora, Ill.—D. A. Belden, general manager, and C. C. Quackenbush, superintendent, Aurora Street Railway Company.

Atchison, Kan.—J. A. Bendure, general manager, Atchison Railway, Light & Power Company.

Bay City, Mich.—E. S. Dimmock, general manager, and W. R. Morrison, assistant general manager, Bay Cities Consolidated Railway Company.

Binghamton, N. Y.—G. Tracy Rogers, president, Binghamton Street Railroad Company.

Birmingham, Ala.—J. B. McClary, general manager, Birmingham Railway & Electric Company.

Boston, Mass.—Charles S. Sergeant, second vice-president; H. L. Wilson, auditor; J. H. Studley, Jr., and John Balch, assistant engineer, Boston Elevated Railway Company.

Bridgeport, Conn.—Andrew Radel, president, and James Butler, superintendent, Bridgeport Traction Company.

Buffalo, N. Y.—R. E. Danforth, superintendent, Buffalo Railway Company. George Chambers, superintendent, Buffalo Traction Company.

Brooklyn, N. Y.—J. H. Vander Veer, superintendent of shops; J. S. Breckenridge, chief engineer; F. H. Shepard, elevated equipment, and Giles S. Allison, sales agent, Brooklyn Rapid Transit Company.

Camden, N. J.—William S. Scull, president, and W. E. Harrington, general manager, Camden & Suburban Railway Company.

Charleston, S. C.—Nicholas S. Hill, Jr., general manager; P. J. Balaguer, auditor, and G. B. Allen, director, Charleston Consolidated Railway, Gas & Electric Company.

Chester, Pa.—Henry C. Moore, vice-president, and R. H. Beach, director, Chester Traction Company.

Colorado Springs, Col.—A. L. Lawton, general manager; F. C. Lawton, superintendent, Colorado Springs Rapid Transit Railway Company.

Chicago, Ill.—E. R. Gilbert, general manager; A. E. Davies, superintendent, Chicago Electric Traction Company. John McNulta, receiver; John Farson, president; H. M. Sloan, general manager; Edward H. Harrison, auditor; George H. Binkley, engineer; W. A. Harding, master mechanic and electrician, Calumet Electric Street Railway Company. Charles T. Yerkes, president; John M. Roach, general manager; F. E. Smith, auditor; John Millar, master mechanic, Chicago Consolidated Traction Company. D. G. Hamilton, president; Robert McCulloch, general manager; T. C. Penington, treasurer; F. R. Greene, secretary; G. O. Nagle, superintendent; George W. Knox, electrical engineer; A. C. Heidelberg, assistant superintendent; C. N. Duffy, auditor, Chicago City Railway Company. William Walmsley, superintendent; Benjamin Dawson, electrician, South Chicago City Railway Company. George A. Yuille, second vice-president; J. C. Moore, secretary; M. B. Orde, assistant treasurer; James R. Chapman, electrical engineer, Chicago Union Traction Company.

Cleveland, Ohio—Charles W. Wason, president, Cleveland, Painsville & Eastern Railroad Company. John Ehrhardt, assistant secretary; Albert E. Duty, assistant secretary, and C. B. Easty, master mechanic, Cleveland City Railway Company. R. M. Douglass, general superintendent; F. S. Barton, assistant secretary and treasurer; W. G. McDole, auditor; Charles W. Wason, purchasing agent; B. Maher, assistant secretary, and L. M. Wolf, assistant purchasing agent, Cleveland Electric Railway Company.

Cincinnati, Ohio—G. B. Kerper, general manager; Henry Burkhold, private secretary, Cincinnati Street Railway Company.

Columbus, Ohio—P. V. Burington, auditor; J. W. McCord, Columbus Street Railway Company.

Council Bluffs, Ia.—W. S. Dimmock, general superintendent, Omaha & Council Bluffs Railway & Bridge Company.

Davenport, Ia.—F. C. Denkmann, vice-president; James F. Lardner, secretary; John F. Huntoon, general superintendent, and John D. Fish, electrician, Tri City Railway Company.

Dayton, Ohio—George B. Kerper, general manager, and Nelson Routzahn, superintendent, People's Railway Company.

Des Moines, Ia.—George B. Hippee, general manager, and J. S. Goodrell, chief engineer, Des Moines City Railway Company.

Duluth, Minn.—Herbert Warren, general manager, Duluth Street Railway Company.

Detroit, Mich.—S. Hendrie, manager; F. A. Baker, director, Detroit & Pontiac Street Railway Company.

Denver, Col.—C. K. Durbin, general superintendent, Denver City Tramway Company.

Evansville, Ind.—H. D. Moran, vice-president and general manager, Evansville Street Railway Company.

Elgin, Ill.—William Grote, president; James B. Lane, vice-president; Charles Wuestenfield, Elgin City, Carpenterville & Aurora Railway Company.

Findlay, Ohio—George B. Kerper, president; W. G. Nusbaum, engineer, and William Twining, electrician, Findlay Street Railway Company.

Gloucester, Mass.—E. C. Foster, president, Gloucester Street Railway Company.

Grand Rapids, Mich.—G. S. Johnson, president; Benjamin S. Hanchett, Jr., assistant secretary and treasurer, Consolidated Street Railway Company.

Galveston, Tex.—F. W. Fratt, superintendent and engineer, Galveston City Railroad Company.

Hartford, Conn.—E. S. Goodrich, president; Elmer M. White, cashier, Hartford Street Railway Company.

Harrisburg, Pa.—F. B. Musser, superintendent; Mason D. Pratt, engineer, Harrisburg Traction Company.

Hazleton, Pa.—E. S. Doud, secretary and treasurer; C. A. B. Houck, electrician, Lehigh Traction Company.

Houston, Tex.—H. F. McGregor, vice-president and general manager; R. M. Johnston, stockholder, Houston Electric Street Railway Company.

Hamilton, Ont.—C. K. Green, director; J. B. Griffith, manager, Hamilton Street Railway Company.

Hamilton, Ohio—Will Christy, president; F. J. J. Sloat, general manager; C. E. Hooven, secretary; J. C. Hooven, director, Cincinnati & Hamilton Electric Street Railway Company.

Indianapolis, Ind.—Charles Remelius, superintendent motive power; John Grant, assistant general manager; H. B. Bales, auditor, Indianapolis Street Railway Company.

Jersey City, N. J.—E. D. Hibbs, auditor, North Jersey Street Railway Company.

Johnstown, Pa.—H. C. Evans, director, Johnstown Passenger Railway Company.

Joliet, Ill.—F. E. Fisher, superintendent; W. H. Huen, auditor; W. J. Kelsch, electrician, Joliet Street Railroad Company.

Kansas City, Mo.—Walton H. Holmes, president; J. A. Harder, auditor; William A. Sallerton, superintendent; Edward Butts, chief engineer; T. Blake, engineer; W. H. Miller, George Wing, Metropolitan Street Railway Company.

Lynn, Mass.—E. C. Foster, vice-president and general manager, Lynn & Boston Railroad Company.

London, Ont.—C. E. A. Carr, general manager and secretary; J. F. Hill, auditor, London Street Railway Company.

Lexington, Ky.—E. C. Hathaway, general manager; E. A. Longuere, engineer, Lexington Railway Company.

Louisville, Ky.—T. J. Minary, president; S. G. Boyle, secretary; J. T. Funk, C. L. Christopher, superintendents track construction, Louisville Railway Company.

Merrimac, Mass.—James T. Wattles, Haverhill & Amesbury Street Railway Company.

Meriden, Conn.—N. H. Heft, president; William Tooker, engineer, Meriden Electric Railroad Company.

Memphis, Tenn.—F. G. Jones, vice-president and general manager; C. H. Ruddock, director; W. B. Mallory, director, Memphis Street Railway Company.

Milwaukee, Wis.—John I. Beggs, general manager; H. C. Mackay, auditor; F. Sargent, consulting engineer; T. E. Mitten, general superintendent railway department; Chester P. Wilson, engineer; George Kemmerlein, superintendent of transportation;

W. H. Greenslade, assistant superintendent of transportation; S. G. Mitten, superintendent of overhead construction; E. Wolds, superintendent of maintenance of rolling stock; C. H. Lemon, surgeon; T. Simmons, roadmaster; T. G. Hoffman, clerk, Milwaukee Electric Railway & Light Company.

Minneapolis, Minn.—J. F. Calderwood, auditor; P. S. Mackay, assistant auditor; F. D. Valentine, chief clerk; A. M. Baldwin, purchasing agent, Twin City Rapid Transit Railway Company.

Mexico, Mex.—Arthur S. Partridge, engineer, Compania de Ferro-Carriles del Distrito Federal de Mexico.

Montreal, Can.—Duncan McDonald, superintendent; H. A. Brown, electrician; W. A. Ross, comptroller, Montreal Street Railway Company.

New Bedford, Mass.—E. E. Potter, general superintendent; Elton S. Wilde, treasurer, Union Street Railway Company.

New York, N. Y.—H. H. Vreeland, president; A. C. Tully, purchasing agent; J. F. Kane, chief of construction, Metropolitan Street Railway Company.

New Brunswick, N. J.—E. H. Radel, secretary and treasurer; John Blair MacAfee, Brunswick Traction Company.

Nashville, Tenn.—E. G. Conette, general manager; N. P. Yeatman, secretary and treasurer, Nashville Street Railway Company.

New Orleans, La.—J. K. Newman, president; George H. Davis, manager; A. O. Kittredge, consulting accountant, New Orleans & Carrollton Railroad Company. A. H. Ford, secretary and treasurer; C. D. Wyman, general manager; T. H. Tutwiler, engineer, New Orleans City Railroad Company.

Omaha, Neb.—W. A. Smith, general manager; D. H. Goodrich, secretary, Omaha Street Railway Company.

Oakland, Cal.—E. A. Heron, president, Oakland Transit Company.

Portland, Me.—William R. Wood, president; William A. Wheeler, director; A. Whitney, director, Portland Railroad Company. Merle R. Griffith, electrician; F. C. Boyd, director, Portland & Yarmouth Electric Railway Company.

Port Chester, N. Y.—N. H. Heft, engineer; Marion Swing, assistant engineer, Port Chester Street Railway Company.

Philadelphia, Pa.—Henry C. Moore, vice-president; J. J. Mahoney, electrical engineer, Roxborough, Chestnut Hill & Norristown Railway Company.

Pittsburgh, Pa.—S. E. Moore, auditor; C. S. Mitchell, assistant auditor, United Traction Company.

Port Huron, Mich.—A Dixon, president; H. A. Dixon, superintendent, City Electric Railway Company.

Peoria, Ill.—L. E. Myers, secretary and general manager, Peoria & Pekin Terminal Railway Company.

Quincy, Mass.—John R. Graham, president and general manager, Quincy & Boston Railway Company.

Quincy, Ill.—H. E. Chubbuck, electrical engineer; L. A. Scovil, superintendent, Quincy Horse Railway & Carrying Company.

Pasadena, Cal.—W. H. Smith, Los Angeles & Pasadena Electric Railway Company.

Pueblo, Col.—John F. Vail, general manager, Pueblo Traction & Electric Company.

Rockland, Me.—George E. Macomber, president; Thomas Hawken, superintendent; William N. Todd, Rockland, Thomaston & Camden Street Railway Company.

Rochester, N. Y.—J. H. Stedman, manager of transfers, Rochester Railway Company.

Reading, Pa.—Samuel E. Rigg, superintendent; Henry C. Moore, director, United Traction Company.

Richmond, Va.—Berkeley Williams, purchasing agent, Richmond Traction Company.

Syracuse, N. Y.—Ira A. MacCormack, vice-president and managing director, Syracuse Rapid Transit Railway Company.

Scranton, Pa.—C. E. Flynn, general manager, Carbondale Traction Company.

Springfield, Ill.—C. K. Minary, manager; T. H. Minary, electrician, Springfield Consolidated Railway Company.

Springfield, Ohio—Fred. Colburn, president; S. L. Nelson, general manager; L. O. Williams, superintendent, Springfield Railway Company.

St. Louis, Mo.—F. S. Drake, master mechanic, Cass Avenue & Fair Grounds Railway Company; J. J. Coleman, general manager, Citizens, Missouri, Southern, St. Louis and Union Depot Railroad Companies. J. J. Coleman, general manager; Samuel Barnes, electrical engineer, Lindell Railway Company. T. M. Jenkins, general manager; G. J. Smith, master mechanic, St. Louis & Suburban Railway Company.

Saginaw, Mich.—L. M. Richardson, superintendent, Saginaw Valley Traction Company.

St. Joseph, Mich.—W. Worth Bean, president; H. C. Mason, superintendent; W. Worth Bean, Jr., assistant superintendent, St. Joseph & Benton Harbor Electric Railway & Light Company.

Salt Lake City, Utah—W. P. Read, general superintendent; O. P. Arnold, assistant superintendent, Salt Lake City Railroad Company.

Sioux City, Ia.—Fred. H. Fitch, general manager; C. M. Feist, master mechanic; Louis W. Price, cashier, Sioux City Traction Company.

Schenectady, N. Y.—S. D. Greene, vice-president; W. Gibson Carey, Schenectady Street Railway Company.

St. Joseph, Mo.—J. B. Shirley, auditor; J. H. Van Brunt, superintendent, St. Joseph Railway, Light, Heat & Power Company.

Taunton, Mass.—John McClannel, assistant superintendent of transportation, Taunton Street Railway Company.

Trenton, N. J.—Henry C. Moore, president; Charles Y. Flanders, director, Trenton Street Railway Company.

Toledo, Ohio—Albion E. Lang, president; Thomas H. McLean, vice-president and general manager; Charles L. Wright, auditor; E. J. Bechtel, superintendent construction; G. Munz, superintendent shops, Toledo Traction Company. W. B. Brockway, secretary and auditor; C. A. Denman, general manager, Toledo, Bowling Green & Fremont Railway Company.

Topeka, Kan.—Albert M. Patten, superintendent, Topeka Railway Company.

Toronto, Can.—E. H. Keating, manager; Ewan Mackenzie, assistant superintendent; P. McCullough, electrician, Toronto Railway Company.

Venice, Ill.—Fred. E. Allen, president; E. J. Spencer, secretary, Venice, Madison & Granite City Railway Company.

Wilkesbarre, Pa.—Thomas A. Wright, general superintendent; James Fagan, electrical engineer, Wilkesbarre & Wyoming Valley Traction Company.

Wilmington, Del.—Henry C. Moore, vice-president; W. E. Boughton, director, Wilmington City Railway Company.

Wheeling, W. Va.—W. A. Shirley, secretary and treasurer, Wheeling Railway Company.

Webb City, Mo.—E. J. Pratt, superintendent motive power; C. E. Baker, superintendent transportation, South-West Missouri Electric Railway Company.

York, Pa.—W. H. Lanius, president, York Street Railway Company.

Youngstown, Ohio—A. A. Anderson, general manager and treasurer; Harry Dixon, assistant treasurer; James F. Uhl, Mahoning Valley Railway Company.

Others in Attendance

Neff, Stewart L., superintendent, Union Loop, Chicago.

Waterman, John H., director, Little Rock Traction & Electric Company, Little Rock, Ark.

McDonald, F., Waterloo & Cedar Rapids Traction Company, Waterloo, Ia.

Crankshaw, J. B., electrical engineer and manager, Cincinnati, Lawrenceburg & Aurora Street Railway Company, Cincinnati, Ohio.

Johnson, J. M., electrician and master mechanic, LaCrosse City Railway, LaCrosse, Wis.

Valier, Porter, superintendent, LaCrosse City Railway Company.

Cameron, J. L., president, Salt Lake City Rapid Transit Company.

Flint, J. A., secretary, treasurer and manager, San Diego Electric Railway Company, San Diego, Cal.

Asire, M. E., secretary and treasurer M. C. & P. I. Railway Company, Marquette, Mich.

DeCoursey, H., train master, Leavenworth Electric Railroad Company, Leavenworth, Kan.

Coomb, E. E., manager, Leavenworth Electric Railroad Company, Leavenworth, Kan.

Nary, W. T., superintendent, Hoosac Valley Street Railway Company, North Adams, Mass.

Torbert, H. G., assistant manager, Suburban Street Railway Company, Dubuque, Ia.

Blackwood, D. P., passenger agent, Washington, Arlington & Falls Church Railway Company, Washington, D. C.

Gunn, E. B., superintendent, LaFayette Street Railway Company, LaFayette, Ind.

Diserens, F. L., superintendent, Cedar Rapids & M. City Railway, Cedar Rapids, Ia.

Daniell, Edward, secretary, treasurer and superintendent, Menominee Electric Light, Railway & Power Company, Menominee, Mich.

Doyle, J. L., master mechanic, Metropolitan Elevated Railroad Company, Chicago.

Budd, B. I., purchasing agent, Metropolitan West Side Elevated Railway Company, Chicago.

McCoy, Frank, superintendent, Monongahela Street Railway Company, Pittsburgh, Pa.

Ellis, T. M., general manager, Rockford Railway, Light & Power Company, Rockford, Ill.
Williams, William H., electrician, St. Louis & East St. Louis Railway Company, St. Louis, Mo.
Cummins, W., superintendent, Indiana Railway Company, South Bend, Ind.
Halliday, E. W., president, Cairo Electric Railway Company, Cairo, Ill.
Ginn, F. E., superintendent, Lancaster Traction Company, Lancaster, Ohio.
Hertig, C. M., president, Benton Power & Traction Company, St. Cloud, Minn.
Ralph, I. D. H., president and general manager, Owosso & Corunna Electric Company, Owosso, Mich.
Misaki, Siezo, chief engineer and superintendent, Hauskin Electric Railway Company, Kobe, Japan.
McFarland, J. W., superintendent, Chattanooga Electric Railway Company, Chattanooga, Tenn.
Baylies, R. N., president, Rockford Railway, Light & Power Company, Chicago.
Irwin, William G., president, Indianapolis, Greenwood & Franklin Railway, Indianapolis, Ind.
Wright, J. E., secretary, Detroit & Northwestern Railway, Detroit, Mich.
Boyd, F. C., director, Ohio Central Traction Company, Galion, Ohio.
Anthony, William, Ohio Central Traction Company, Galion, Ohio.
Downs, Edwin E., vice-president and general manager, Citizens' Traction Company, Oshkosh, Wis.
Cass, L. S., president and general manager, Waterloo & Cedar Falls Rapid Transit Company, Waterloo, Ia.
Thompson, Fred W., superintendent, Muskegon Street Railway Company, Muskegon, Mich.
Detwiler, G. K., secretary, Toledo & Maumee Valley Railway Company, Toledo, Ohio.
Hart, George A., president and general manager, Manistee, F. C. & E. Railway, Manistee, Mich.
Winters, Valentine, president, Dayton & Western Traction Company, Dayton, Ohio.
Miller, E. F., supervisor of motormen, South Side Elevated Railroad Company, Chicago.
Clegg, Harry Pease, secretary and general manager, Oakwood Street Railway Company, Dayton, Ohio.
Gustafson, C., superintendent, Oakland, San Leandro & Hayward Electric Railway, Consolidated, Elmhurst, Cal.
Jewett, Edwin, chief engineer, South Chicago City Railway, Chicago.
Saemann, Franklin I., treasurer, Sheboygan Light, Power & Railway Company, Sheboygan, Wis.
Green, C. K., manager, Hamilton Radial Electric Railway, Hamilton, Ont.
Colvin, J., superintendent, Washington, Alexandria & Mt Vernon Railway Company, Washington, D. C.
Carney, N. L., president, Electric Street Railway, Clarksville, Tenn.
Semenza, Guido, Milan Edison Company, Milan, Italy. (Italian representative Street Railway Journal).
Zimmerman, Frank M., superintendent, Collins Park & Belt Railway, Atlanta, Ga.
Grover, T. F., vice-president and general manager, Fond du Lac Street Railway & Light Company, Fond du Lac, Wis.
Wilkins, James H., chief electrician and master mechanic, St. Louis & Belleville Railroad Company, Belleville, Ill.
Frederick, C. R., engineering department, Northwestern Elevated, Chicago, Ill.
Seacord, Judd, superintendent, Galesburg Electric Motor & Power Company, Galesburg, Ill.
Brown, William J., general manager, Home Electric Company, Dubuque, Ia.
Parsel, Jr., J. S., superintendent, Fairfield Traction Company, Lancaster, Ohio.
Kent, James, superintendent, Washington Electric Company, Washington, Pa.
Paul, G. J. A., superintendent, Henderson Street Railway Company, Henderson, Ky.
Clark, Edward C., assistant secretary, Cedar Rapids & Marion City Railway, Cedar Rapids, Ia.
Holbrook, Royal H., chief engineer, Cedar Rapids & Marion City Railway, Cedar Rapids, Ia.
Carpenter, Reid, treasurer, Citizens' Electric Railway, Mansfield, Ohio.
Greene, E. M., superintendent, Signal Mountain Railway Company, Chattanooga, Tenn.
Payne, H. B., electrician, Ottawa Railway, Light & Power Company, Ottawa, Ill.
Miller, Irving W., superintendent, Olean Street Railway Company, Olean, N. Y.
Given, Frank S., assistant general manager, Pennsylvania Traction Company, Lancaster, Pa.
Vieley, Elmer, master mechanic, Cedar Rapids & Marion City Railway, Cedar Rapids, Ia.
Cummins, M., superintendent, Indiana Railway Company, Elkhart, Ind.
Perdue, Whittier, superintendent of construction, Chicago Electric Traction Company, Chicago.
Hazelrigg, S. F., general manager, Atlantic Coast Elevated Railroad Company, Asbury Park, N. J.
Allen, Andrew J., general foreman of motive power, South Side Elevated Railroad, Chicago.
Burke, J. P., vice-president and manager, San Jose & Santa Clara Railroad Company, San Jose, Cal.
Cobb, C. H., vice-president and general manager, Kankakee Electric Railway Company, Kankakee, Ill.
Dyer, Jr., R. A., superintendent, Auburn City Railway Company, Auburn, N. Y.
Weed, H. I., attorney, Citizens' Traction Company, Oshkosh, Wis.
Gillingham, Jr., W. J., signal engineer, Illinois Central Railroad Company, Chicago.
Berry, Kav., electrician, Henderson Street Railway Company, Henderson, Ky.
Reed, William L., secretary, Omaha, Council Bluffs & Suburban Railway Company, Council Bluffs, Ia.
Townsend, George, president, Omaha, Council Bluffs & Suburban Railway Company, Council Bluffs.
Poor, F. A., foreman signals, Illinois Central Railroad Company, Chicago.
Barvion, A. M., general manager, Home Electric Light & Power Company, Elkhart, Ind.
Hart, H. D., director, St. Charles Street Railroad Company, New Orleans, La.
Kilmer, F. D., Santa Fe Railway Company, Oak Park, Ill.
Hourigan, John, auditor, Albany Railway Company, Albany, N. Y.
Harry, C. L., manager, Kokomo City Street Railway Company, Kokomo, Ind.
Evarts, Charles O., treasurer, Kansas City & Leavenworth Railway Company, Leavenworth, Kan.
Kimberley, D. H., president, Kansas City & Leavenworth Railway Company, Leavenworth, Kan.
Henry, F. R., secretary and treasurer, Missouri Railroad Company, St. Louis, Mo.

Press Representatives at the Convention

Baumgartner, E. H., "Railway Age," Chicago.
Beattie, T. S., "Municipal Railway and Record," New York.
Bennett, J. B., Street Railway Journal, New York.
Church, J. V. S., "Electrical World and Engineer," Chicago.
Clarke, Charles S., "Western Electrician," Chicago.
Collins, Leslie, "Western Electrician," Chicago.
Colvert, F. E., "Electrical Review," Chicago.
Crossman, T. E., "Official Stenographer," New York.
Drury, F. H., "Chicago Street Railway Men's Journal," Chicago.
Fairchild, C. B., "Street Railway Review," Chicago.
Fairchild, Jr., C. B., "Street Railway Review," Chicago.
Foote, Allen R., The Other Side Publishing Company, Chicago.
Forbrich, Charles W., "Western Electrician," Chicago.
Forbrich, W. F., "Western Electrician," Chicago.
Goddard, Stephen H., "Electrical Review," New York.
Higgins, Edward E., Street Railway Journal, New York.
Kenfield, F. S., "Street Railway Review," Chicago.
Kenfield, H. J., "Street Railway Review," Chicago.
Martin, T. C., "Electrical World and Engineer," New York.
McMahan, C. S., Street Railway Journal, Chicago.
Metcalfe, George R., "Street Railway Review," Chicago.
Reynolds, John N., "Railroad Gazette," Chicago.
Royse, Daniel, "Street Railway Review," Chicago.
Semenza, Guido, Street Railway Journal, Milan, Italy.
Smith, W. R. C., "American Electrician," Chicago.
Wakeman, J. H., "Electrical World and Engineer," New York.
Whitney, Clarence W., "Western Electrician," Chicago.
Wilcox, A. M., "Tramway and Railway World," London.
Wilson, Hugh M., "Railway Age," Chicago.
Windsor, H. H., "Street Railway Review," Chicago.

EXHIBITS AT THE CONVENTION

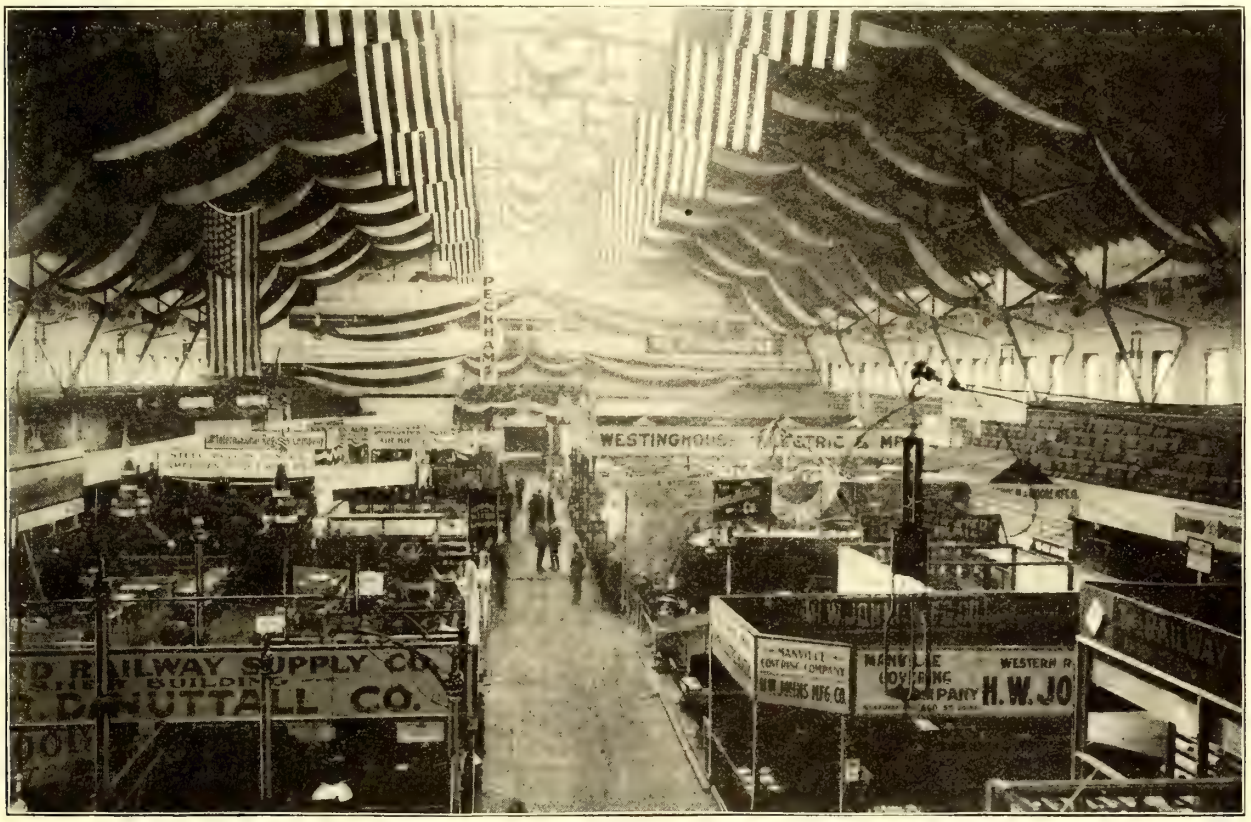
THE BUDA FOUNDRY & MANUFACTURING COMPANY, of Chicago, showed some of the well known Paulus drills and a special rapid running small drill for putting in rail bonds. The company's foreign business, in the hands of Laing, Wharton & Down, of London, has increased to large proportions, one foreign city alone having ordered within the past few months 500 drills. The exhibit was in charge of John McKinnon.

THE GREEN ENGINEERING COMPANY, of Chicago, was represented by P. Albert Poppenhusen. This company has recently secured several of the largest orders ever placed for traveling grates. The company represents the Edgemoor Iron Company, Goubert Manufacturing Company, Monarch Manufacturing Company and Broomell, Schmidt & Company.

THE CHISHOLM & MOORE MANUFACTURING COMPANY, of Cleveland, was represented by Col. W. E. Ludlow, manager of its American rail joint department, who has for the last twenty years been studying the needs of the track department of railways. The company states that with the completion of its malleable plant it is prepared to make about 10,000 joints per month, and therefore makes the following proposition to those who will want to commence laying track early next spring. It will close contracts for what joints will be wanted in the spring, and give the benefit of prices in force at time contract is made, purchaser to pay for same within thirty days of date of shipment, and shipments to be made at such time as purchaser may designate, but not later than May 1, 1900. A section of rail, 3 ft. in length, showing drilling, must be furnished within thirty days of date of contract. The company will at once make a joint and fit to rail and return for acceptance, and will guarantee that all others shall be same as sample. The joints on exhibition were samples of those furnished to different cities as follows: Chester, Pa.; Cincinnati, three sizes; Wilmington, Del.; Louisville, Ky.; Mobile, Kansas City and Detroit. There was also shown one of the latest types of joint on an 80-lb. T-rail, which, in order to test the material, had been driven on with forty blows of a 20-lb. sledge. Among the company's latest orders are 10,000 joints for the Chicago Union Traction Company, and 7500 for the Calumet Electric Railway in Chicago. The company is open for new ideas in track material and is prepared to manufacture same in its immense new plant. One of the newest things it has brought out is a rail-bracing tie-plate, which is proving popular. It also exhibited samples from its twenty-one sizes of differential hoists, in capacities from ½-ton to 20 tons and operated by compressed air, electricity, steam or hand power. Its souvenir was a track gage of Pennsylvania Railroad standard, which will be sent to anyone requesting same. The gage shows that with Fahrenheit thermometer readings of 80 degs. or over, the rail ends should butt tightly together; from 60 degs. to 80 degs., they should be 1/16 in. apart; from 40 degs. to 60 degs., ⅛ in. apart; from 20 degs. to 40 degs., 3/16 in. apart, and from zero to 20 degs., ¼ in. apart.

A. L. IDE & SONS, of Springfield, Ill., were represented by their genial Chicago agent, Enos Bookwalter.

THE PAIGE IRON WORKS, of Chicago, exhibited blue prints and photographs of their special track work, crossings, curves, switches, stands, etc. The company's output is distributed all over the city of Chicago and can be found on the Calumet, the Chicago City, North & West Chicago, South Chicago City, and the Chicago Electric Traction Company's lines. The company's shops are running to their fullest capacity, supplying orders not only for the roads mentioned but for others in almost every State in the Union. The exhibit was in charge of E. S. Nethercut, chief engineer. Other representatives present were J. M. Spackman, secretary; George Lowe, superintendent; T. H. Lovejoy, assistant superintendent.



GENERAL VIEW OF EXHIBITION HALL

C. F. ORR & COMPANY, of Chicago, exhibited some handsome uniforms for street railway conductors and motormen. C. F. Orr, owner of the business, reports that his trade with street railway companies all over the country is increasing at a rapid rate. He has recently booked orders from several Southern roads.

THE ATLAS RAILWAY SUPPLY COMPANY, of Chicago, had one of the handsomest booths at the exposition. A dainty maid served boullion and crackers and each lady visitor was presented an American beauty rose. Each gentleman caller went away with a carnation in his coat lapel. The company exhibited the Atlas rail joint, of which 275,000 are in use; also, "Cartime Surfacer," which is not a paint in the ordinary sense of the word, as it is a combination of materials which is not affected by ammonia,

carbonic, sulphurous or other gases, salt water, smoke or acids. It will not crack, peel off nor blister, and will last three times as long as white lead or mineral paint. It expands and contracts with the heat and cold on iron or tin roofs and will not scale off or become loose. These compositions have been in use on many of the leading railroads for the past nine years.

K. M'LENNAN & COMPANY, of Chicago, sole manufacturers of Gale's commutator compound, were represented by W. J. Isaacs, the manager of the company. This company's exhibit consisted of Gale's commutator compound. One of the features of the booth was a large bulletin board, on which were attached several hundred extracts from testimonials, and at the side of the board two original testimonials were displayed. Judging from the number of samples of compound which this company gave out at its exhibit, its compound is a necessity to the users of dynamos and motors. A neat souvenir was distributed in the way of a "Mauser" cartridge knife, which was much sought.

THE MANVILLE COVERING COMPANY, of Chicago, Western representatives of the H. W. Johns Manufacturing Company, had an attractive exhibit, showing a very complete line of molded mica overhead insulation, electric car heaters, vulcabeston



HE ADQUARTERS OF THE STREET RAILWAY JOURNAL

parts for street car motors and controllers. A special feature of this exhibit was the "Noark" fuse, it does not arc, but is an ideal protective against overload or short circuit, and a safe, accurate and correct motor protection. H. A. Reeves, who is manager of the electrical department of the Manville Covering Company, has had charge of the same department of the H. W. Johns Manufacturing Company since 1891, during which time he has succeeded in handling some large contracts for the latter concern. Six representatives of the H. W. Johns Manufacturing Company were also in attendance.

THE DIXON CRUCIBLE COMPANY, of Jersey City, N. J., was represented by Sam Mayer and Dudley Johnson, the company's Chicago representatives, and A. L. Harris, E. A. St. John and William Allen. The souvenirs of this company were large Uncle Sam pencils—also a thick pencil which, when once placed in the buttonhole, could not be detached without a deal of study, also souvenirs of plumbago medals made of the same graphite as used in Dixon's world renowned pencils. The Dixon booth soon became the headquarters of many of the old-timers, who thought they knew a good thing when they saw it. Large orders were booked for Dixon's graphited wood grease for use on electric railway car gears, and which was claimed to be something new and something better than ever before offered railway companies. Its advantages were said to be that it prevents noisy gears, keeps the gears and bearings constantly lubricated, prevents all drippings from gear cases and lasts longer and is more economical than any other lubricant.

THE LESCHEN-MACOMBER-WHYTE COMPANY, of Chicago, was represented by F. B. Macomber, George S. Whyte and E. E. Robirds. The exhibit consisted of galvanized steel strand, galvanized curtain cord, galvanized telephone wire, rubber insulated wires and cables, weather-proof feeder wires, magnet wire, "Century" tape, "Beacon" bearing metal, overhead line material, and the Standard head light. A very neat paper cutter was distributed as a souvenir. While the principal business of the Leschen-Macomber-Whyte Company is wire rope, its trade in the street railway direction is rapidly increasing and is now reaching large proportions.

THE MEAKER MANUFACTURING COMPANY, of North Chicago, was represented at the Chicago convention by J. W. and G. L. Meaker. The exhibit consisted of the Meaker registers, every detail of which is so thoroughly familiar to street railway men that any attempt at description would be superfluous. The company's handsome new catalogue which was given out, explained the register to the few who were so far behind the times as to be ignorant concerning it.

THE CHAPMAN VALVE MANUFACTURING COMPANY, of Indian Orchard, Mass., had a booth in charge of E. W. Buss, Western manager, where was displayed a line of valves for steam, water, gas, oil and ammonia, ranging in pressure from 50 lbs. to 250 lbs.

J. R. M'CARDELL & COMPANY, of Trenton, N. J., showed their tower wagon, of which over 400 are in use, although the company's first patents were issued in 1895. This wagon is in service in every country where there are electric railways, and over forty have been shipped to Europe during the present year. The wagon can be operated easily by one man, and can be changed to any position in one-quarter of the time required by collapsible wagons. It embodies certain principles of construction that render it impossible that it ever should become loose-jointed or dangerous. The wagon is built on honor with an eye solely to its utility and durability.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY, New York, in connection with McGill, Pomeroy & Company, the company's Western agents, showed its new type of circuit breaker. Old standard types were not exhibited since they are too well known to street railway men to need it. V. C. Gilpin, in charge, stated that he will be pleased to set up this new type of circuit breaker anywhere and without charge until thoroughly tested. It has been designed to meet the severest conditions incident upon the transmission of power, and combines with ease of operation and high current carrying efficiency, promptness and certainty of action. The main switch contact is made by a "laminated wedge," involving a new feature in switch construction and producing a switch which combines high carrying capacity with small size. During the opening of the main switch it is amply protected by a shunt switch, whose circuit is not only of low resistance, but non-inductive as well, thus altogether obviating the possibility of arcing at the main contacts. The final break is made on carbon.

THE MURPHY FURNACE COMPANY, Detroit, Mich., had its interests cared for by W. G. Amos, Chicago agent, who is well known to Western steam users.

EUGENE MUNSELL & COMPANY and THE MICA INSULATOR COMPANY, of New York, Chicago and London, occupied space No. 11, 200 sq. ft. The booth was very tastefully gotten up, dark rich blue material paneled in gilt, being used as the background, giving a very rich effect. The companies' space, being fitted up with easy chairs and a handsome rug, somewhat resembled a richly furnished parlor. The Mica Insulator Company's exhibit consisted of "micanite" plate, flexible plate, cloth, paper, M. I. C. compound, "empire" cloth and paper, "micanite" tubes and troughs, and various forms of insulation, of which this company makes a specialty. Eugene Munsell & Company's exhibit consisted of "mica" in the sheet, and a variety of sizes. Both the India and amber qualities were shown, also mica as it comes from the mines, and mica segments. Directly over the desk, suspended from the sign, was a large rare specimen of India mica, measuring 14 ins. x 36 ins., probably one of the largest sheets ever mined. This is such a rare specimen that there are probably less than 3 lbs. or 4 lbs. of mica of these dimensions in

the United States. The souvenir distributed was a very neat card-case, and it was highly appreciated by the delegates in attendance. The exhibit was in charge of Charles E. Coleman, Western manager, assisted by Howard M. Frantz.

WILLIAM WHARTON, JR., & COMPANY, Inc., of Philadelphia, Pa., exhibited their standard manganese steel special track work, among which was the Nichols protected heel tongue The Wharton unbroken main line switch, although well known, was examined by many. There were shown several novelties in track work, among which was the Nichols protected heel tongue switch, which prevents entirely the throwing of the tongue between wheels and the kicking of the tongue. A steam and street railway crossing, in which the steam rail was made entirely of



EXHIBIT OF THE IRONSIDES CO.

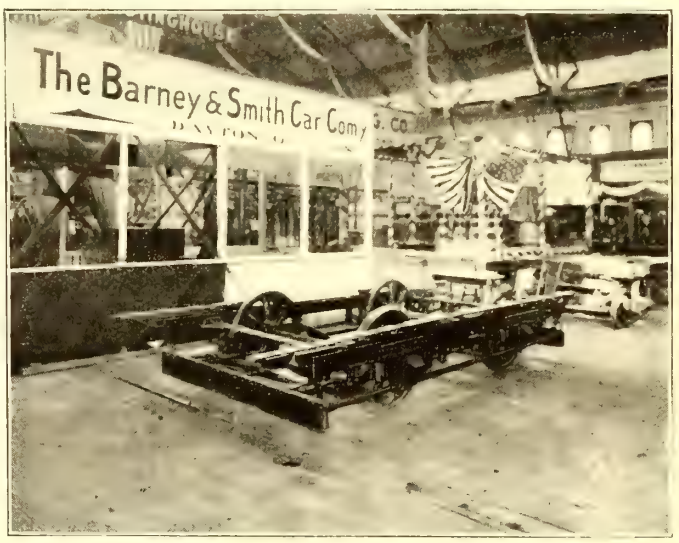


EXHIBIT OF THE BARNEY & SMITH CAR CO.



EXHIBIT OF THE INTERNATIONAL REGISTER CO.



EXHIBIT OF HEYWOOD BROS. & WAKEFIELD CO.

manganese steel, combining the running rail, guard rail, filler and third-rail, all in one piece, proved of interest to those who had had trouble with other steam railroad crossings in their tracks. A steam and street railroad crossing frog with manganese steel center for paved streets was shown and highly commended by track engineers. An example of its particular adaptation was shown by a large plan of a very intricate track layout in front of the new South Boston station in the city of Boston, in which a great mass of special work is crossed by a steam track. This layout, by the way, will be one of the, if not the most, important layout in Boston. Samples of T-rail, frogs and switches, cast entirely out of manganese steel, showed what strides had been made in handling this remarkable metal, which combines extreme hardness with great toughness. A double spring frog, long radius switch, complicated curving pieces and photographs of work made by the Wharton Company were further objects of the exhibit. The representatives present were F. P. Howe, first vice-president; Victor Angerer, second vice-president, Philadelphia; A. S. Partridge, St. Louis representative, and J. C. Robinson, of Harrington, Robinson & Company, agents in Boston.

THE AMERICAN MASON SAFETY TREAD COMPANY, of Boston, was represented by Herman Pfeffer, its Chicago agent, and Fletcher Randall, Cleveland agent, who showed the Mason unwearable non-slipping treads for street cars. These treads are adapted for both open and closed cars. They may also be applied to wood, iron, marble or granite stairs, to hydrant and manhole covers, coal hole covers and for similar uses. The tread is now in use on the Cleveland Electric Railway, the steps of the Boston Subway, the Brooklyn Bridge, the Chicago Elevated Railway and in many other important places.

ADAM COOK'S SONS, of New York, made an exhibit through their Western agents, Winne & Kellogg, of Chicago. The display included a variety of lubricating oils of the "Albany" brand, and greases, and compression and spindle grease cups of various sizes and for various purposes.

OWING to large increase of its business, the Springfield Manufacturing Company, of Bridgeport, Conn., manufacturer of car wheel and tool grinders, was unable to prepare for exhibit either a car wheel grinder or tool grinder. This company manufactures, in addition to the car wheel grinder exhibited at Buffalo and Boston, a machine using an 18 ins. x 1½ ins. emery wheel, also two different styles of single end grinders specially adapted for the smaller systems. The company was represented by its general manager, George W. Jackman.

THE FALK COMPANY, of Milwaukee, Wis., showed numerous large and very handsome photographs, some of which represented track, overhead and power-house construction of the Oshkosh & Neenah (Wis.) road, owned by the Citizens Traction Company, of Oshkosh, Wis. All of this work was built by the Falk Company under the superintendence of W. F. Carr, chief West Chicago Street Railway. Other pictures represented the engineer of the Falk Company, and recently chief engineer of the

construction of the Metropolitan Street Railway at Kansas City, Mo., illustrating particularly track construction and showing track laid in concrete beam without ties, which was described by Mr. Butts, chief engineer of the Metropolitan Street Railway Company, of Kansas City, in his paper read before the association. Other pictures showed some of the novel features of cast welding on the Third Avenue line, New York City, where the cars are run continuously, and special clamps were devised in this case so that the work could be carried on without interruption to traffic. Another of the series of large pictures was of gears and pinions manufactured by the Falk Company. This picture showed one of their large shipments to Cairo Tramways Company, Cairo, Egypt, which practically illustrated the wide extent of the business of the Falk Company. The company was represented by Gen. Otto H. Falk, Herman W. Falk, President, E. A. Wurster, Secretary and Treasurer, Clement C. Smith, Vice-President, Charles L. Jones, Assistant Secretary, Jacob Wendell and R. L. McDuffie, Eastern representatives of the company.

THE DEARBORN DRUG & CHEMICAL WORKS, with general offices and laboratories in Chicago, had a very elaborate booth decorated in red and green, with trimmings of red and green, and an abundance of flags. This company of chemists, organized some fourteen years ago, has built up a very extensive business in the treatment of boiler feed waters as per analysis, going into the subject most thoroughly and scientifically. In fact, it has developed the boiler compound business so that it is recognized to-day by the most practical engineers as a subject on which considerable economy can be obtained in the operation of the steam plant. All such analyses of waters are made free of charge and reported to the steam user with information as to the treatment required to prevent scale formation, and to overcome internal corrosive action, pitting, etc. These preparations are blended and prepared to meet the requirements of each case. These methods cannot help but appeal to the operator. These people are also in the refining and lubricating business, and their laboratory equipment for the refining and proper blending of lubricating oils, and the retesting of same, is probably the most thorough of any in existence. In the marketing of oils, this company, in the first place, gets the proper oil for the conditions of the steam plant, the first requisite being the highest quality and afterwards the price per gallon. Many of the largest steam plants in the United States are buying their oils of the Dearborn Company through its laboratory inspection, and the saving made in quantity required to give thorough lubrication has been something remarkable. When the proper oils are once introduced, every shipment is absolutely uniform on account of the double check testing system they employ. The company exhibited a very complete line of lubricating oils and greases, that are used especially by the street railway companies now running high pressure plants. Also to be seen in this booth were a great many interesting samples of scale formation, caused by different waters, and many samples of pipe, boiler tubes and braces, showing the different effects of pitting, caused by many waters charged heavily with sodium and potassium salts. Other specimens were shown illustrating the effect of some of the "cure all" boiler compounds, which are usually made from caustic soda, and while they reduce some scale formation, the deleterious after effect on the steam plant (such as pitting and corrosion) is a great deal worse than the apparent good effect obtained from removing some scale. This company has maintained for years that vegetable extracts only should be employed as feed water treatment; that they do the work perfectly in the boiler and act as a preservative to the entire system. The company gave as souvenirs a very handsome pocket spirit-level, and delighted the hearts of the ladies by presenting to each a bottle of very fine perfume, a product of its own laboratories. There were in attendance at the exhibit of this company Robert F. Carr, vice-president and general manager; Charles M. Eddy, secretary and treasurer; William B. McVicker, Eastern manager; T. J. McMaster, G. W. Spear and A. Ruffner, of the Chicago office. The company now has branch offices in Detroit, St. Louis, St. Paul, Denver, San Francisco and Los Angeles.

THE BARNEY & SMITH CAR COMPANY, of Dayton, Ohio, showed three trucks. Its maximum traction, double suburban and single truck. These trucks are too well known to the trade to require any description or explanation. A. M. Kittredge, superintendent; H. M. Esterbrook and H. Tesseyman were in attendance.

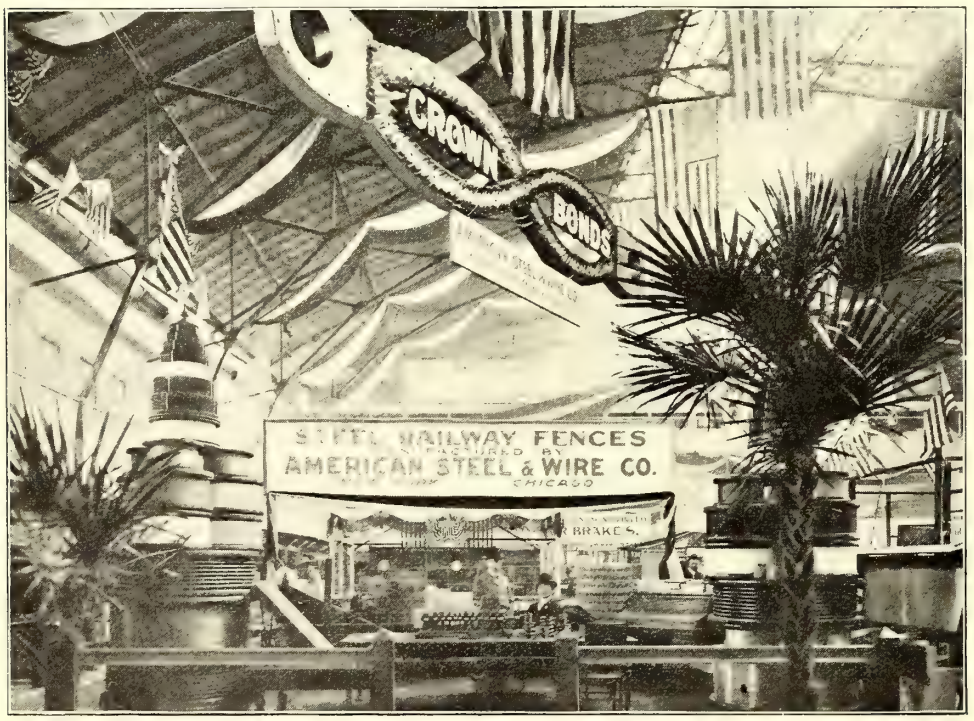


EXHIBIT OF AMERICAN STEEL & WIRE CO.

THE CENTRAL ELECTRIC COMPANY, of Chicago, had a very handsome booth decorated in yellow and black, and with a number of steel trolley poles spanning the doorway. M. M. Wood was in charge. There was exhibited a display board made up of overhead material, car fixtures, etc., elegantly polished. These were mostly of the well known Wood type, manufactured by the Central Union Brass Company. A brass cannon, a yoke of brass oxen, and a brass street car attracted no small attention. The company's souvenir was a neat brass paper cutter. The following gentlemen were also present: George A. McKinlock, president; Charles Brown, secretary, and C. W. Cobb.

THE GARTON-DANIELS ELECTRIC COMPANY, of Keokuk, Ia., was represented by J. V. E. Titus. Its booth contained a panel mounted with Garton station type arresters of different styles of finish, and connected with a 500-volt circuit. By the aid of a static machine the operation of the arresters was shown in a very satisfactory manner. They interrupt a short circuit so quickly that the ammeter shows little or no deflection. On a table was displayed a full line of pole, station and car arresters, as well as samples of 500-amp. and 800-amp. kicking coils, of which this company makes a specialty. Two samples were also shown of the Automotoneer, an invention of George W. Knox, electrical engineer of the Chicago City Railway Company. This device prevents too rapid starting of electric cars and attracted much attention. A more complete description will be given in these columns later.

THE EXHIBIT of the American Steel & Wire Company was a composite of all the different products of the company applicable to street railway interests. High above the booth swung a mammoth "Crown" rail bond, which was illuminated with more than a hundred incandescent bulbs, and at night was one of the most brilliant features of the exhibit. The words "crown bonds" were brought out with numerous electric lights. Crown bonds, indeed, in innumerable shapes and sizes, crown bonds, straight and twisted at every known curve and angle, were the "piece de resistance" of the American Steel & Wire Company's exhibit. These bonds, however, were supplemented on every side of the exhibit with devices calculated to interest every department of street railway maintenance and operation; trolley wires, round and odd-shaped, feeder wires and cables, steel armored cables, lead encased cables, submarine cables, magnet wires, every form of insulated wire, wire ropes, rheostat cables, car truck springs, etc. These again, were re-enforced by voluminous representation of



A GROUP OF PROMINENT EXHIBITORS

guy wires and span wires, both plain and twisted, also with huge model of the "high grade W. & M," double galvanized telephone and telegraph wires in "extra BB," "B B" and steel grates. Another feature was the exhibit of woven wire right-of-way fence. A panel of the company's celebrated "American" style of fencing was shown erected on the posts with stretcher attached and in operation. This company makes a specialty of railway fence building and has now contracts covering the erection of several thousand miles of right-of-way fencing in different parts of the country. It stands ready to demonstrate its ability to furnish all labor and material and turn over to the railway companies a better fence, and for less money, than the railway companies could secure in any other manner. Souvenirs in the form of solid leather memorandum and pocket-books were judiciously distributed. E. J. Pietzcker was in charge of the exhibit for the electrical department and George P. Rider was in charge of the fence exhibit.

H. P. CAMERON, Syracuse, N. Y., showed G. E.-800 commutators, and samples of his different styles for all kinds of street railway service. These commutators are made from the best drop forged Billings & Spencer segments, insulated with amber mica and turned to standard size. Perfect fit is guaranteed in every instance. He keeps a large stock made up and can ship any number promptly. Some large orders have recently been received.

THE MILLER KNOBLOCK COMPANY, of South Bend, Ind., was represented by its manager, A. W. Morrell. Its exhibit was a very fine line of assembled commutators for all standard

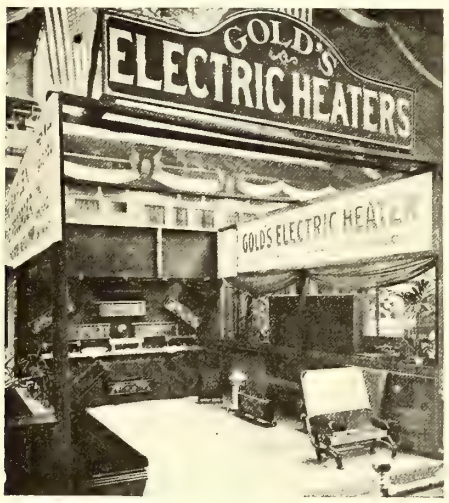


EXHIBIT OF GOLD'S ELECTRIC HEATERS

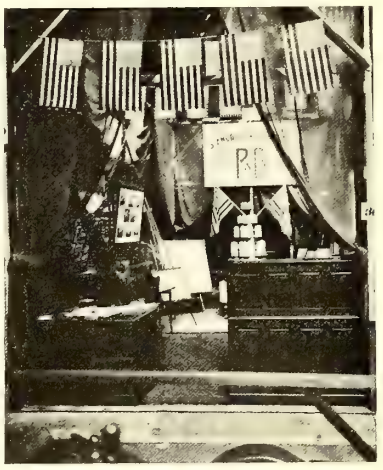


EXHIBIT OF THE STANDARD PAINT CO.



EXHIBIT OF THE SAFETY INSULATED WIRE & CABLE CO.

street railway motors. Its recently improved process for assembling commutators puts it well to the front on this class of work. A constantly increasing business has made it necessary to double the capacity of the company's shops. This exhibit elicited universal praise from street railway men. The company was also represented by A. M. Knoblock.

McGILL, POMEROY & COMPANY, of Chicago, were present in the persons of Mr. McGill, J. W. Porter and E. R. Mason. They showed samples of trolley poles, harps, wheels, rawhide pinions, and in connection with the Ohio Brass Company, a complete line of electric street railway supplies— "from the wire to the ties." In addition to their own line of supplies, they represent the following: The Ohio Brass Company, Mansfield, Ohio; the Forest City Electric Company, Cleveland, Ohio; the Cutter Company, Philadelphia, Pa.; the Orient Electric Company, Youngstown, Ohio.

THE CREAGHEAD ENGINEERING COMPANY, of Cincinnati, made its usual large exhibit of flexible brackets, overhead line material, iron and wood pole fittings, rail bonds, etc. One particularly attractive feature of this exhibit was an extra heavy double bracket for center pole construction, which was recently supplied for the rebuilding of the overhead work on the New Orleans & Carrollton Railway at New Orleans, La. A number of large photographs showing the company's material in use on roads in different parts of the world, completed this attractive exhibit, which was in charge of its superintendent, G. R. Scrugham. A steel pocket rule was given as a souvenir.

A. MAJOR, of New York, exhibited two useful and valuable articles. One of these is Major's cement, which is known throughout the country and extensively sold by druggists. Mr. Major discovered it in 1876 and put it on the market; it has had an increasing sale ever since. The other is an economincal arrangement for water-coolers. It is a receptacle that can be used in any water-cooler. With it in the cooler, the ice melts only half as fast and keeps the water at the temperature of cold spring water. It is now used by a number of prominent firms who approve of it and recommend it highly. Their testimonials state that the receptacle does everything Mr. Major represents it to do. The superintendent of one of the largest of Edison's electric plants in New York City stated to Mr. Major that since the receptacle has been used, not one man in the engine or boiler room has suffered from the effects of ice water. It also accomplishes a great saving in ice.

THE W. T. VAN DORN COMPANY, of Chicago, showed eleven patterns of couplers for cable, electric and elevated roads. Full-sized couplings for all these classes were shown in detail. Also two sizes of Mr. Van Dorn's well known ball joint. Two small cars fitted with Van Dorn's No. 5 complete with ball joint, made up the remainder of the exhibit. Visitors at this booth without exception pronounced the Van Dorn coupler perfect.

THE STAR BRASS WORKS, of Kalamazoo, Mich., had a neat booth in charge of Walter C. McKinlock. This company's trolley wheel, which has been on the market not quite two years, is running on thousands of cars. Some of the points of superiority claimed for it are as follows: It will run in sleet longer than any other, is self-oiling and therefore saves bushings, will run smoother and last longer, is a good conductor and is not complicated, will not injure the overhead equipment, is made in the standard sizes, 4 ins. and 6 ins., and will fit any standard harp.

THE GARL ELECTRIC COMPANY, of Akron, Ohio, represented by M. Garl, had on exhibition its street railway phones, which have been described in the JOURNAL in the past. The company has just bought out a new portable pocket phone which the motorman may carry in his pocket. The transmitter and receiver are all fastened together in one piece, the receiver forming a cap over the transmitter. When needed, the cap is removed and the phone plugged in at the stations along the line. The phone complete weighs only a pound. The company also showed house phones, and an ingenious fire and burglar alarm, which explodes a blank cartridge when disturbed by either fire or burglars. The cartridge serves the purpose not only of attracting the owner's attention, but of frightening the burglar as well.

THE AMERICAN VITRIFIED CONDUIT COMPANY, of New York, was disappointed by not receiving the material intended for its exhibit in time for making the extensive display, as originally planned. The company showed a few samples of its self-centering single and multiple ducts in its standard types of conduits for street railway and lighting service. The company was represented by B. S. Barnard.

CLIFT WISE, of Chicago, known to convention goers for the past fifteen years as one of Chicago's street railway contractors, was on hand as usual.

THE NORTH AMERICAN RAILWAY CONSTRUCTION COMPANY, of Chicago, had its interests cared for by A. S. Littlefield, president; D. J. Evans, secretary, and E. M. Fry, general superintendent. This company has had an immense amount of

work on its hands this summer, among its contracts being 25 miles in Indianapolis, the track work for the Northwestern Elevated in Chicago, and extensions of the Metropolitan Street Railway, of Kansas City, and the Chicago & Milwaukee Electric Railway.

THE STANDARD RAILWAY SUPPLY COMPANY, Chicago, was present in the person of its president and general manager, Garson Myers. This company represents the Christensen Engineering Company, R. D. Nuttall Company, Albert & J. M. Anderson Mfg. Co., Du Puy & Company, and others.

PIERCE & RICHARDSON, of Chicago, the well known Western contractors, were represented by the three gentlemen who comprise this firm: Richard H. Pierce, Robert E. Richardson and Samuel G. Neiler. This company acts strictly as consulting engineer, not being interested in nor handling any manufactured products. Among the company's clients are Armour & Company, Salt Lake (Utah) & Mercer Railroad, and the Chicago City Railway.

THE COMPRESSED AIR MOTOR COMPANY, of Chicago, had a small booth from which it issued its handsome new catalogue. Those of the company present were Henry D. Cooke, president; William E. Selleck, general manager; Robert Hardie, engineer; C. V. Kasson, head of sales department. This Company's compressed air system for operating street railway cars has often been discussed in the columns of the STREET RAILWAY JOURNAL. Air cars have been running in Chicago since May 30, 1899, and have performed continuous and uniformly satisfactory service. One interesting peculiarity about this operation is that on the first trip each night the run is made with air stored over from the previous run, and it is not unusual to attach one trailer, and sometimes two trailers.

THE SWARTS METAL REFINING COMPANY, of Chicago, is a name well and favorably known to street railway people throughout the entire country. This company has built up an immense business in the handling of worn-out trolley wire, scrap windings, brass castings, etc., etc. The company also furnishes a superior metal for motor bearings, which is coming into general use on the best roads. The company was represented by its president, S. Swarts.

SARGENT & LUNDY, of Chicago, known as engineers for many of the largest steam plant installations in the West, were present in the persons of Frederick Sargent and A. D. Lundy, neither of whom needs any introduction to street railway men of the present day. This company is retained as consulting engineer for a large number of the railways now being constructed in the West.

THE HEINE SAFETY BOILER COMPANY, of St. Louis, was present in the person of its genial Chicago representative, James H. Harris, who has represented this firm in Chicago for nearly twelve years, during which time he has been one of the best known among steam supply men.

NAUGLE, HOLCOMB & COMPANY, of Chicago, the contractors who built the Suburban Railroad in Chicago, and who are at present constructing 250 miles of the Tennessee Central Railway, much of which is through the roughest part of the Tennessee Mountains, were represented at the convention by E. E. Naugle. This company is the largest producer of ties and poles in the West, and has an enviable reputation for experience and reliability.

THE SPIRAL JOURNAL BEARING COMPANY, of St. Louis, exhibited with the Morris Electric Company its new motor bearing, which consists of an iron shell lined with two dissimilar metals, brass and anti-friction, so placed that the journal has a continuous bearing on both metals. From this combination it is claimed that a greater mileage is obtainable than from either a solid bronze or babbitted bearing. The company guarantees to replace without charge all spiral bearings removed from service on account of heating or breaking before wearing out. L. P. Delano, president, represented the company.



EXHIBIT OF WM. WHARTON, JR. & CO.

THE CYLINDORAMA RAILWAY COMPANY showed a new attraction for parks, which consists of a revolving steel cylinder 200 ft. long x 50 ft. in diameter, which contains forty convolutions of tracks, running around the inside of the shell. The cars, of which forty can be operated continuously, are held at the bottom of the cylinder by the action of gravity, but appear to the passenger to be running at great speed, due to the revolution of the cylinder. The cylinder is fitted with scenery, tunnels, bridges, etc. It is believed that this new park attraction cannot fail to meet with very great success. Samuel Barnes, secretary and general manager, and Harry J. Armstrong were in charge.



EXHIBIT OF OHMER REGISTERS

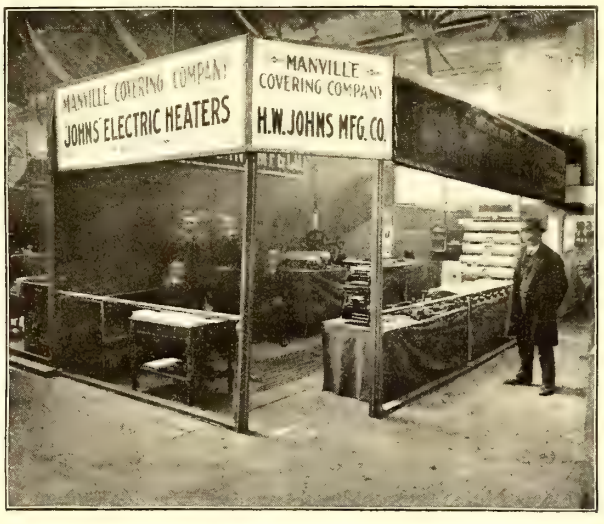


EXHIBIT OF JOHNS' ELECTRIC HEATERS

THE WESTERN ELECTRICAL SUPPLY COMPANY, which has rapidly built up the largest business in the Southwest in the handling of street railway supplies, was represented by the manager of its street railway department, Charles Scudder, Jr.

THE CENTRAL UNION BRASS COMPANY, of St. Louis, was represented by its manager, T. C. White. This company is bringing out an extensive line of overhead material and making

a special drive for street railway business. Mr. White reports that his factory is very busy and that the company's new material is meeting with much favor from street railway companies.

A. C. BECKEN, of Chicago, exhibited a case of Paillard non-magnetic watches, which, it is claimed, are absolutely uninfluenced by magnetic action. These watches are handsome and durable and accurate time-keepers.

THE SIEGRIST LUBRICATOR COMPANY, of St. Louis, had its booth enlivened by one of the best "coon" orchestras in town, whose good music and singing attracted and entertained a continuous crowd. The company's booth was a handsome one, decorated in purple. There were exhibited automatic oil cups and automatic sight feed lubricators, also a double automatic lubricator which has the advantage of two passages for the feeding oil, removing in a large measure the danger of stoppage on account of an obstruction in the oil passages; also the company's standard automatic oiling table. The company's manager, J. N. Edelin, was present with a constant supply of good cheer for his friends.

THE ALLEN & MORRISON BRAKE SHOE & MANUFACTURING COMPANY, of Chicago, showed its composite brake shoe, which was brought out some two years ago, and which is already well known to the trade. This shoe is in service on a great many lines and giving excellent satisfaction. A. M. Allen, J. H. Miller, F. R. Spear and F. D. Freeman, of the company, were present.

THE AMERICAN BRAKE SHOE COMPANY, of Chicago, illustrated the construction of its " Diamond S" brake shoe with sectional broken and complete shoes. The "Diamond S" is in service on a large proportion of the cars, both steam and electric, throughout this country. Representatives of the company were F. W. Sargent, W. D. Sargent, George H. Sargent, A. T. Herr, H. H. Haskell, J. W. Gardner, Arthur Gemunder, G. C. Isbester. The Sargent Company, of Chicago, displayed in this booth a number of steel castings. This company has for years furnished for street railways everything in the line of steel castings.

THE CURTAIN SUPPLY COMPANY, of Chicago, displayed all kinds of curtain fixtures, in a full-sized car model. The company will soon issue its new catalogue. This company, which bought all the old companies in the business, now controls all the curtain fixtures made. Those of the firm present were W. H. Forsyth, G. H. Forsyth, F. C. Kenly and A. L. Whipple.

THE HANNA SOLID OIL COMPANY, of Chicago, although a new company in the field, is becoming well known through its manager, J. W. Hanna, who was often seen at the Convention Hall.

HEYWOOD BROS. & WAKEFIELD COMPANY, of Wakefield, Mass., made a very good exhibit of car seats of the Wheeler, Bushnell and Henry patterns. The special feature of the display was the "walk-over" seat, which was shown in leather, rattan and plush finish. The claims made for this seat are its simple mechanism and its neat appearance. The seat department of the exhibit was in charge of Bertram Berry, of New York, and James Hitchcock, of Chicago. The company also showed a new time recorder for use in car shops or factories of any kind where a large number of workmen are employed. Those interested were supplied with a handsome catalogue and samples of the records made by the recorder. This part of the exhibit was in charge of R. E. Kimball, of Chicago.



EXHIBIT OF THE GENERAL ELECTRIC CO.

THE DIAMOND STATE STEEL COMPANY, of Wilmington, Del., made an interesting exhibit of some of its track specialties, among which may be mentioned the Churchill girder and T-rail joints, the Diamond spike, the Diamond crescent spike, the Diamond tie-plate and the automatic rail joint spring. The Churchill girder rail joint was shown in full and also in cut sections, exhibiting the perfect union of parts and the wedged underbearing, preventing any movement of the rail ends and thereby eliminating wear. Blocks of wood illustrating the cutting of wood fiber by the Diamond spike, as compared with the ordinary pressed and even rolled point spikes, presented a striking contrast which attracted considerable attention. The automatic rail joint spring, which has already proven its effectiveness in steam railway practice, is claimed to add largely to the strength of channel as well as T-rail joints, and are invaluable in crossings where bolts tend to loosen and break. The Diamond tie-plate is a modification of the well known Servis type with longitudinal under flanges and projecting fluted web to shield the flange ways from water dripping from the rail. The company was represented by

W. S. Boughton, treasurer, formerly with Lorain Steel Company, and Benjamin Reece, engineer.

THE INTERNATIONAL REGISTER COMPANY, of Chicago, made a very handsome exhibit of its well known machines. The company was represented by A. H. Woodward, president; W. H. Brown, secretary; A. H. Place, W. J. Volkins, vice-presidents; A. H. Englund, of Philadelphia, and Charles N. Wood, of Boston. The features of the exhibit were the standard single register, with aluminum face, designed for one class of fares, and the double register for any two kinds of fares, such as tickets and cash, transfers and cash, five-cent and ten-cent fares or any other two classes as may be required. Any of these registers may be fitted with any style of pulls, cord or rod, and for any type of open or closed car. The double registers are fitted with two bells of different tones. Some of the registers shown were made with the aluminum face, others with black face. The exhibit included a full line of register fittings for both rod and cord, such as handles, pulleys, brackets, rods, etc. There was a great demand for the company's small portal scale souvenir, which was one of the most practical souvenirs at the convention.

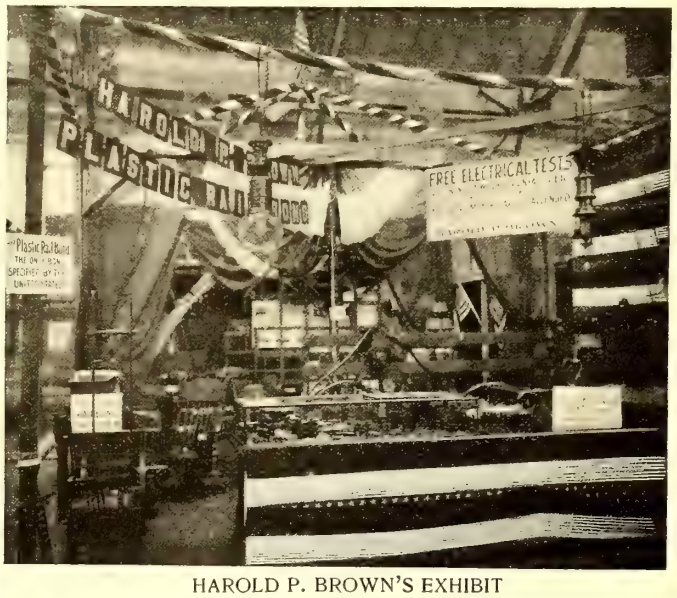
THE OHIO BRASS COMPANY, of Mansfield, Ohio, made a very handsome exhibit, which was well arranged and was very comprehensive. The company was ably represented by three men from the Mansfield office, and one from the New York office. These were C. K. King, secretary; A. L. Wilkinson and G. A. Mead, of Mansfield, and R. A. Byrns, of New York. The arrangement of the display was well calculated to show off the material to good effect. Surrounding the space were placed both wood and iron poles, equipped with two styles of iron brackets. The brackets included the company's well known flexible brackets and these were fitted with hangers of the various types required in actual service. One pole was equipped with a flexible bracket on which the suspension yoke was fitted for supporting two parallel trolley wires. A full line of clamps and ears for figure 8 wire were shown, including a greater variety than ever before exhibited by the company. The insulating material used in the entire exhibit was of the Ohio Brass Company's well known standard type known as "Dirigo." Mention should be made of the very fine sample board which formed the background of the exhibit, made up of a well arranged display of small line material in a great variety of styles. A full line of feed-wire fittings was also shown. The entire central part of the company's space was taken up by a pyramid of steps, on which all small parts were displayed in great profusion. Besides this elaborate exhibit of line material the company also showed a variety of other supplies, such as headlights, ratchet brake handles, bell-metal motor bearings, track brushes and brush holders, the Monarch track scraper, gongs, bonding caps of steel and copper, etc., etc.

THE WATSON-STILLMAN COMPANY, of New York, had a practical exhibit which included a motor lift for pit work with a capacity of 3000 lbs.; hydraulic rail punches, suited for punching a hole 1 in. in diameter in 1-in. iron; swivel jacks of 7 tons and 10 tons capacity; hydraulic T-rail bender, and a hydraulic girder rail bender.

THE GENERAL ELECTRIC COMPANY was in full force with a large delegation from its various offices and factories. The delegates who attended were S. D. Greene, S. Trawick, George Rosenthal, E. D. Mullin, T. P. Bailey, R. H. Beach, F. W. Willcox, F. E. Case, F. H. Strieby, A. H. Armstrong, W. F. Hayes, B. E. Sunny, F. Barbour, W. J. Ferris, E. D. Priest, J. J. Mahoney, F. M. Kimball, R. A. Swain, George J. Cadwell, J. W. Johnson, W. B. Potter, F. N. Boyer, J. G. Barry, J. W. Buell, J. H. Livsey, H. R. Bishop, Jr.; George Breed, R. E. Moore, W. G. Carey, T. Ferris, Ward S. Arnold. The exhibit comprised two GE-55's mounted on a truck, which are to be used as an equipment for the Northwestern Elevated Railway. These motors are of 150-h.p. capacity. In addition, there were two GE-100's, equipped with the B-13 controller and electric brakes. The motors and brakes were mounted on a St. Louis Car Company's truck. One of the special features of the exhibit was the new GE-65 of 250 h.p. capacity. This motor was built expressly for the Paris & Orleans Railway, Paris, France. The exhibit of street car motors comprised a GE-52 and also a 57. A line of stationary motors was also shown, the new C. E. type being displayed. There was also an air compressor which the General Electric Company is building for elevator work. A line of standard switchboards also attracted much attention as showing the latest type for feeder panel boards. This part of the exhibit included two standard generator panels and an additional panel whereon was mounted a form G-2 station wattmeter. A large line of supplies of overhead material, circuit breakers, lightning arresters, assembled commutators, armature coils and porcelain insulators similar to those used on the third-rail system were also displayed.



EXHIBIT OF THE FALK CO.



HAROLD P. BROWN'S EXHIBIT

THE NEW HAVEN CAR REGISTER COMPANY, of New Haven, Conn., showed, in addition to its well known regular line of "New Haven" single, double and triple registers, its new round single and double registers, which the representatives of the company present claimed are the most complete, and in every respect, the finest round registers ever made. These machines are constructed in a very thorough manner, and are said to contain all the recognized desirable features, and in addition special and valuable points which none of the other makes possess. The completeness of the double register, which consists of two single registers in one case, is recognized at a glance, and the many unique features, such as showing the number of the trip, as well as the direction, the number of each class of fare rung up on the trip up to 1000 in large numerals, which can be plainly read from end of longest car, the total number of each class of fares up to 100,000, and indicating the class of fare last rung up in prominent letters, were appreciated by all practical railway men. Each machine is also provided with red safety shields and with automatic locking and controlling devices, preventing one side of register from being rung up while the other side is being operated. A locking device is also provided so that conductors can lock the register upon temporarily leaving car, preventing the ringing of any fares during their absence. This register is also adapted for use on two connecting roads, one side for each road, each conductor securely locking his side of register when leaving car. It can also be arranged as two separate registers, each side operating and being reset to zero independent of the other side. All these

different arrangements make this machine peculiarly adapted to meet the various conditions of registering fares on electric railways. The round single registers are provided with very prominent numerals and the safety shield is lettered "not registered." This shield covers the figures as soon as the conductor begins ringing up the fares, and remains in view until after the fare is rung up and registered. This machine has been adopted by the Third Avenue Railroad, of New York, on its new equipment. Both of these registers, in addition to being very complete, strong and durable, presented a very fine appearance with finely finished antique copper cases and ornamental aluminum dials and attracted much attention at the convention. The different parts of the New Haven registers were also shown mounted on boards, together with the "New Haven" simplex and duplex counting machines, used in commercial business for any kind of counting records. The representatives of the company at the convention were J. S. Bradley, president; F. C. Boyd, W. M. Anthony and H. E. Beach.



VIEWS TAKEN NEAR THE CENTER OF THE HALL

THE EUREKA ELECTRIC COMPANY, of Chicago, had a compact and comprehensive exhibit of its telephones, and called special attention to its excellent telephonic apparatus for railway

work, emergency purposes, etc. It was a shrewd idea to make such a display and it attracted much attention on the part of the managers and superintendents of roads. The exhibit was in care of I. J. Kusel, president; H. J. Kusel, vice-president, and Arthur Stein, secretary and treasurer. They are to be congratulated on the display made and the effect created.



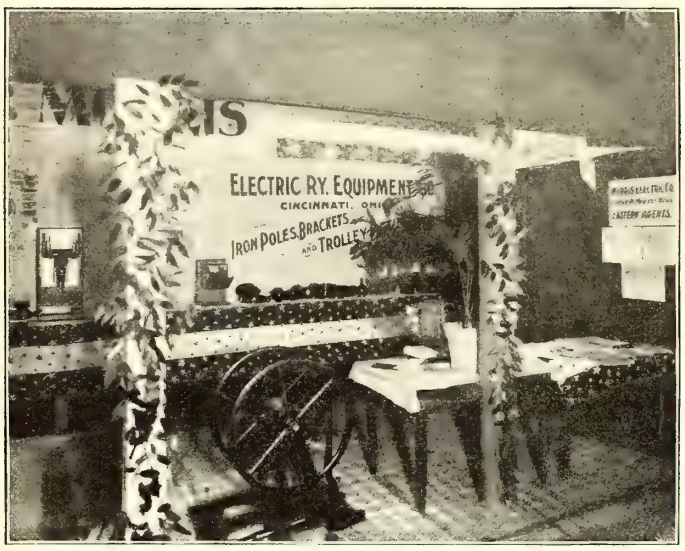
SOME VIEWS TAKEN IN DIFFERENT SECTIONS OF THE HALL

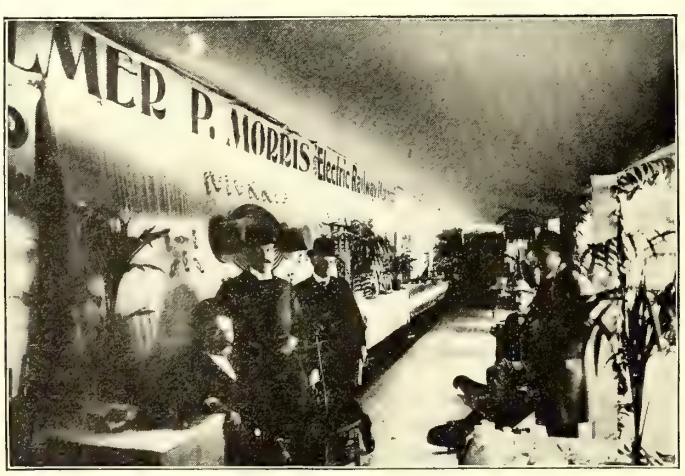
W. R. BRIXEY, manufacturer of Day's kerite wires and cables, was represented by G. F. Porter, New York manager, who had samples of this product with him. This company has recently taken some of the big orders in the street railway line.

THE PITTSBURGH REDUCTION COMPANY had one of the smallest exhibits in the place, but it was decidedly one of the most novel and interesting. It consisted essentially of a large glazed frame holding an assortment of its aluminum wires and cables, which of late have made so distinct a place for themselves in electrical transmission and allied work. A few samples of other aluminum goods were also shown by J. A. Rutherford, representative.

THE FRANK RIDLON COMPANY, of Boston, was represented by Chas. N. Wood, who exhibited a Wilson trolley-pole catcher, which he showed in operation with a Nuttall pole. The

compact little round box containing the roll-up machine is easily attachable to the dashboard and the cord is held at the point where the conductor sets it, so that his mind and hands have greater freedom to attend to his more legitimate business of looking after the passengers and collecting fares that would otherwise be missed. The attachment is inexpensive, simple, and does not get out of order. It not only prevents trolley-pole accidents, but it keeps out of sight all the cord that is otherwise a nuisance by dangling idly. Testimonials that it kept the pole in position were shown from those using the device, testifying to its value on trolley cars, particularly in places where the high speed of running was likely to throw the trolley off.





THE TAUNTON LOCOMOTIVE MANUFACTURING COMPANY, of Taunton, Mass., was represented by W. R. Billings, treasurer; J. C. Sproat, J. H. Wright, agent, Lancaster, Ohio, and Messrs. Wendell & MacDuffie, both of these New Yorkers being also on hand. The exhibit was made wholly in the open air, and comprised a double-truck share snow plow, a nose plow and a snow sweeper, the last being the company's initial attempt in this direction. The double-truck plow has a long leveler that can be swung out widely from the cars, and which can level down the snow for carting away, sleighing, etc. Some seventy of the plows have been sold this year. The sweeper shown was sold to the Cleveland, Painesville & Eastern road. It has several notable features. The weight is about 11 tons, and the main sill is 11 ins. x 4½ ins. The heaviness of the sill gives strength, but with this go adjustability and the keeping of the sill level, even after years of service. Friction clutches are used on the broom motor shaft, and the brooms have malleable iron heads with extra heavy rattan in the brushes. There are extra heavy accessories and arrangements for the draw-bar, and specially heavy and long leveling wings on each side which can be quickly opened and shut. A first-class digger is supplied. The machine presented a most solid and massive appearance.

ALEXANDER H. LEWIS, Cincinnati agent for the Cahall boiler and the Kilgour safety brake, was in evidence for the first two or three days.

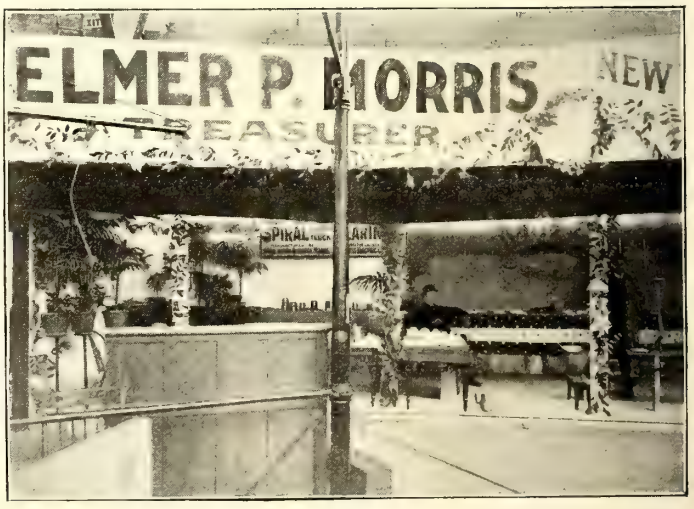
THE GOLD CAR HEATING COMPANY, of New York, had an effective and attractive display of its well known electric heaters, tastefully grouped and showing details. The exhibit included complete lines of this company's street car heaters and the types for house, office and apartment heating. The company was well represented, its forces on the ground including E. E. Gold, president; John E. Ward, general manager; Egbert H. Gold, Western representative; F. Weston, New York, and J. Watson and T. Downing, Western salesmen. A large business was done at the booth, which was visited by the delegates in great numbers, and the company was elated as to the victory recently achieved by it in the courts, and in regard to which a special circular was issued. The company, which has quite a reputation in the souvenir line, gave out liberally a choice leather pocket note-book, with many features of desirability.

THE CONSOLIDATED CAR HEATING COMPANY, of Albany, N. Y., had an attractive exhibit on the main aisle under the care of R. S. Scales, Western representative; W. P. Cosper, general agent at St. Louis, and J. H. Dubarry, Jr., of New York City. The heaters were shown separately, in detail, and in operation, under longitudinal and cross seats. Special attention was directed to the new three-point switch with a dial, which indicates visually the steps in throwing on the heaters and heating the car. Along the back of the booth or space the gratings of the heaters were used to mask some colored incandescent lamps under mica, giving a very pretty effect.

C. S. KNOWLES, Boston, a well known supply dealer, was ably represented by Percy Hodges, who is in charge of the street railway department.

THE STANDARD AIR BRAKE COMPANY, of New York City, was represented by J. R. Ellicott, general manager; E. H. Beacham, and G. E. Baker, of New York. The exhibit was very complete, illustrating thoroughly the application of mechanical brakes in the street railway service. It included three types of service, one with the motor driven compressor, one the gear driven and the third showing the eccentric driven. The independent motor driven compressor, which was fitted with a Storey motor, was admirably demonstrated, and the various parts were all available for examination, including compressor, automatic controller, cylinder, reservoir, operating valve, platform staff, etc. The automatic was set at 60 lbs., cutting in at 45 lbs. The other type cuts out at 90 lbs., and cuts in at 80 lbs. The interest shown by large throngs proved that while air brakes are still unfamiliar to many people in street railway work, the resort to them is rapidly becoming general and is encouraged by public opinion. Handsome catalogues were distributed and instruction books to those who could benefit by them.

J. G. WHITE & COMPANY, electrical engineers, etc., of New York, distributed a handsome brochure in which the statistics of the growth of electrical industries in the United States are presented very concisely. The total capitalized value is put at over $3,000,000,000, half of which is to be credited to electric railways alone, all due to the development of electric traction in the last ten years.



SNAP SHOTS OF THE MORRIS EXHIBIT

THE CHARLES SCOTT SPRING COMPANY, of Philadelphia, was represented by D. L. Roche, of that city; Scott R. Hayes, of Cleveland, and J. T. Harahan, Chicago. This com-

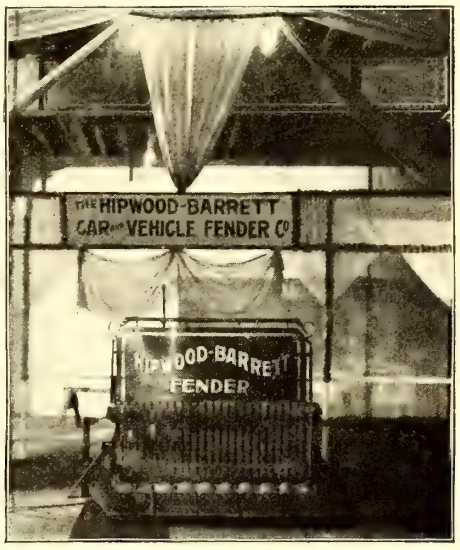
pany's compact exhibit included specimens of the various branches of its work, particularly a full line of springs for trolley trucks and trolley stands, as well as valve springs. At a central table stood a large nickeled spring, of the kind made to go under steam passenger coaches. Around the exhibit smaller springs were mounted on wooden pedestals for better inspection. The company distributed among its friends a valuable card case pocketbook in leather.

THE TAYLOR ELECTRIC TRUCK COMPANY, of Troy, N. Y., exhibited one of its heavy 8-ft. wheel base single trucks, designed for heavy vestibule single-truck cars, one of its Empire State radial trucks, one of its swing bolster double trucks for regular double-truck passenger car service, and a recently designed extra heavy swing bolster double truck, for long, heavy, high-speed suburban cars. The exhibit was in charge of John Taylor, manager of the company, and the Taylor trucks were thoroughly examined in detail and highly spoken of by many delegates. Of the extra heavy swing bolster style, sixteen have been ordered for Ottawa, Canada, while six long car sets have been sold to the Quebec, Montmorency & Charlevoix Street Railway.

THE R. D. NUTTALL COMPANY, of Allegheny, Pa., had a large space and was represented by F. A. Estep, president, associated with them in its occupancy being the Standard Railway Supply Company, Garson Myers, president, and C. N. Wood, of Boston, with whom was C. W. Held. The Nuttall exhibit included a variety of the trolley poles, springs, gears, pinions, etc., of the company's familiar make. The motor gear cutting plant owned by this company gives it unusual facilities in that line and the product



EXHIBIT OF THE STANDARD AIR BRAKE CO.



THE HIPWOOD-BARRETT FENDER

has thus won the reputation deserved by every piece shown in the exhibit.

F. B. BROWNELL, of the Brownell Car Company, St. Louis, was in attendance through the convention.

THE EXHIBIT of the Lorain Steel Company, of Lorain, Ohio, spread out over almost one entire end of Tattersall's, and needed the space taken for this varied display, which in many respects was one of the most comprehensive in the whole hall, as it ranged from car controllers and motors to the details of track construction. The exhibit was in charge of P. M. Boyd, of Lorain, secretary; S. P. S. Ellis, Pittsburgh; F. A. Merrick, Johnstown; W. W. Kingston, Atlanta; R. T. Lane, Johnstown; A. S. Littlefield, Chicago; O. C. Evans, Cincinnati, and H. C. Evans, of New York. The exhibit included, in the truck department, the company's new double truck, "style F," and its new single truck, "style C," the double taking two 50-h.p. "steel" motors, and the single two 35-h.p. "steel" motors, constituting a very substantial, but flexible mechanism. In the rail and crossings department were shown the company's guaranteed 9-in. switch pieces, with hardened plates, Lorain standard crossings and a remarkable 9-in. girder crossing with the continuous arms made in two pieces, so that there is only one pair of joints in it. Note must also be made here of the beautiful examples shown of electric welds, taken from real practice on 6-in. 66-lb. rail, recently, at Buffalo. The company also showed two of its new controllers, for which many points of excellence and uniqueness are made, and which are strikingly compact, simple as to wiring, easy of access, and renewability of working parts, which greatly simplify the work of the motorman. The single controller of this type for two motors up to 35 h.p. each was attached to one of the trucks and in operation. The double controller shown will take care of four motors up to 35 h.p. each, and is practically two motors rolled into one. The controllers were a subject of much interest on account of their originality and were in constant operation by the company's experts.

THE JACKSON & SHARP COMPANY, the well known car builders of Wilmington, Del., was represented by J. Monteith Jackson.

THE HIPWOOD-BARRETT CAR AND VEHICLE FENDER COMPANY made an exhibit which probably attracted as much attention as any in the hall, partly because of the intrinsic merit of the fender, and partly because it was accompanied by one of the most ingenious and effective devices for showing the working of a piece of apparatus ever seen at a convention. This was the "mutascope," by means of whose 1200 photographs, taken at the rate of forty per second, a car equipped with the Hipwood-Barrett fender is actually seen approaching the spectator at the rate of 15 miles an hour, while in the course of its travel it picks up two 65-lb. child dummies, one standing erect on the track, the other prostrate with one arm extended in the direction of the approaching car—conveys them a few feet further till the car can be stopped —and then is shown the operation of closing up the fender and running it out of the way under the car. The Hipwood-Barrett fender is constructed on the principle of providing yielding striking surfaces, by which the blow to the "strikee" is greatly lessened, and he is landed safely upon the fender. It is stated that the 65-lb. dummies shown by the mutascope, which are made of ordinary canvas, filled with sand, have been struck and captured by the fender 104 times to date without at any time tearing or ripping the canvas. As souvenirs of the convention, the company presented to its friends several circulars descriptive of the fender, together with a beautifully gotten up little souvenir showing pictures of all the challengers and defenders of the America's cup since the latter was first won in 1851. The European patents of this company have recently been sold to Frederic Romünder, of Cologne. The company was represented by A. B. Dalby, president; George Hipwood (inventor of the fender), treasurer; George Weiler, Western manager, and Henry S. Jenkins.

THE OHMER REGISTER COMPANY exhibited, as its principal feature, a complete working installation of a ten-fare Ohmer register with auxiliary apparatus, and this was examined with the greatest care by some of the principal street railway managers and auditors attending the convention, several spending an hour or more in watching the operation of this peculiar and valuable invention. The register has been brought to still greater perfection during the past year, and is now a very simple and highly efficient machine. Its principal mechanism is of malleable iron, and springs have been almost completely done away with, the action of the conductor's cord being to raise the iron parts to the point where the record is taken, these parts returning to their original position by means of their own weight. The counters are also simple and well made, and by an ingenious mechan-

ism, a record may be taken at the end of every single or round trip, or at any time, in such a way as to form a perfect check upon the conductor. This feature, joined with that of the multiple register plan of construction for registering different classifications of fares, transfers, etc., makes it possible to greatly simplify the work of the auditor's department, and at the same time that of the detective force, in ways which have already been quite fully explained in the STREET RAILWAY JOURNAL. Moreover, the method of ringing up fares by the conductor provides a "visible receipt" similar to that given by the cash registers now in common use in stores, and the system devised by the company for recording the different



EXHIBIT OF K. M'LENNAN & CO.

kinds of cash fares, transfers, etc., makes it possible to not only detect dishonesty in the case of any single conductor, but to find out who is his confederate, if any, together with the method employed by them for "beating the company." The Ohmer register will find a wide field, especially in interurban work in America and upon foreign tramways, where several different rates are charged, and one feature which gives it additional value abroad is that it can be used on double deck cars with almost the same advantage as with single deckers. The company was represented at the convention by John F. Ohmer, president and general manager; J. H. Stedman, secretary; H. Tyler, superintendent of manufacture; William F. Breidenbach, Western manager, and E. M. McDonald, and A. N. Loper, traveling agents. Mr. Stedman, the company's secretary, has recently become financially interested, and through his wide acquaintance and popularity will, undoubtedly, add great strength to the company.

THE CONTINUOUS RAIL JOINT COMPANY OF AMERICA made an exhibit consisting of several T and girder rail sections fitted with their joints, and showing well the admirable character of the work which this company does. Ordinarily, it is not an easy thing to make three fits with a fish-plate, one to the bottom of the rail, a second to the top of the base, and a third to the under side of the head, but the Continuous Joint is so carefully rolled as to make these fits absolutely perfect, and when this is done there is no question as to the strength or value of the joint, which is very popular among steam railroads, and might readily find wide use in street railways. The company was represented by J. F. Braine, general manager; William F. Ellis, New England agent; H. M. Montgomery, Western agent, and F. C. Schmitz, New York agent.

THE CONSOLIDATED CAR FENDER COMPANY exhibited not only its well known fender, which is undoubtedly the most widely used of any in the United States, but also showed a new step lifter for open cars, by means of which the motorman can easily raise or lower the step from the platform at the end of the trip, and also, when necessary, in passing through crowded streets, and the Campbell snow broom, which is a great improvement over the brooms ordinarily in use. The broom head is made in sections of malleable iron, and the rattan is passed through holes specially prepared for its reception and firmly held in place. It is claimed for this broom head that it will outlast an immense number of those ordinarily in use. The company distributed at the convention a number of bright and taking souvenirs, one of which, especially, was in great demand among the supply men as well as the delegates, and created much amusement. Another contained a Chinese coin given in the hope that "As a pocket piece it may serve as a charm against accidents and misfortune, and be a continual reminder of (the Providence) Fen-Der, a great magician and astronomer of ancient China." Other souvenirs were a small leather covered mirror and a mirror of a different pattern. The company was represented by Col. A. C. Woodworth, general manager, and George Hollingsworth, superintendent.

THE COLUMBIA MACHINE WORKS, of Brooklyn, N. Y., made an exhibit of a few of its street railway specialties, and was represented by W. R. Kerschner.

F. E. DONOHOE, Western agent, and E. H. Hammond, of the Chicago office, represented the American Electrical Works at Providence.

THE PENNSYLVANIA STEEL COMPANY, of Steelton, Pa., had its interests in the care of M. D. Pratt and C. S. Clark, the former being the company's street railway engineer and the latter its Boston manager. The entrance to the exhibit was framed by a huge arch of the company's No. 250 9-in. rail, weighing 128 lbs. to the yard, and the piece thus shaped into a perfect semi-circle of 12 ft. radius weighing about 2000 lbs. Among the samples exhibited were pyramids of rail sections, one column being T-rail and the other girder, through the range of from 12 lbs. to the yard up to 128 lbs. There were also samples of the company's regular Adamantine cast steel special work in frogs, switches and switch stands, and of the Adamantine worked up this way on T-rail frogs and switches using 60-lb. rail. A most interesting feature, both by its suggestiveness and by its relation to export trade, was that of the steel ties to be bedded in cement and intended specially for use on tropical roads, where the conditions are adverse to longevity in wood. With the tie were shown also the drop forged steel brackets used in the work. This style of construction will go on the Sao Paulo (Brazil) road, and is in requisition also for Australia.

THE M'GUIRE MANUFACTURING COMPANY, of Chicago, had, as usual, a very fine, comprehensive and complete exhibit, both within Tattersall's and outside, and was represented by a large staff, at the head of which were W. A. McGuire, president; W. J. Cooke, vice-president; W. P. McGuire, and E. E. Cook, superintendent. The exhibit in the hall covered a large space and comprised two No. 39 trucks, one elevated truck, one solid steel Columbian truck, six ratchet brake handles and six new



EXHIBIT OF EUGENE MUNSELL & CO. AND MICA INSULATOR CO.

Columbian car heaters. A great deal of interest was taken by experts and the public in the "A1" suspension truck shown, bearing a sign to the effect that it was one of 120 ordered for the Havana Electric Railway, and which is also of the type of which the New South Wales Government has bought 230. Of the No. 39 and the solid steel, the company also reported that it was exporting a number to Germany. An interesting feature of this exhibit, and one which attracted great attention, was a pair of side bars of the truck which had been twisted to form a spiral, then bent double. This showed the great ductility of the cast steel used and ability to withstand fracture. Outside the hall, the company had a 14-ton

electric snow sweeper, of which fifty-seven have already been sold this year, fourteen of them going to one road in St. Louis. In addition to the material included within its exhibit proper, the McGuire Company had auxiliary exhibits, so to speak, in the spaces of the General Electric Company and the Westinghouse Company, where railway motors carried on its trucks were in actual operation.

THE BADT-GOLTZ ENGINEERING COMPANY, of Chicago, comprising F. B. Badt and William Goltz, was conspicuously represented by the former, who was not only in constant attendance at the exhibition, but entertained friends in off hours at the Union League Club. Mr. Badt was quite busy with the delegates in regard to Weston instruments, Leonard rheostats and signs, Helios lamps and Edison-Brown plastic bonds. He had as a souvenir a handy pocket calendar for 1899-1900.

THE SIEMENS & HALSKE ELECTRIC COMPANY, of Chicago, was glad to welcome numerous visitors at its fine factory during the convention, but did not make an exhibit. The company was represented on the floor of the house by W. G. De Celle, W. H. Abbott, C. E. Wilson, W. R. Mason, of St. Louis, and Alex. Churchward, its electrical engineer.

THE JOHN A. ROEBLING'S SONS COMPANY, of Trenton, was very much in evidence all the time, not so much by exhibit and sample or souvenir, as by the indefatigable efforts of its large staff, which comprised M. R.Cockey, G. W. Swan, H. Jenkins, A. B. Conover, A. M. Whaley, H. E. Fisher, W. G. Tingley and W. P. Bowman, each paying attention to the roads represented from his respective territory.



EXHIBIT OF THE CENTRAL ELECTRIC CO.

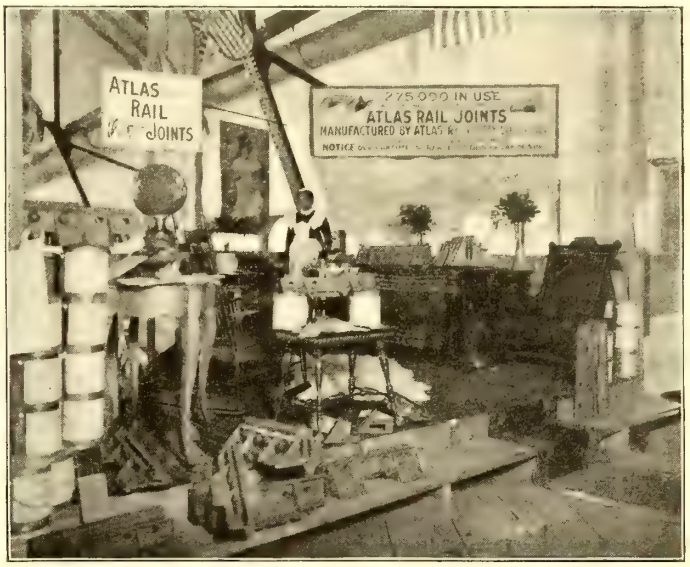


EXHIBIT OF ATLAS RAIL JOINTS

ROSSITER, MACGOVERN & COMPANY, of New York, were represented by Frank MacGovern and John A. Steuart, the Western representative. Mr. MacGovern was an assiduous attendant at the exercises of the convention and gave close attention to matters coming within the field which he has made specially his own. The changes in apparatus and his recent venture in the acquisition of the Excelsior Electric Company's manufacturing plant have brought Mr. MacGovern into touch with so many railway men that he had no time for social distractions except in their company.

THE SAFETY INSULATED WIRE & CABLE COMPANY, of New York, was represented by Lieutenant E. J. Spencer, of St. Louis, who had a well appointed booth. With him were associated M. B. Austin and A. B. Brown, of Austin & Brown, the Chicago agents. A very good display was made of some twenty special wires and cables, running up to the largest sizes. For example, there were shown sections of the cables made for the Chicago elevated roads, equalizer cables employed in Chicago railway power-houses, and the 6000-volt three-conductor three-phase cables of the Metropolitan Company. The Niagara power cable was also shown, and a number of special sections of cables relating to the war and in use by the United States signal corps.

JOHN W. BROOKS, of the Monadnock Block, as special agent in the territory, issued circulars as to the Syracuse headlights for cars, the Crouse-Hinds Electric Company's switches, switchboards, panel boards, etc., and the "Syracuse China" drop sockets of Pass & Seymour, the well known porcelain manufacturers. Crouse-Hinds switches range from 10 amps. to 5000 amps.

THE STANDARD PAINT COMPANY, of New York, and most other big cities in the world, had a pretty booth in which were grouped artistically cans and packages of the famous P. & B. compounds and other specialties so familiar in various departments of railway insulation. These were set off by framed diplomas of merit, etc. The company was represented by F. S. De Ronde, general manager at New York; J. C. Shainwald, manager at Chicago; O. K. Heppes, of the Chicago office, and F. S. Howard, traveling agent. In addition to the distribution of literature, samples, etc., the company presented its friends a handsome and costly leather pocketbook, which, it is needless to say, was eagerly sought after. It is whispered that there were some in white leather for the ladies.

THE SPEER CARBON COMPANY, of St. Marys, Pa., was represented by John S. Speer and A. Kaul, Jr., and made a promising debut at a street railway convention, although it was by no means Mr. Speer's first appearance at such scenes. The company had a display of its railway carbon specialties in the Morris space and exhibited electric light carbons in addition to carbon brushes. The company distributed considerable numbers of a new and handsome catalogue price list of fifty-two pages, devoted to dynamo and motor brushes for all classes of work, and of all the standard makes on the market. The data in this useful catalogue are most minute as to sizes and the type of brush required, price, etc. Besides this, Messrs. Speer and Kaul gave away with liberal hand leather cigar cases and purses.

HAROLD P. BROWN, of New York, with the co-operation of Lieutenant F. B. Badt, of Chicago, made, on the main aisle, an effective exhibit of his solid copper bond, emphasizing this evolution of the appliance in sharp contrast with the other extreme as embodied in the flexible types. This interesting Brown bond consists essentially of a piece of rolled electrolytic copper, 3 ins. long, about 1½ ins. wide and ⅛ in. thick, although these dimensions may be varied. At each end is a cup-shaped projection, and inside the concavity is a piece of sheet steel supporting a pair of steel springs. The steel is used to keep the springs from wearing the copper. The pieces are all held together by a small iron strap until the bond is applied, when the sharp web on the inside of the spring cuts it away and enters the angle plate, thus aiding the conductivity of the bond, which is amalgamated to prevent rusting, and which has its contact surfaces covered with plastic alloy. Naturally, this ingenious novelty attracted much attention. A case contained examples of other types to show freaks and peculiarities of wear; while the Brown bond was shown on sections of rail, in place. In order to give an accurate idea of its value, Mr. Brown had a compact plant operating in his space, comprising a Zucker-Levett American Giant double armature generator giving 3000 amps. at 10 volts, driven by an Edison 20-kw. motor, with Ward-Leonard rheostats, and two very fine Weston instruments, one reading up to 2000 amps. and the other reading fractions of a volt down to .00001. The effect of the bond in estab-

lishing perfect electrical continuity of track was demonstrated to all comers in this way. The current was first put in series through a joint of 80-lb. T rail, with no bond and a joint of 70-lb. T rail, with a Brown solid copper bond on each side and angle plates loosely set up. The unbonded 80-lb. joint, with 2000 amps., showed a drop of 0.423 volts. Mr. Brown then amalgamated the top of the rails at the inner ends, and laid upon these amalgamated spots one of his No. 0000 bonds. The drop with 2000 amps. was then .018 volts. The drop of 1 in. of solid rail with same current was .00223 volts, showing bond was equal to about 8¼ ins. of rail in resistance. The drop on the 70-lb. rail joint with 2000 amps. was .01946 volts. With an extra bond laid on top of rail the drop with same current was .00762 volts; the drop of 1 in. of this rail, with same current, was .00286, showing the bond was equal in resistance to about 7 ins. of rail. This joint was set up with a small monkey-wrench. In actual work, Mr. Brown said, much better results would have been attained. Tests were also made in the same way with other makes of bonds. One showed .425 volts' drop, with 1000 amps. and .75 volts, with 2000 amps. The other showed respectively .22 volts and .37 volts' drop. Both heated to redness in the time required to make tests.

THE MORRIS ELECTRIC COMPANY, of New York City, was represented by Elmer P. Morris, treasurer; G. C. Ewing and Mr. Delano. The exhibit was extensive and remarkably varied, covering the whole range of electric railway supplies. It was grouped along a considerable stretch of the left aisle and was tastefully arranged and decorated with plants, foliage and bunting. At one end was an annex known as the ball grounds and fair grounds, according to the selection of the visitor, the entrance to this abode of hospitality illustrating over its portal the operation of the Hunter illuminated sign. Conspicuous among the exhibits was the Morris rail bond, to which attention was directed by a large sign and by a model 4 ft. long. The rear wall of the exhibit on which these were placed, showed also an assortment of the car straps of J. E. Rhoades & Sons, the Anderson line material, and the Garton lightning arresters. There was also displayed a very interesting collection of complete and dissected bearings for various sizes of journals made by the Spiral Journal Bearing Company, of St. Louis. At the front of the booth were shown by well selected samples, the poles, brackets and line material of the Electric Railway Equipment Company, 25-amp., 50-amp. and 60-amp. circuit breakers of the General Equipment Company; the street track drill made by the Michigan Manufacturing Company; one, two and four duct Mason terra cotta conduits made by the Potomac Terra Cotta Company; Dale Manufacturing Company's shades and socketless clusters; the sand boxes of Louis Fink, of Boston, and the Bock triple-glaze insulators of Thomas & Company, of East Liverpool, Ohio. The samples of Speer carbons shown are referred to in another item. Other features of the exhibit were the track cleaner of Van Dorn & Dutton, and the neat work in detail and complete of H. P. Cameron's assembled commutators. The Munder incandescent lamp was shown and a clever point was made by large pictures of the Brooklyn Bridge with its huge "Welcome Dewey" sign built up from 8000 Munder lamps.

THE CRANE COMPANY, of Chicago, although making nearly everything used in power plants, found that the limited space at its disposal prevented an exhibit of a complete line and only such articles were shown as it was thought would prove interesting to users of high pressure steam. The exhibit comprised an assortment of extra heavy gate valves for 250 lbs. steam pressure, showing the No. 8-E with inside bronze screw, the No. 10-E with outside steel screw and yoke and the No. 11-E with outside steel screw, yoke and by-pass. High pressure globe and angle valves, Nos. 20-E and 21-E, pop safety valves, automatic relief valves, flanged fittings, large pipe, flanged to show style of workmanship, brass valves and pipe threading tools. Sections of the wedges and hard metal seats of the gate valves were also shown to illustrate the method of construction. The exhibit was in charge of J. A. Minwegen.

J. P. SJOBERG & COMPANY, manufacturers of street car woodwork, New York, were represented by J. P. Sjoberg and W. J. Walker.

THE SPRAGUE ELEVATOR COMPANY, of New York, through C. A. Benton, called attention to the ingenious system worked out by F. J. Sprague for handling trolley cars in car houses by electric elevators, so that better storage can be obtained in a tall building with facilities for easy release for service. The proposed scheme of operation was designed for the following conditions, viz.: that the elevator should be operated with load only, which load need not necessarily be the maximum one, but should consist of, at least, an empty trolley car on the platform. These conditions are specified for economical operating reasons only, otherwise the net hoisting duty imposed upon the machine would be too great to allow the economical operation. The elevator system is in equilibrium when the platform is carrying its maximum load, and under these conditions the highest economical rate of operation is attained, for the reason that the only power consumed is that which is necessary to overcome the friction in the various parts of the system. By employing the system as above described, it is evident that with proper changes in the weight of the drum and car counterweight, any conditions of average load can be successfully met with this type of machine. The capacity of the hoisting machine itself, as shown in blue print and as designed and built for the Central London Railway, is 10,000 lbs. net on the hoisting drum at a speed of 200 ft. a minute. By the multiple sheave arrangement proposed, the machine is amply able to meet the duty required at a speed of 100 ft. per minute. The control used in connection with this machine is entirely electrical and includes all the safeguards in the way of automatic upper and lower limits of car travel, slack cable device and speed regulator. These devices, in connection with the form of controlling switch used on the car itself, render the system safe under all conditions. In addition to Mr. Benton, the Sprague interests were represented by Mr. Shepard on behalf of the multiple-unit system, and Mr. Kittle, of Chicago, in behalf of its generators and motors.

THE IRONSIDES COMPANY, of Columbus, Ohio, had a very attractively arranged exhibit, representing a collection of barrels marked with the names of its respective specialties. The sign "Lubrication Without Oil" attracted attention. The specialties of this company comprised materials for preservation and protection of wire ropes and fibre ropes, the lubrication of gearing, paints for metallic surfaces, etc. For the electric cars the company is placing special stress on its lubricant for motor gearing, and to demonstrate the merits of this material, had on exhibition a pair of stand-

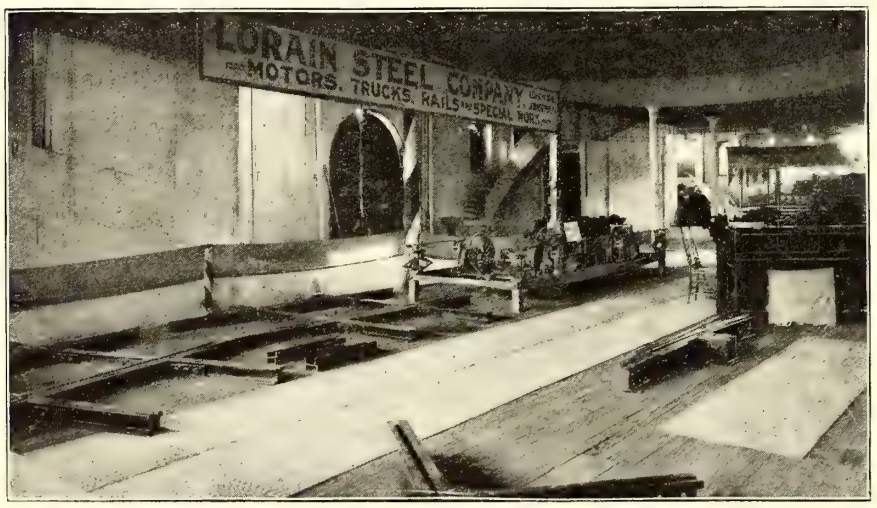


EXHIBIT OF THE LORAIN STEEL CO.



EXHIBIT OF GARTON LIGHTNING ARRESTERS

ard motor gears which had been treated with this lubricant gear shield. Large number of orders were reported as having been placed during the convention. This material has not only been shipped to all sections of this country, but orders have been taken from many distant parts of the world.

THE CHICAGO MICA COMPANY, of Chicago, had a neat pink and green booth in the gallery in charge of W. F. Hatch, secretary, and W. A. Snider. This is a new company in the mica business, but reports that it has already established a good trade. Its special mica composition is known as "Micabonds."

W. R. MASON, St. Louis, representative of the Siemens-Halske Company, of America, and who never misses a convention, was on hand in the interests of his company.

THE W. H. SILLS MICA COMPANY, of Chicago, had a wall space where it showed, on a board, a handsome collection of its products. C. B. Wisner, president, gave away an interesting card which showed graphically the years in which financial panics have and will occur again. It, therefore, warns the holder when to make and not to make investments.

THE UNITED STATES ROCKING GRATE BAR COMPANY, of Chicago, had one of its rocking grate bars on exhibition and gave away a "Lecture on Combustion," by his Satanic Majesty. John J. Moroney and J. F. Thompson were in charge.

MAYER & ENGLUND, of Philadelphia, were represented by A. H. Englund.

THE HALE & KILBURN MANUFACTURING COMPANY, of Philadelphia, displayed in its exhibit several styles of the popular "walkover" seats. The No. 80-¾ seat, made with movable foot rail, attracted much attention, every one heartily approving this new feature. The grip handle, which is applied to several seats in their exhibit, also received favorable comment. Some reversible seats were also exhibited as well as sample of spring edge longitudinal seating. The Hale & Kilburn patent steel top spring work was praised by every one, and many referred to it as the best spring construction upon the market. H. T. Bigelow, Western representative of the company, had charge of the exhibit.

THE W. R. GARTON COMPANY, of Chicago, represented many well known manufactures. The new circuit breakers of the General Equipment Company, of Camden, N. J., served to attract general and very satisfactory attention, while the Eureka flexible copper rail-bond, the latest type, was displayed in a most becoming manner. The bond is made by the Eureka Tempered Copper Works, of North East, Pa. A line of its well known knife switches, copper and gauze brushes and segments, was also shown.



EXHIBITS OF CONSOLIDATED FENDERS, M'CARDELL WAGONS, MEAKER REGISTERS AND SIEGRIST LUBRICATING SYSTEM

The W. R. Garton Company also arranged an operative display of the Multiplex reflectors, arc and incandescent, a line of which is just being introduced by the Multiplex Reflector Company, of Cleveland, Ohio. This reflector is a decided departure in this line and was well received. The Partridge Carbon Company, of Sandusky, had an exhibit of its plumbago, as well as treated, special and regular carbon motor brushes. The Billings & Spencer Company, of Hartford, Conn., had a handsome display of its drop forged commutators bars. One of these bars weighed almost 50 lbs. The Keystone Electrical Instrument Company, of Philadelphia, had on display a magnificent board showing its various switchboard instruments, including ammeters, voltmeters for railway and arc light circuits; ground detectors, portable instruments, etc. A. O. Schoonmaker, of New York, exhibited some mammoth sheets of India and amber mica, and his mica discs were to be seen everywhere. The enclosed arc lamps of the Lea Manufacturing Company, of Elwood, Ind., made a decidedly favorable appearance. This company makes a full line of both d. c. and a. c. machinery. Johnson & Morton, of Ithaca, N. Y., had a series of photographs of their products on display. Samples of the Pitts-

burgh Steel Hollowware Company's pressed steel gongs were also shown, and had it not been for convention rulings, certainly would have made themselves heard. The Graphite Lubricating Company, of Bound Brook, had a pretty display board of its genuine graphite and bronze trolley wheel bushings. Enamalac and Armalac, the Massachusetts Chemical Company's specialties, along with samples of its various tapes and compounds were shown to advantage. Besides Mr. Garton and Mr. Lee, members of the W. R. Garton Company, Messrs. A. L. Short, of the Eureka



EXHIBIT OF DIAMOND BRAKE SHOES

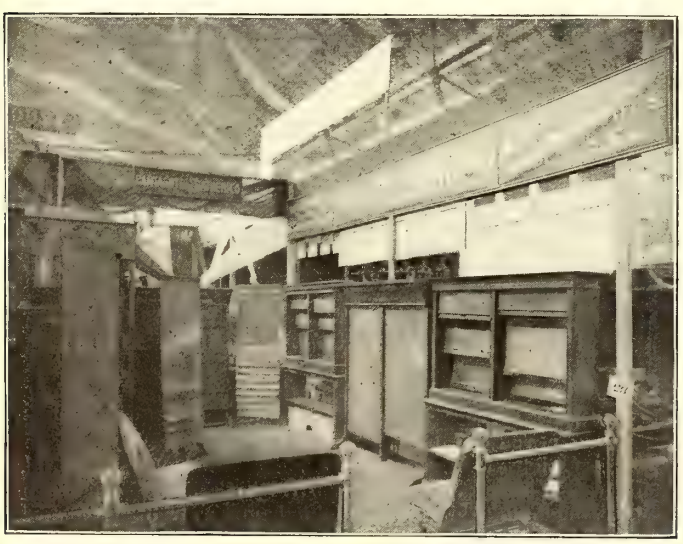
Tempered Copper Company, and James Partridge, of the Partridge Carbon Company, were present to assist in the exhibit.

BERRY BROS., manufacturers of railway varnishes, Detroit, Mich., were represented by L. M. Combs, of St. Louis, who says he will never miss another street railway convention if in his power to be there.

J. B. PERRY, of Toronto, Ont., was in attendance in the interests of the McCollum Compound Friction Car Brake Company, of Toronto.

F. A. LAPHAM, of the Cleveland Frog & Crossing Company, Cleveland, was a constant attendant.

PATTERSON & GREENOUGH, of New York, were represented by Frank L. Crocker, their Chicago representative. This firm is selling agent for the Waterloo Woolen Manufacturing



THE PANTASOTE EXHIBIT

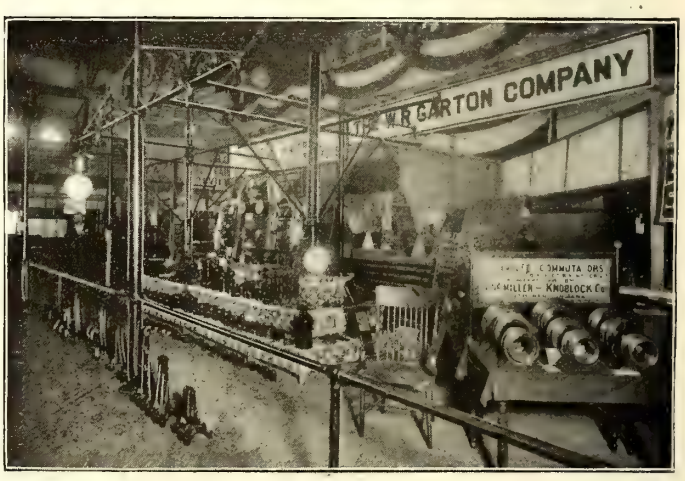
Company, of Waterloo, N. Y., and made a nice exhibit of uniform cloths, etc.

THE STIRLING BOILER was represented by B. M. Barr, of the New York office, and J. P. Snedden, chief engineer, of the Chicago office.

H. T. MERCUR, general agent of the Corning Brake Shoe, Corning, N. Y., was an active representative of this well known company.

THE ELECTRIC RAILWAY EQUIPMENT COMPANY, Cincinnati, Ohio, the well known manufacturer of street railway overhead line material and steel and iron tubular poles and brackets, had in charge of W. J. McCallum a display which was one of the most elaborate at the convention. A characteristic iron railing surrounded the space and a generous array of pole and bracket construction served to give the visitors at the convention an idea of the excellency of this line of the company's work. Across one side of the exhibit was arranged a number of 30-ft. steel tubular poles, showing various sections, diameters and lengths. Through the center of the space was arranged an oblong pedestal, supported at one end by a center pole, showing an arrangement for double track construction, and at the other by a pole upon which were mounted several of the companies numerous brackets. Upon this pedestal were shown in excellent shape the various items that go to make up one of the most complete lines of overhead material made in the world. A thorough demonstration of the company's type of figure 8 material, in all its forms, as well as that of the West End type, was most successfully given. Malleable iron pole fittings, cross arms, clamps, etc., were presented galore. Ornamental bases and trimmings for poles were also shown; in fact, all the poles erected were trimmed throughout in the latest approved fashion. One of the principal features in this display was the demonstration of the Equipment Company's method of tubular pole construction, which is meeting with so much favor to-day.

THE HUBBARD BRAKE COMPANY, of Chester, Pa., was represented by George E. Pratt, the vice-president of the com-



VIEW ON ONE OF THE AISLES

pany. The company made no exhibit, but Mr. Pratt distributed pamphlets that briefly explained the working of the company's new solenoid electric brake and secured several trial orders during his stay at the convention.

THE BINGHAMTON OIL REFINING COMPANY, of Binghamton, N. Y., was represented by A. S. Dexter, manager of the Chicago office.

A. C. VOSBURG represented the New Process Rawhide Company, at Syracuse, N. Y. Mr. Vosburg reports that the company's new plant is running to its fullest capacity and that the demand for its rawhide pinions has extended to every part of the world where gearing is used.

THE HARRINGTON RAIL BONDING COMPANY, of New York, was represented by S. H. Harrington, the general manager of the company.

THE G. C. KUHLMAN COMPANY, street car builders at Cleveland, Ohio, was represented by G. C. Kuhlman.

THE R. BLISS MANUFACTURING COMPANY, of Pawtucket, R. I., had on exhibition full-size working models of its well known Wood platform gates, of which from 45,000 to 50,000 are now in use on the street, steam and elevated railways of the United States. A working model was also shown of a new folding gate for double-door and vestibule cars. This gate, when closed, is folded back against the car body, fitting very well into the narrow panel found on double-door cars. Another novelty shown was the Crone pneumatic gate for use on air power cars or cars using air for brakes. This has been in use for two years and gives good results. The exhibit was in charge of N. H. Colwell, the general manager of the company.

JAMES L. HOWARD & COMPANY, Hartford, Conn., were represented by F. K. Dorrance, of the Western Union Building, Chicago. Models were shown of the Agard vestibule sliding door. This door is used successfully on the cars of the Hartford Street Railway and other Eastern roads, and is considered a very decided improvement over hinged doors.

F. H. NEWCOMB, of New York, manufacturer of uniform caps, made an interesting exhibit, showing samples of uniform caps as supplied to various companies throughout the United States.

THE CROUSE-HINDS ELECTRIC COMPANY, of Syracuse, manufacturer of the Syracuse changeable electric headlight, was disappointed in not getting its goods to the convention in time to make an exhibit. The company was represented, however, by its Chicago representative, John W. Brooks. The company reports that it has never been so busy since its organization. The "Syracuse Changeable" has become the standard headlight on a large number of roads throughout the United States, and is generally regarded as not only the highest type of headlight manufactured, but the most economical one to purchase, as one light answers for either end of car or for either a summer or winter car.

THE HUNTER ILLUMINATED CAR SIGN COMPANY was represented by Lytle J. Hunter, the president of the company, and made an exhibit in connection with the Morris Electric Company, the Eastern agent for the company. The company showed



EXHIBIT OF THE DEARBORN DRUG AND CHEMICAL WORKS

an illuminated car sign with over thirty changes and arranged to be easily operated by the motorman.

EDWARD ROBINSON, New York, sole proprietor and manufacturer of the Wells light, was an early arrival at the convention. The Wells light is known to practically every steam and street railway for use in night construction and repair work.

THE VULCANUS FORGING COMPANY, of Cleveland, Ohio, was represented by Alfred G. Hathaway, who is well known in the street railway field as the builder of the Hathaway transfer table.

P. F. LEACH was present at the convention, representing Leach & Simpson, of Chicago, selling agents for The Bass Foundry & Machine Company, of Fort Wayne, Ind., builders of engines and boilers, and manufacturers of car wheels and railway castings.

THE ADAMS-BAGNALL ELECTRIC COMPANY, of Cleveland, was represented by E. J. Bagnall.

THE JEWETT CAR COMPANY, of Jewett, Ohio, was disappointed at not receiving its shipment for exhibition. A. H. Sisson, manager; C. E. Krebs, secretary, and N. Paulson, superintendent, were in attendance.

THE ST. LOUIS CAR WHEEL COMPANY, of St. Louis, was represented by A. A. Hilton, sales agent for the company.

SALVATOR POTIS, formerly chief engineer of the North and West Chicago Street Railway Companies, was a visitor at the convention.

THE AMERICAN CAR & FOUNDRY COMPANY, whose general offices are now in St. Louis, with manufacturing plants located at various points, both East and West, had a very practical exhibit of street car wheels. The exhibit was in charge of Scott H. Blewett, of the home office. A feature of the wheel exhibit was the display of finished wheels, with parts broken from their rims in such a way as to show the strength of the metal used in the rims, hubs and spokes, and the depth of the chill. The sample wheels shown included plate wheels for interurban service, plate wheels for ordinary city use, and a new style of key seat designed to save the strength of the axle. The display was made under the joint auspices of the Missouri Car & Foundry Company, the Wells



NEW M'GUIRE SWEEPERS

& French Company and the Terre Haute Car & Manufacturing Company, as the output of all of these concerns is now controlled by the American Car & Foundry Company.

THE AMERICAN RAILWAY SUPPLY COMPANY, of New York, maker of badges, had on exhibition a very handsome sample board of conductors' and motormen's badges in bronze, nickel and aluminum finish.

THE STANDARD UNDERGROUND CABLE COMPANY, of Pittsburgh, was represented by its Western sales manager, J. R. Wiley. The full line of samples usually shown at ex-



TAUNTON NOSE AND SHARE PLOWS

hibitions of this kind is now at the Export Exposition in Philadelphia, and on this account Mr. Wiley simply distributed the company's literature and "took orders." The Standard Company's manufacturing capacity is now so heavily taxed that it is building a new factory at San Francisco, and another in the East.

THE PROTECTED RAIL BOND COMPANY was very ably represented by J. M. Atkinson, Chicago, representing the Western territory, and A. H. Englund, of Mayer & Englund, Philadelphia, Eastern representative.

THE GARL ELECTRIC COMPANY, of Akron, Ohio, had an attractive booth, in which were shown the telephones manufactured by this company for railway work. In the branch of car

dispatching by telephonic communication, the company has made a specialty and its system is employed on a large number of roads. Mr. Garl was present in person and explained the method of operation to the visiting delegates.

THE PANTASOTE COMPANY, of New York, was represented by John M. High, the general agent, and H. M. Grier, the Western agent of the company. The display of car curtains for both open and closed cars, as well as curtains and upholstering material, was very handsome. Some especially striking effects are obtained by the use of curtain material wih silk finish. Pantasote curtains were shown on a sample car made by the St. Louis Car Company for the Chicago City Railway Company. Pantasote as applied to other products, such as sportsman's outfits, caddy bags, etc., also formed a part of the exhibit.

THE MILWAUKEE RAIL JOINT & WELDING COMPANY, of Milwaukee, had an exhibit at Tattersall's consisting of a variety of rail sections showing the actual condition and appearance of the cast joints employed in its system. The exhibit was carefully examined by many delegates who universally commended the system, especially the feature by which the joints can be cast without removing ties. In addition to completed joints, the company showed the steel jackets used as molds. E. M. McVicker, manager, and H. L. Prather, of Cleveland, Eastern agent, were present.

J. A. RUTHERFORD was at the convention with an attractive exhibit of samples of wire and cable for street railway purposes, as manufactured by the Pittsburgh Reduction Company, of Pittsburgh, Pa.

A. M. KITTRIDGE, manager of the Barney & Smith Car Company, Dayton, Ohio, made a hurried visit to the convention.

THE PECKHAM MOTOR TRUCK & WHEEL COMPANY, of New York and Kingston, did not consider it necessary to make as elaborate an exhibit as in former years, partly because its trucks have been employed so extensively in Chicago that practically all types can be seen, from the single trucks used under surface cars, to the heaviest double trucks employed on the South Side Elevated cars, and partly because the truck has been so widely adopted elsewhere that it can now be seen in operation in practically every large city in this country and abroad. The company had on exhibition, however, two of its latest type of truck. the 14-B3, described in the last issue. These trucks were equipped with motors, were examined with a great deal of interest by the delegates in attendance and their merits were explained by E. G. Long, J. A. Hanna and W. H. Gray, who represented the company. Edgar Peckham, the well known president of the company, was not in attendance. In addition, the company had one of its "Metropolitan Special" trucks in the exhibit of the Westinghouse Company.

E. A. and HIRAM B. CURTIS, of the Chicago Truck Company, were there.

THE BALTIMORE CAR WHEEL COMPANY, of Baltimore, Md., was represented by J. Paul Baker, secretary of the company, and exhibited one of the Lord Baltimore maximum traction trucks. This style of truck met with many favorable comments and gave the impression of strength and durability. Mr. Baker stated that the company had received many orders for this type of truck, including one of good size from Baltimore.

THE EXHIBIT of the Griffin Wheel Company, of Chicago, was one of the most tasteful at the convention. The space was given up to showing samples of different sized wheels made by this company, and sections of wheels, exhibiting the character and depth of chill. The exhibit was in charge of C. K. Knickerbocker, who had many customers among the delegates, all of whom spoke in the highest terms of the service given by the Griffin wheels. An attractive feature of the exhibit was the unique railing surrounding the booth; it was made up largely of small half wheels which gave a most business like appearance to the space.



EXHIBIT OF THE WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

THE J. G. BRILL COMPANY, of Philadelphia, was represented by W. H. Heulings, Jr., and G. M. Haskell, of the company's New England office. The Brill Company made no regular exhibit, but had a parlor at the Auditorium, where were shown models of the company's trucks, as well as photographs of some of the latest styles of cars built by it. These headquarters were very popular, particularly in the evenings, and visitors were most hospitably welcomed.

THE ST. LOUIS CAR COMPANY, of St. Louis, made no exhibit, but was ably represented by George Kobusch, the president of the company; Charles Y. Flanders, Eastern agent, and Lytle J. Hunter, Cincinnati representative.

THE CLING SURFACE MANUFACTURING COMPANY had an exhibit which attracted much attention from those steam users who are employing belted plants, and while direct connection has made great advance during the past few years, there are still many power stations in which belts are employed, and a number of engineers remarked that their number might have been greater if the Cling Surface had been on the market for a longer period of time. This compound has been indorsed by the highest

authorities in steam engineering, and its merits were clearly demonstrated in a practical way at the Chicago Convention.

G. P. MAGANN AIR BRAKE COMPANY, of Detroit, was represented by W. D. Ray, the company's general manager, and expected to have on exhibition its storage system of air brakes applied to a Peckham truck. Unfortunately the apparatus did not arrive in time to be shown in the hall, but the advantages of the storage system of air brakes were explained by Mr. Ray, who pointed out the fact that no compressing machinery is required on the car and that the car mechanism is reduced to the greatest degree possible. The absence of compressing machinery includes, of course, the elimination of all noise, and possibility of accident to this part of brake mechanism. Although this system has been on the market for less than a year, the orders secured have been numerous and the company is now entering upon the second year of its existence with an enviable record.

THE ELECTRICAL INSTALLATION COMPANY, of Chicago, was well represented at the convention, those of the firm present being J. I. Case, president; F. H. Fitch, vice-president; J. A. Brett, general manager, and A. M. Hewes, secretary and treasurer. This company has made a remarkable record during the six and a half years it has been in business, having closed in that time 112 contracts for street railway and lighting work, which number will be materially increased before the end of 1899, by the addition of several other contracts, upon which the company is now figuring. During the past season, the company has completed work in Kansas City, Vicksburg, Miss.; Chicago, and many other cities. The company is prepared to entertain propositions for any kind of electrical construction in any section of the country.

W. E. DODDS, of the Allis Company, Milwaukee, and J. B. Allan, Chicago representative of the company, were in attendance.

THE POWER TRACK CLEANER COMPANY, of Toronto, Can., exhibited at the convention, a track cleaner and digger, which is for use in both winter and summer. This is a contrivance for cleaning the track, so made that it passes over the uneven joints in the track and clears all obstructions before it. It is within control and easy operation of the motorman and can be placed upon the smallest platform without interfering with the brake or controller. Those roads which have used it have given the most flattering testimonials concerning its work. The company will shortly open up an office in the States, probably in Chicago.

THE KANSAS CITY CAR & FOUNDRY COMPANY, of Kansas City, Mo., showed various types of street car wheels. The company manufactures every type of wheel for car and engine service. The company was represented by F. W. and A. J. Fisher.

THE WESTERN ELECTRIC COMPANY, of Chicago, was represented at the convention by J. C. Cannon, Philip Rust and F. L. Swan. They had headquarters in booth 30, where they entertained friends of the company and distributed printed matter and souvenirs to visitors. The souvenir was a match-box having on one side an illustration of a petite arc lamp, and on the other, an illustration of a 16-in. fan motor. On both edges of the box were "Western Electric Company, Chicago-New York." The box was finished in silver and white celluloid.

JOHN T. McROY, inventor of the McRoy vitrified clay conduits, and who is owner of what is said to be the largest clay converting works in the world, was on the special New York Central Lake Shore train, bound for Chicago, and attended the convention. Mr. McRoy says that the entire output of his work is sold for two years to come.

THE AMERICAN CAR COMPANY, of St. Louis, was represented by William Sutton, president, and E. J. Lawless, of New York.

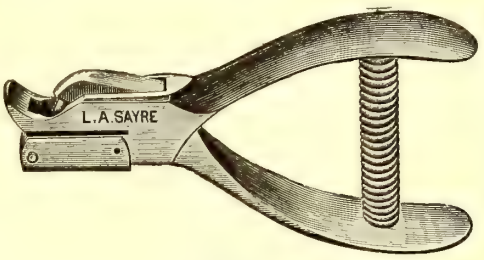
GEORGE E. SHINKLE and A. WHITING WATRISS, Chicago representatives of Charles A. Schieren & Company, were active at Tattersall's, though they did not make an exhibit.

THE HAM SAND BOX COMPANY, of Troy, N. Y., was present, as usual, and the exhibit of its box attracted much attention. The construction of this box is so well understood that no particulars are required here. It need only be said that the fact that the box has no valves and few parts, and is warranted not to rust, leak, waste sand and draw moisture, made the exhibit an interesting one. The box is used extensively in Chicago.

E. J. BAGNALL, of the Adams-Bagnall Company, was in Chicago during two days of the convention, and visited the exhibit at Tattersall's. The Adams-Bagnall Company is just putting upon the market a new arc lamp, which it believes is the first satisfactory lamp of this kind yet put out.

THOMAS AHEARN, of Ottawa, one of the best known engineers and contractors, of Canada, was present at the Chicago convention on Wednesday and Thursday, and will come to New York before returning home.

L. A. SAYRE & COMPANY, makers of punches, Newark, N. J., were represented by Mr. Sayre, who showed their No. 428 punch, which is especially adapted to street railway service and which is in use on a large number of railways. Mr. Sayre presented to the street railway people present one of the most unique and handsome souvenirs that was shown. It consisted of one of their No. 428 punches in miniature size and a handsome deck of playing cards, both enclosed in a handsome case. An illustration of this punch is shown herewith.



MINIATURE PUNCH

Exhibit of the Christensen Engineering Company

The Christensen Engineering Company's exhibit at the convention consisted of—

First.—A complete air-brake instruction stand showing the operation of the independent motor compressor air brake. This instruction equipment is more particularly described in the Christensen Engineering Company's catalogue B, page 37.

Second.—An installation of a five-car equipment, with automatic air brakes complete and in operation, with air gages showing the pressure in each cylinder on application of the brakes. The triple valves are the Christensen quick-acting type, suitable for steam railway practice. This is the device on which the Court of Appeals for the District of Columbia recently rendered a favorable decision. The engineers' valves in this five-car equipment are of the automatic train pipe feed type, giving excess pressure in the main reservoir.

Third.—An exhibit of a special high-pressure air compressor made for the United States torpedo service. It is designed for 1500 lbs. per square inch, and is capable of compressing up to 2500 lbs. The storage tanks for this compressor are tested to a pressure of 4000 lbs. per square inch, and are made in one piece of steel on the cold-drawn process.

Fourth.—A complete portable air-compressing apparatus for use around car shops and power-houses. It consists of an air compressor of 11 cu. ft. of free air capacity per minute, together with automatic cut-out switch, fuse, piping, etc. It weighs about 800 lbs., and is mounted on a truck, so as to be wheeled about wherever it is desired to use the compressed air.

Fifth.—A portable air-compressing apparatus, built up in substantially the same manner as the one above mentioned with the exception that it is a much larger compressor, being of a capacity of 50 cu. ft. of free air per minute. Its weight complete is about 1600 lbs.

Sixth.—An air hoist of the standard type, made by the Christensen Engineering Company, having an automatically closing valve working in such a way that no air can enter into the hoist from the main reservoir, nor escape from the hoist to the atmosphere without the operator holding the valve open, either for admission or exhaust.

The company brought a new catalogue to the convention, and among the many courtesies bestowed upon the delegates was the presentation by the company to each lady attending the banquet of a beautiful basket of flowers. The company was represented by S. W. Watkins, N. A. Christensen, A. Beveridge, and W. J. Richards, of the home office, and F. C. Randall, general Eastern agent.

Exhibit of the Westinghouse Company

The most costly and elaborate exhibit made at the convention was that of the Westinghouse Electric & Manufacturing Company. The largest piece in the exhibit was a 500-kw. "engine type" railway generator complete—a beautiful machine in design and workmanship. The armature was placed on a platform apart from the fields, so that both could be examined to better advantage. There also appeared in the Westinghouse exhibit a 200-kw. rotary converter, equipped with starting motor, and a rail-

way station switchboard complete for three generators, six feeders and one load panel, together with two No. 68 500-volt railway motors, with auxiliary apparatus, mounted on a Peckham truck, two No. 49 500-volt railway motors, with auxiliary apparatus, mounted on a McGuire truck; one No. 70 railway motor complete, one No. 69 railway motor complete, one No. 56 railway motor complete, and several armatures partially wound, with commutator connected, so that all stages in the building of the armature could be observed, and a complete line of detail apparatus, including fuse boxes, lightning arresters, canopy switches, etc., used in street railway equipment.

The 500-kw. generator was one of three of the same size recently sold to the Monongahela Traction Company, of Pittsburgh, and the switchboard is also sold to the same company. The No. 68 and No. 69 motors are the latest types built by the Westinghouse Company, and in placing them on exhibition the company called attention to a number of new features of great importance. One of these is the increased current-carrying capacity of the field windings, by means of which an equal temperature rise in both field and armature is permitted, instead of, as has heretofore usually been the case, the passage of more current, in proportion, through the fields than through the armature. Another feature is found in the use of field poles, which are bolted to the yoke, instead of being cast in, as has been the practice for the last ten years with the Westinghouse and other companies. These new motors were originally built on an order from the Third Avenue Railroad Company, of New York City, and since then large orders have been placed by the Brooklyn Rapid Transit Company and others.

The company was represented at the convention by the following: William Bauder, J. M. Duncan, C. S. Cook, W. M. Probasco, F. McCoy, J. H. Reid, C. E. Skinner, N. W. Storer, F. S. Smith, of Pittsburgh, Pa.; W. W. Grant, of Ottawa; J. R. Gordon, of Atlanta; H. C. Marsh, of Cincinnati; R. S. Brown, of Boston; C. H. Bragg, of Philadelphia, and C. S. Powell, of Cleveland; W. S. Rugg, Irvin Dryer, C. W. Regester, Frederick Nelson, C. G. Burton, W. R. Pinkard, L. M. Harvey, T. A. Hall, T. P. Gaylord, and Ivor Hennings, of Chicago; T. Julian McGill, of Minneapolis; C. F. Medbury, of Detroit, and A. Hatet, of the Westinghouse Electric Company, of France.

New Type of Electric Brake

A new electric brake, in which the motors are used as generators, has been placed on the market by the Hubbard Brake Company, of Chester, Pa. The brake consists of a large solenoidal magnet, to the plunger of which the brake levers are connected without interfering with the hand brake. The latter is left intact and ready for use. The solenoid is actuated by changing the motor terminals so that they will act as generators while the car is in motion, and these connections are made by a movement of the brake controller. The amount of current taken from the motors is about 25 amps. maximum, and the braking effect is automatically reduced as the speed of the car decreases, so that the greatest braking efficiency is obtained, while the possibility of sliding the wheels is prevented. The latter fact also eliminates trouble from flattening wheels. In case of accident to the motors the line current can be used to set the brake, but ordinarily the motor current is used.

In the system two brake controllers are employed, one on either platform. They are of about one-third the size of the car controllers, of which they are independent, except that if the brakes should be applied while the car controller-handle is on the "on" position, the connection between the motors and the line current is broken.

The general manager of the company is George E. Pratt, well known in street railway circles.

Resistance Tests in Chicago

The Chicago Edison Company has recently been making some interesting tests of resistance under different conditions of working contact. Readings were taken upon a Weston milli-voltmeter reading .0002 volts per degree. The first test was taken across the joint of an Edison tube through extension strips with contacts bolted. The average current was 1800 amps. and the ten readings varied from .00550 to .00544 volts. The average was .005466. The same joint was tested later with contacts amalgamated and treated with the Edison-Brown plastic alloy. The current used was 1740 amps. and the average drop was .003564.

Similar tests were made on a tube in the Edison Company's subway, near the Chicago River, with ordinary bolted contact and 1800 amps. The drop in voltage, with 1800 amps., averaged .004619. For the same joint, with contact amalgamated and treated with Edison-Brown plastic alloy, the average current being 1730 amps., the drop was .00321. Other tests were made, indicating about the same difference in resistance, due to the use of this device.

Cork as a Frictional Agent

The use of cork for frictional purposes in brake shoes by the Composite Brake Shoe Company, of Boston, is well known, and it has proved so satisfactory for this purpose that the company is extending its application to other industrial uses, notably to discs and friction clutches in machinery. Such discs are now being used on the friction clutches of heavy movable-bed reversible planers for reversing the travel or motion, and where the application of the clutch with cork inserts is made twenty-five or more times per minute. The action is found to be quick, but without gripping effect, due, without doubt, to the elasticity of the cork. Oil is freely used on the clutch without apparent detriment to the functions of the cork inserts.

The application of cork in brake-shoes is not confined to steam and street railway service, but is coming into general use on fire apparatus and heavy wagons and carriages, and is also being experimented with on horseless carriages. Another field which is attracting special attention just now is its application to rubber tires, for which it has manifest advantages.

In the electric railway service in New England this brake-shoe is very largely used, and it is found that the elasticity of the cork overcomes the usual gripping effect and the flattening of wheels, and secures a smoother running of the cars. Wood plugs were formerly used, but cork is more tenacious, and, because of its elasticity and resilient nature, it will not become impregnated with iron particles from the wheels, or gather up sand and grit from the street, an important feature in connection with rubber tires.

Legal Decision

A decision in favor of the defendant has recently been rendered in the suit of the Consolidated Car Heating Company vs. the Palmer & Monson Street Railway Company. The suit was brought for the alleged infringement of patent No. 608,211, on improvements in electric heaters, and was defended by the Gold Car Heating Company, whose heaters were being used by the street railway company. The decision just rendered declares that these Gold heaters are not an infringement of this patent.

The Largest Rope Cable in the World

What is said to be the largest rope cable in the world is in use on the Glasgow district subway, and was manufactured by D. H. & G. Haggie, of the Wearmouth Patent Rope Works, Sunderland. Its weight is about 55 tons. The last cable removed from this cable road was also manufactured by the Messrs. Haggie, after a life of 14½ months. The previous best record was 10½ months. In other words, the rope just removed ran 85,000 miles, while the previous best record was 61,000 miles. The success of this cable is largely due to the improved cable-making machinery specially erected by Messrs. Haggie. The process adopted by them consists in making the strands and closing the rope on one machine, thereby securing the greatest possible efficiency and a perfect mechanically constructed rope.

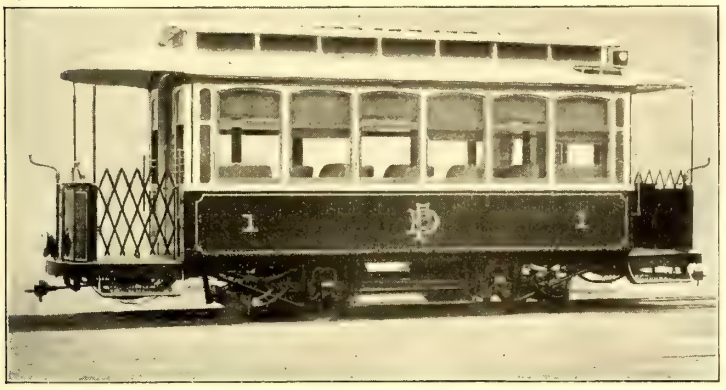
Enclosed Rheostats

The inclosed type of rheostat has become the favorite type for motor starters during the past few years. The resistance material is usually in the form of a reflex ribbon, which is embedded in sand, which sand is the filling material of a shallow box made entirely of iron or having one face of slate. A patent was issued Oct. 24, 1899, to H. Ward Leonard, which thoroughly covers the essential features of this form of rheostat box. The patent contains twenty-eight claims, and a typical claim reads as follows:

Claim 23. "In a resistance box, the combination of a box having two large parallel surfaces and a relatively narrow edge, one of the large surfaces being in the form of a cover, a resistance within the box arranged in steps or sections, terminals to which said steps or sections are connected, and a removable filling of mineral insulating material surrounding said resistance."

Street Car for Mexico

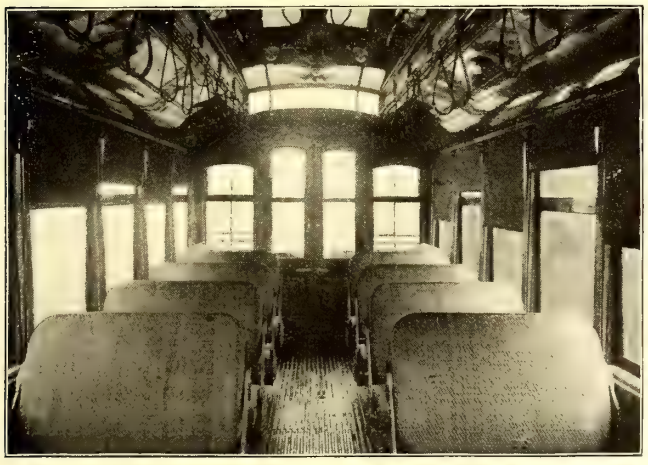
The car shown in the illustrations herewith is one of a large number recently built for the Ferro Carril del Districto of the City of Mexico. Externally these cars are very handsome, the large monogram and the straight panels setting off the gold of the lettering to admirable advantage. The length over the end panels is 18 ft. and the total width 8 ft. 2 ins. There are two platforms, each 4 ft. in length, making the length over the dashers 26 ft. The cars are mounted on Brill No. 21-E trucks, with 7-ft. wheel base, and equipped with two G. E.-1000 motors. There are eight reversible back seats, covered with woven cane, and four stationary back seats in the corners. Spring roller curtains are fitted to the windows, which are made to drop into the side of the car. The



CAR FOR MEXICO

use of the cross seats was one of the reasons which brought the innovation of a straight-side car for street railway use. By a proper design and putting together of the side frame an exceedingly strong belt was obtained below the windows. The braces were cut into the belts, and posts secured with screws, and the sheathing was put on in the usual way and then glue-blocked afterward. Inside, the height from the floor to the belt rail is 2 ft. 3 ins., and from the bottom of the sill over the trolley-board about 9 ft.

As these cars have to be run in trains, there is a 15-in. opening in the center of each dasher. This has a sliding iron door, which goes in from the top, and when not in use is placed in grooves at



INTERIOR OF MEXICAN CAR

one side of the opening. Brill angle iron bumpers and Brill gates are fitted to the car. There are also two Brill sand-boxes and two Dedenda gongs. The trim is solid bronze throughout. The signal lamps are in a rather unusual position, being placed diagonally opposite each other on the roof landings. This is at the right-hand corner of the car going forward. It should be added that there are four spectacle glasses for each lamp, presenting four different colors—red, blue, green and yellow. The headlights are electric.

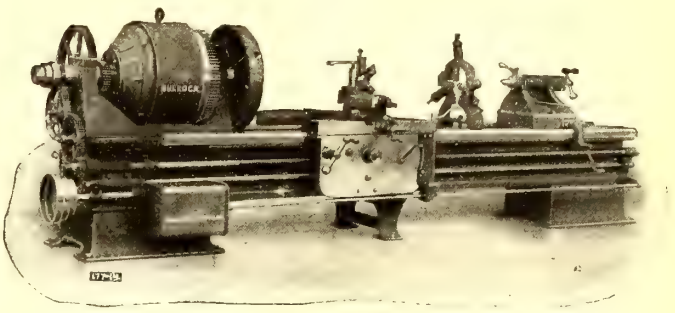
These cars were built on the Brill special system of construction, by which, after being completely finished "in the white," they are taken apart and shipped; one only of the whole number was completely painted in this country. From the view of the interior it will be seen that the car is a pleasant and agreeable one for the passenger, presenting the good features of elegance with light effect. The central chandelier is a combination of oil and electric lamp.

Electrically Driven Lathe

The practice of driving machine tools individually by electric motors, a method which is growing popular in many industrial establishments, seems particularly applicable to electric railway repair shops.

The illustration herewith shows a 28-in. swing-screw cutting engine lathe of this kind, driven by a Bullock, type "N" motor. As will be seen, the motor is placed directly on the spindle in the head stock, taking the place of the cone pulleys. The armature spider is built directly upon the hollow spindle of the lathe.

By means of a new system of variable speed control the motor is given a greater range of speed, without loss of torque, than is

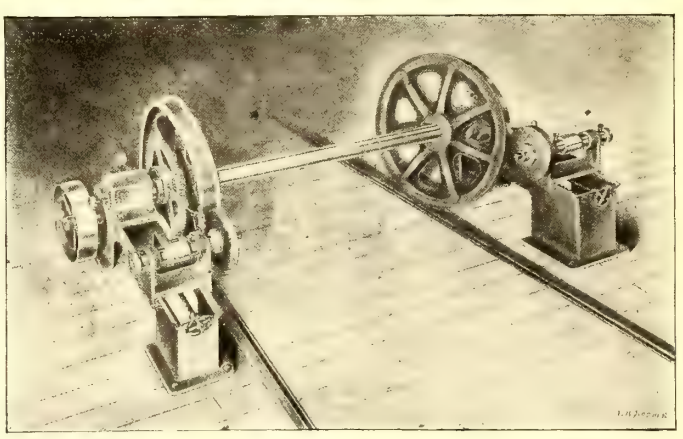


ELECTRICALLY DRIVEN LATHE

ordinarily given by the cone pulley, having sixteen speeds in either direction, including the back gear. The controller is placed upon the leg of the lathe directly under the head stock, and is operated by a spliced shaft running along the bed of the lathe, and a handle which travels with the carriage. The slowest speed is 60 r.p.m., and the highest about 250 r.p.m.

Car Wheel Grinder

Below is shown a new car wheel grinder designed to meet the demand for a substantial grinder at a low price. In this grinder the car wheels are rolled into bearings from the rear end, and the difference in the size of the axles is provided for by an adjustable



CAR WHEEL GRINDER

bushing operated by a screw. The car wheels are revolved at about 10 r.p.m. by a large gear and pinion, the latter being driven by a large pulley, which is belted to a small pulley on the countershaft. The large gear is held on the car wheel axle by a screw with adjustable bushings, and is put on before the car wheel is rolled into the machine.

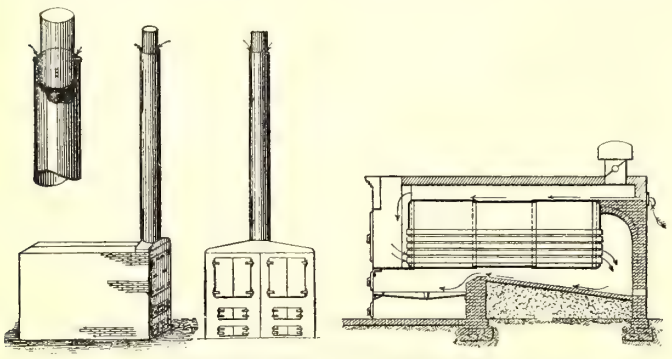
The bearings for the emery wheel are two sleeves, each 7 in. long, with dust-proof collars. A sliding motion is obtained by a keyway cut on the outside of the sleeve bearings. An eccentric on the car wheel gear gives an automatic feed across the face of the car wheel. An emery wheel with a grooved face is used for grinding the car wheel flanges.

The advantages claimed for this grinder are that the adjustable bearings for the axle enable the operator to grind the wheel true

with the axle, even though the axle be worn or sprung, and that the weight of the car wheels can be much more easily supported by adjustable bearings when the strain is downward than on centers where the strain is outward as well as downward. The machines carry two 14 ins. x 1½ in. emery wheels. The grinder is manufactured by the Hampden Corundum Wheel Company of Brightwood, Springfield, Mass.

Schlicht Process of Combustion

Radical changes in methods of generating steam have been comparatively rare recently, as it is generally assumed that this branch of steam engineering has reached a stationary condition, so far as principles are concerned. For this reason the Schlicht process of combustion, which is certainly bold and novel in conception, has attracted much interest, especially from the fact that it has been employed in a number of manufacturing establishments with excellent results. Some of the prominent users of this



NEW PROCESS OF COMBUSTION

process are Fuchs & Lang Company, Brooklyn; Barber Asphalt Paving Company, Long Island City; the Fleischmann Distillery, Blissville, L. I.; Summit Silk Mills, Summit, N. J. The theory of the economy resulting from this process is the introduction of hot air, instead of cold air, into the combustion chamber. The method of this introduction, which constitutes the peculiarity of the system, is through the chimney. The process was thoroughly described by Mr. Schlicht in an address read before the Franklin Institute about a year ago, and in which he stated that when a tube of smaller diameter than the stack or chimney is inserted in the latter, the gases of combustion will escape through this tube, while a current of air will flow down outside of the tube within the flue, and thus reach the fire. It is not necessary to have the deflector the same height as the stack or, in fact, at all approaching the height of the stack; its insertion a short distance at the top of the stack is sufficient for the purpose.

The air in this passage down the stack is, of course, heated from the hot gases of combustion, so that when it reaches the fire the oxygen in it will readily ignite with the combustible elements in the fuel. With this method of working, of course, no air is admitted to the grate in the usual way. At first sight it would appear paradoxical to conceive a current of air flowing in the stack in a direction directly opposite to the gases of combustion, and it was upon this ground that the Government Patent Office originally rejected Mr. Schlicht's application, on the ground of inoperativeness. It was not until the inventor had made a demonstration in the basement of the Patent Office of the practicability of this invention, that its critics were convinced and then spoke in the highest terms of the invention.

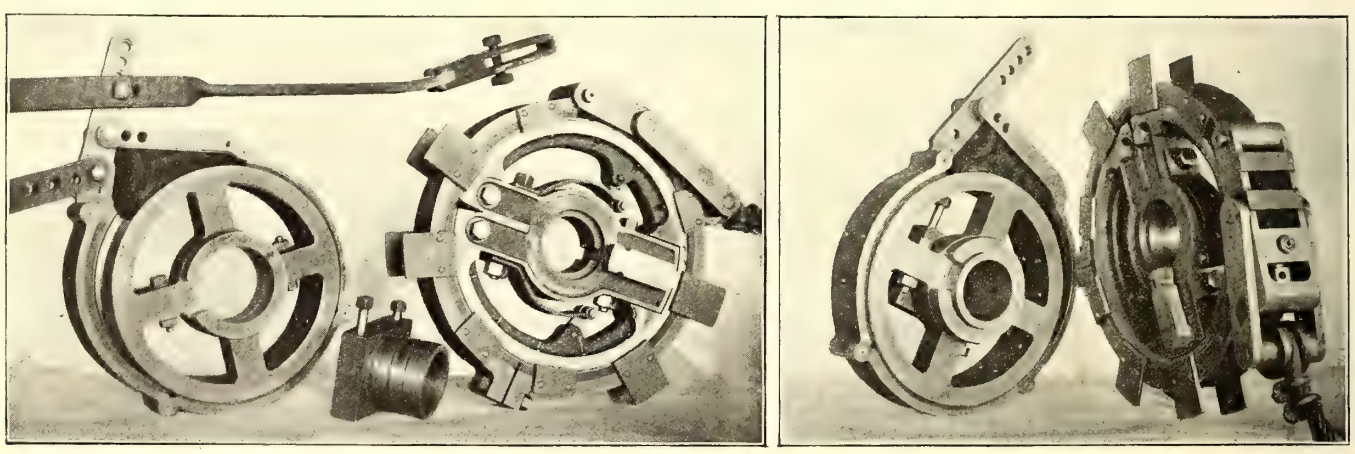
Another interesting feature of the device is that separate chimneys to each furnace are not necessary for its successful use, but that each furnace will automatically take the quantity of air proportional to the combustion occurring therein. For instance, if twice the amount of fuel is being burned in one furnace than in another, both connected with the same stack, approximately twice the amount of air will automatically flow into the combustion chamber of that furnace. When used in furnaces burning soft coal the system materially reduces the amount of smoke injected into the air. The process is being placed on the market by the Schlicht Combustion Process Company, of New York. H. M. Thompson is vice-president and general manager of the company.

New Compound Friction Car Brake

For over a year tests and experiments with a new mechanical friction brake have been conducted on one of the large double truck cars of the Toronto Railway with such success that the company has acquired the right from the owners to equip its entire system with the new invention. Officials of the Buffalo Railway Company and of the Rochester Railway Company, who have visited Toronto to examine the device, have also been so impressed with its possibilities that both companies are planning to give it a trial in high speed service on their respective systems.

The brake is composed of two wheels 18 ins. in diameter, which, when fitted closely side by side on the car axle, occupy only 6 ins. of actual space. One of the wheels is expandable and is keyed firmly to the axle. The other wheel runs loosely on a sleeve on the axle. The wheels are connected togther by a loose rocker, or clutch, resting in opposite recesses in each wheel, causing both wheels to run together. A steel band lined with ½ in. of compressed paper encircles the periphery of each wheel, the band on the loose wheel being compressible while that on the keyed wheel is a rigid circle.

To operate the brake, the motorman, with suitable connection rods, gently compresses the band on the loose running wheel, retarding its motion, thereby reversing its pressure on the loose clutch, which in its turn, expands the other wheel within the rigid circular band. To this band the chain from the brake frame lever is attached, and thus the strain is put upon the brake shoes. It will be observed that unlike other friction car brakes, this not only depends on a compound, or double friction, but the wind of the chain is on an 18-in. circumference. A compression of only 1/16 of an inch on the loose wheel friction gives a great leverage on the main keyed wheel friction, makes the operator's work in the cab very easy, and gives him absolute control of his car.



COMPOUND FRICTION BRAKE

In stopping on grades, there is no back roll of the car, as the wind is so far from the axle, and although the most sudden emergency stop can be made, complete control over the operation of the brake is retained. As to the durability of the apparatus, it is stated that when the parts were examined after four months' steady running, making approximately 13,000 miles, and 196,000 stops, there was no perceptible wear. It will be noticed that the frictional pressure is most severe on the band linings, and these, it is said, were found had not worn down 0.01 in. in the four months.

The brake complete weighs about 175 lbs., and outside of slight regular lubricating, is said to require no personal attention whatever. J. B. Perry, director of the McCollum Company, Bedford Road, Toronto, which is manufacturing this brake, is about to form a company in the United States to place it on the market.

Important Presentation in New York

One of the principal points brought out in the discussion in Chicago upon Mr. Yerkes' paper was on the relations existing between employees and the managements of the transportation systems in different parts of the country. Apropos of this, one of the most striking events, showing the possibility of cordial relations existing between these two departments, occurred in New York last month, and its importance, judged in many ways, is so great, that more than a passing notice should be given it. It shows clearly that enlightened treatment, coupled with a thorough understanding of the needs and wishes of the men composing the operating force, and a willingness to comply with those wishes, when reasonable, is thoroughly appreciated by the men, and able to bring about a feeling in all departments that the welfare of each is being cared for by the other.

What makes the event, which of itself, we think, was unique, the more remarkable was its occurrence within a month after an attempted strike, during which every atttempt was made to create within the minds of the employees a feeling of distrust against the management, and their fidelity was assailed by all the demagogic arguments known to labor agitators, who had staked their reputations upon creating dissatisfaction against the company. It is needless to say that these efforts failed utterly, and the feeling of loyalty on the part of the road where the attempt was made was greater than ever before. The importance of this to the company can hardly be overestimated.

The event to which reference is made was the presentation of a loving cup and a set of testimonials to H. H. Vreeland, president of the Metropolitan Street Railway Company, by his employees. The presentation occurred at Carnegie Hall, Oct. 7, at the third annual meeting of the Metropolitan Street Railway Association of which Mr. Vreeland is president, and which is a mutual benefit organization of the employees of the Metropolitan Street Railway Company. The cup and testimonials were secured by a committee of the employees, entirely without the knowledge of the management, to whom the entire affair was a complete surprise. The contribution of each employee was limited in amount to 10 cents, and only those were allowed to contribute who had been with the company since before the attempted strike. In this way the offering became essentially a spontaneous tribute from those who were well acquainted with the personality and characteristics of the person whom they honored.

The cup, which is of silver, is illustrated herewith. The resolutions, which were very handsomely engrossed, bore the following words:

"The employees of the Metropolitan Street Railway Company, of the city of New York, being desirous of showing our high appreciation of your worth as an official, a man and a friend, offer you, Herbert H. Vreeland, president, our best wishes, and extend a vote of thanks for the interest taken in our welfare and the many kindnesses shown us in sickness and in health.

"That you and your family, through the grace of God, may enjoy many days in health and happiness is the prayer of the

"COMMITTEE FOR THE EMPLOYEES.

"October 7, 1899."

It is certain that no railway manager was ever a recipient of such a gift from all his employees as this, and it is one which is to be regarded as the most valuable of heirlooms.

The Metropolitan Street Railway Association, to which reference has been made, has been in existence for three years, during which time its membership has increased from 100 to 2630. Any employee of the Metropolitan Street Railway Company is eligible to membership, and it now includes most of the men employed by the company. Its main object is to give free medical attendance to its members, and $150 to their families in case of death, at an expense of 50 cents per capita per month. During the past two years the association has also established an excellent library for its members and their families, and if any member wishes a technical or engineering book for his own use or for that of some member of his family, and the work is not already in the library, it will be purchased upon request.

The meeting on Oct. 7 was preceded by an address by the president, Mr. Vreeland. Among other things he said: "At a time like this, when there is so much misleading talk concerning the evil effects to workingmen of large combinations of property, it is well for us to study our own case, and inquire what the effect of combination has been upon us. It is, of course, no part of our duty to here discuss the affairs of any other class than our own. We are railroad men, pure and simple, and we must regard movements and tendencies as they affect ourselves and our business.

"In probably no industry in the world has consolidation been more active in the last ten years than in railroads. In fact, railroad history of that period is one continuous record of 'combinations,' 'amalgamations,' 'mergings,' 'leasings,' or whatever term lawyers please to give to one and the same thing. In the nine years since 1890, 946 railroads, aggregating 63,000 miles, have been consolidated.

"None of the eloquent gentlemen whose prerogative it is to interest himself in every one else's business will claim that by reason of this consolidation the number of railroad employees in



CUP PRESENTED TO MR. VREELAND

the United States has been lessened or wages reduced. It is true, these consolidations have saved millions of dollars paid to high-class and ornamental officials, but so far as the operating and working forces are concerned (and with this we are most interested), the effect has been good.

"Within the period named, hours of labor have been lessened and wages increased, and in that time the number of railroad employees has grown, not alone by reason of extended mileage, but because even the so-called labor-saving improvements have called for more human help. I think it is safe to say that in every instance where an improved appliance has displaced one man, the demand for greater safety and improved facilities has created a demand for two.

"Nothing will bring this fact home to your minds more surely than a glance at the past and the present of the railroad systems on which you are employed. Do you find that the introduction of electricity as a motive power, instead of horses, has increased or diminished the working forces on the street railways which constitute the Metropolitan system? That system as now consolidated has a wage list ten times as great as that when its constituent properties were operated separately and by horses.

"Nor is this all, for with every increase in the volume of the list of paid operators, there has been a marked improvement in

the personnel and in the standard of the men. No one who knows the truth would, for instance, think of comparing the employees of this system with the rag-tag and bob-tail that constituted the working force of its constituent parts or companies when they were separately operated by horse power. The effect of consolidation upon us has been to elevate out of the slough of what is contemptuously called 'miscellaneous labor' between five and six thousand men into a distinct class, in which not only muscle but brain is demanded.

"New York City represents but a small portion of the mileage of street railways under electrical operation in the United States, and it is known to every one of you that any man who has been trained on this system, and whose character is good, can claim a place and obtain a standing by the very reason of his apprenticeship here, on any system anywhere in the world. So then, so far as we are concerned, we can look without any special discomfort at a combination whose results have been beneficial to us."

The immense audience which crowded the spacious hall were evidently in accord with Mr. Vreeland's remarks, judging from the hearty applause which followed. After the reading of the secretary's report a committee ascended the platform and made the presentation already described.

Mr. Vreeland acknowledged the gift in a few well-chosen words. A high-class vaudeville entertainment followed, and was thoroughly enjoyed by all present.

John M. Roach

The newly-elected president of the American Street Railway Association, John M. Roach, has had a long and most successful experience in electric railroading, and is generally looked upon by those acquainted with the street railway interests in this country as one of the most astute and successful managers of street railway properties in the United States. Like many other men of success, he has achieved his knowledge of and distinction in his chosen profession by beginning at the lower rungs of the ladder, and has successively shown his ability to master the prob-



JOHN M. ROACH

lems connected with railways operating with horse, cable and electric power, exhibiting in each a remarkable grasp upon the fundamental principles of the transportation and mechanical questions involved.

The subject of this sketch was born in Noble County, Jackson Township, Ohio, on Jan. 30, 1851. His ancestors came from Virginia and settled in the garrison on the Muskingon River, near Beverly. Mr. Roach left Ohio when eleven years of age, and went to Rockford, Ill., where he attended a high school for one year. After this he went to Corinne, Utah, and from that place to Helena, Montana, covering the entire range of the Rocky Mountains and spending three years in that section of the country prospecting for gold. On a "bucking" broncho he rode to Walla Walla, Washington Territory; Portland, Oregon; Oakland, and down into the lower part of California, around White Pigeon, Utah, and back to Helena, Montana.

After roving around the western part of the Continent for seven years, making and losing large sums of money, he returned to Rockford for a year, and settled in the city of Chicago on Oct. 7, 1872, entering the employ of the North Chicago Street Railroad Company as a conductor. He was an absolute stranger in the city, and had no friends nor acquaintances there. After serving the company as a conductor for four months he was taken into the office and made a cashier. From that position he served in all the intermediate positions, until in 1889 he was made general manager of the North Chicago Street Railroad Company, and in 1897 general manager of the West Chicago Street Railway Company, in both of which positions he remains in the companies which have succeeded to the control of these properties.

Mr. Roach married Miss Kate Lyon in 1872, at Rockford, Ill., and has one son, F. Lyon Roach, born in 1875. Mr. Roach is a member of the Union League Club, Marquette Club and Union Club, of Chicago, and a Knight Templar, Lincoln Park Commandery.

Personal

MR. SIEZO MISAKI, chief engineer of an interurban road connecting the city of Osaka, Japan, with the neighboring city of Kobe, was in Chicago during the convention and was much interested in the exhibits.

MR. W. S. DIMMOCK, general superintendent, and W. D. Tarkington, master mechanic, of the Omaha & Council Bluffs Railway & Bridge Company, attended the Chicago convention and renewed acquaintance with many of their old friends.

PROFESSOR ALEXANDER B. W. KENNEDY, one of the leading electrical engineers of London, has taken into partnership Mr. Bernard Maxwell Jenkin, who has been for some years past his principal assistant. The new firm will be very strong in engineering circles.

MR. W. J. COOKE, vice-president of the McGuire Manufacturing Company, was reported as ill at his home, and typhoid fever was feared. Mr. Cooke's many friends will sincerely hope that this danger may be averted and that he will soon be around again in his accustomed travels.

MR. F. S. DRAKE, formerly general manager of the Nassau Electric Railroad Company, of Brooklyn, and later master mechanic of the Brooklyn Rapid Transit Company, has now become connected with the St. Louis Transit Company as mechanical engineer, and attended the convention with friends. Mr. Drake has had a very valuable experience in electric railroading, dating from 1889 to 1890, when he was engineer in charge of construction of the first electric railway built in Buffalo. He later went to Pittsburgh and then to Brooklyn.

MR. F. L. FULLER, resigned, on Oct. 1, his position of general superintendent of the West Chicago Street Railway Company, to accept that of assistant to the president of the United Power & Transportation Company, of Philadelphia. This company, as is generally known, is a recent organization and controls and operates a large number of formerly independent railway and lighting companies in the neighborhood of Philadelphia and Wilmington, Del., also in other parts of Eastern Pennsylvania and in New Jersey. Among the companies included in this consolidation are the Wilmington City Railway Company, Wilmington City Electric Company, Wilmington & Chester Traction Company, Chester Traction Company, United Traction Company, of Reading; Reading & Womelsdorf Electric Railway Company, Holmesburg, Tacony & Frankford Electric Railway Company; Roxborough, Chestnut Hill & Norristown Railway Company; Trenton Street Railway Company, of Trenton, N. J.; Citizens' Electric Light & Power Company, of Delaware County; Delaware County & Philadelphia Electric Railway Company, the Lebanon Valley Street Railway Company, the Edison Electric & Illuminating Company, of Lebanon; Wilkesbarre & Wyoming



F. L. FULLER.

Valley Traction Company, Wilkesbarre, Dallas & Harvey's Lake Railway Company, and the Metropolitan Electric Company, of Reading.

To this company Mr. Fuller will bring a long experience in electric railroading, obtained in Chicago and elsewhere, which has given him a high reputation in this line of work. Mr. Fuller's connection with street railways dates from January, 1888, when he entered the service of the St. Paul City Railway Company, at which time he was appointed foreman of the Selby Avenue cable line, just then put in operation. In the following year the company decided to substitute electricity for horses on the greater part of its system, and at that time Mr. Fuller was appointed assistant superintendent. He remained with this company until the consolidation with the Minneapolis system in April of 1893, when he resigned and entered the service of the West Chicago Street Railway Company, of Chicago, as assistant superintendent. At this time the latter company had two cable lines in operation, but on the rest of the line horses were employed. In 1894 it was decided to change all the lines not operated by cable to electric, and Mr. Fuller was appointed superintendent. In 1895 he was made general superintendent and remained in that position until Oct. 1, this year, when he accepted the position mentioned above. Mr. Fuller will make his headquarters in Philadelphia.

MR. E. S. DIMMOCK has been made general manager of the Bay Cities (Mich.) Consolidated Railway Company. Mr. Dimmock has been engaged in steam railroading practically all his life until four years ago. He was in early life for seven years apprenticed in the mechanical department of a prominent road, and later became superintendent of motive power of the Union Stock Yards at Omaha, and superintendent of electric lighting of the stock yards. He is a practical engineer and machinist and will be a valuable acquisition to the Bay Cities Company. He is a brother to W. S. Dimmock, superintendent of the Omaha & Council Bluffs Railway & Bridge Company.

MR. H. F. J. PORTER, whose portrait is presented herewith, is well known through his connection with the general subject of hollow-forged open-hearth and nickel-steel shafts, and, in particular, upon their adaptability to street railway power plants. Mr. Porter has so long been an advocate of this type of forging for such service that his name has become closely associated with it in the development that has been witnessed in all sections of the United States. The earliest installations were made at Chicago, and to that city belongs the credit for much of the prestige now held by such shafts. Now that the hollow shaft has been firmly established in favor for use in large plants, it is hard to appreciate the immense labor involved in its introduction, for not only was it necessary to show its superiority over wrought-iron shafts which had been most generally in service in smaller plants up to that time, but Mr. Porter found a more or less firmly rooted antipathy to steel for this service, owing to the failures experienced in solid shafts made of low grade steels. Mr. Porter was formerly Chicago representative of Bethlehem Steel Company, but of recent years has been connected with the company's general sales department at South Bethlehem. He has not, however, confined himself to commercial life, but has delivered many lectures before technical institutions, principally on subjects connected with recent developments in high-class forging. His most recent work in this direction was an interesting talk on "The Position of Forging in the Arts," given Oct. 19, before the Political Economy Club at Chicago. Shafts of fluid-compressed open-hearth and nickel-steels, annealed and oil-tempered, have been adopted for practically all of the more recently planned large power stations in the East, notably those of the Metropolitan Street Railway Company, at Ninety-sixth Street, New York; the Third Avenue Railroad Company, of New York, and the Boston Elevated Railway Company, and it is safe to say that this practice will be closely followed in all future work involving the enormous units demanded by modern street railway practice.



H. F. J. PORTER.

MR. IRA A. McCORMACK has resigned his position as general superintendent of the Brooklyn Rapid Transit Railway Company to accept that of vice-president and managing director of the Syracuse Rapid Transit Railway Company. Mr. McCormack is known as one of the ablest managers in the country, and had been engaged in steam railroading for twenty years before going to Brooklyn. During this time his record was one of continual promotion. He filled each position in a most satisfactory manner, and was at one time located at Syracuse in charge of the interests of the West Shore Railroad Company. He moved to Brooklyn in June, 1895, to take charge of the eastern district of the Rapid Transit system, but was soon appointed general superintendent. As the Brooklyn Heights Company gained control of the various lines that now go to make up the system of the Rapid Transit Company they were placed in charge of Mr. McCormack, who soon had them running with the same evenness that has been brought about on the original lines of the company. Mr. McCormack's success has been attributed to two things, his just treatment of the employees, and his interest in behalf of the railroad company. He always felt that there were two duties of equal importance attached to his position, one being to the company and the other to the men. Mr. McCormack has the reputation among the rank and file of the company of treating his men with the greatest civility and this conduct he also inculcated among the minor officers of the road in their dealings with the men under them. During all the late difficulties with the men of the Rapid Transit road it was said that no harsh words were uttered against the superintendent. Mr. McCormack will occupy the position recently held by Mr. E. W. Moore, who resigned on account of large business interests elsewhere, except that Mr. McCormack will reside in Syracuse, which his immediate predecessor did not. Mr. C. Loomis Allen, present general manager of the Syracuse Rapid Transit Company, will continue in that position.



IRA A. McCORMACK.

AMONG THE MANUFACTURERS

THE GOLD STREET CAR HEATING COMPANY, of New York, has been awarded a contract for several hundred electric car heaters for the Glasgow tramways.

THE SIEGRIST LUBRICATOR COMPANY, of St. Louis, Mo., has recently published a new and tasteful catalogue, which they will be glad to send to any reader on application.

THE Q. & C. COMPANY, of Chicago, has announced that it now has exclusive control of the sale of Magnolia anti-friction metal to railroads, both steam and electric, of the United States, Canada and Mexico.

RUSSELL & COMPANY, of Massillon, Ohio, builders of the Russell single valve automatic cut-off engine, have recently issued a very tasteful catalogue containing general and detailed views of this engine, together with engravings showing the company's works.

HENRY L. PRATHER, of Cleveland, Ohio, has recently closed a contract with the Rochester Railway Company, of Rochester, N. Y., for the cast welding of several thousand joints on 4½-in., 6-in. and 9-in. rail. The welding system of the Milwaukee Rail Joint & Welding Company will be used.

THE J. G. BRILL COMPANY, of Philadelphia, has recently secured what is undoubtedly the largest order for trucks ever placed in a European country. It was awarded by the Electric Railway & Tramway Carriage Works, of Preston, Eng., and was for 700 trucks of the Brill 21-E and maximum traction types.

THE LYNN INCANDESCENT LAMP COMPANY, of Lynn, Mass., is manufacturing an incandescent lamp for street railway use, which embodies a number of important improvements. The lamp is anchored and cannot droop or be broken by the motion of the car. The lamps are made to burn in series on 500, 525, 560 and 600-volt circuits and are carefully selected so that they are uniform and long lived.

WILSON & COMPANY, of Brooklyn, N. Y., manufacturers of the Wilson trolley pole catcher, call attention to the fact that this device locks and holds the trolley pole fast the instant the trolley leaves the wire and does not draw it down below the trolley

wire in this contingency, as stated in the last issue. The company has a large number of letters from prominent railway companies, speaking in the highest terms of this device.

THE UNION BOILER TUBE CLEANER COMPANY, of Pittsburgh, Pa., has recently finished what is said to be the largest contract ever awarded for cleaning boilers, being twenty-two water tube boilers, containing an aggregate of 10 miles of 4-in. tubes—a task no other concern in the world has the equipment to accomplish. The company has also just shipped eight machines to England and Scotland. The initial machine for export was shipped just one year ago. One of the latter was a repeat of the first order.

THE LORAIN STEEL COMPANY, of Lorain, Ohio, has just published what is probably the most tasteful rail catalogue which has ever been published. The rail sections, which are usually illustrated by line sections are here represented by fine vignetted half-tone engravings, which adds much to the appearance of the book, while making the section shown no less convenient for measuring purposes. The rails are all reproduced full size, and there are some sixty-five of them, including both slot and service rails. The special work, crossings, joints, etc., are illustrated in the same way.

THE MANUFACTURING PLANT of the Vulcanas Forging Company, situated between Wason Street and Case Avenue, Cleveland, was entirely destroyed by fire Oct. 25. The fire was discovered by the watchman in making his rounds and had gained such headway by the time of the arrival of the fire apparatus that it was utterly impossible to save the building. Several freight cars which were standing in the rear of the building waiting to be loaded with forgings were also destroyed. The building was two stories high, and about 175 ft. long x 50 ft. wide. The loss is estimated at $30,000.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, of New York, is issuing circulars and price lists devoted to underground electrical apparatus. The Tailleur coupling boxes, service boxes, junction boxes and coupling joints and Ferguson's all copper safety catches are among the devices illustrated and described. The company has branch offices in all the large cities, and manufactures arc lamps, incandescent lamps, pure drawn copper switches, automatic clock and voltmeter switches, push button switches, fan motors, power motors, dynamos, switchboards, rheostats, underground materials, Wright's discount meter, etc.

THE TRADE PAPER ADVERTISING AGENCY, 150 Nassau Street, New York, has made a valuable addition to its force, in securing the services of Sam A. Elkington, who has been associated as advertising manager and advertising writer for the past ten years with a number of the leading trade journals of this country. There are few men more successful as an advertising expert, or one that is more familiar with technical journals than Mr. Elkington, and advertisers desirous of using trade papers will find his services of great assistance and value to them. Mr. Elkington will have charge of the Philadelphia office of the company.

THE CHRISTENSEN ENGINEERING COMPANY, of Milwaukee, has recently published a revised edition of its catalogue on the Christensen straight air brake apparatus, which gives not only views and complete information of the company's air brake, but a short synopsis of the progress of the company since it entered the field, and a discussion of the desirability of the use of straight over automatic air for electric railway service. It is interesting to note that the company has sold and delivered, during the past two years, nearly 1000 equipments, and that during that time the cost of maintenance for these equipments, computed from the sale of repair parts, has been only a fraction of 1 per cent.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, reports sales for the month of September involving sixty-one machines ranging in size from 3 kw. to 150 kw. Among the more important were fifteen engine-type generators for United States Army transports and ten 50-h.p. motors to operate at 200 r.p.m. for Messrs. Dick, Kerr & Company, of London, England. Several repeat orders were received, among them being the following: Maryland Steel Company, Baltimore, Md., third order; Consumers Park Brewery, Brooklyn, N. Y., third order; Atlas Cement Company, Northampton, Pa., fifth order; Missouri Lead & Zinc Company, Joplin, Mo., third order. When representative concerns, such as those named, find it to their advantage to continually add to their equipment of Bullock apparatus, it can mean but one thing, and that is, that the machines have given perfect satisfaction. A new bulletin, just issued by the company, describes type "N" motors. This is the first bulletin of the standard 6 ins. x 9 ins. size which has been issued. Those interested in electrical literature will appreciate this reduction in size, as it is more readily filed than the larger pamphlets. It may be had by addressing the company.

THE SIMPLEX ELECTRICAL COMPANY, of Boston, Mass., reports an active demand for "American" car heaters. In addition to many recent orders in New England and in the West, the company reports the sale of 600 heaters to the United Railways and Electric Companies of Baltimore, Md., this being the third successive order received from Baltimore within the past two years. The Simplex Company claims great durability for the "American" car heaters, and lays particular stress on the claim that their coils never rust out, as they use a special non-corrosive wire instead of steel alloy. While the wire is far more expensive than that commonly used, the results more than justify this practice—so the company claims. Since the Simplex Company announced the sale of enamel car heaters, there has been much interest evinced and sample equipments ordered by street railway companies. The peculiar advantages claimed for the enamel heater are, that owing to the resistance wires being completely imbedded in enamel uniformly distributed over cast iron plates, there is no possibility of injury or trouble developing by any meddling or carelessness on the part of passengers, and that the heaters being entirely waterproof offer no opportunities for trouble when the cars are cleaned, even if a hose is used. The company insists that this is the heater of the future.

THE RESULT of a series of tests carried on by Professor R. C. Carpenter, of Cornell University, upon "Cling Surface," a compound for belts manufactured by the Cling Surface Manufacturing Company, of Buffalo, was published in the May issue. Those whose attention was attracted to that article will be interested in a letter which Professor Carpenter sent under date of Oct. 7, to the same company. In this he says: "Later tests of the use of Cling Surface on belting substantiate in every particular the statements made in my report of April 17. They also indicate higher efficiency of transmission and less loss of power in the case of belts treated with Cling Surface than in the case of belts not so treated, when working under the conditions prevailing at the time of the earlier test. This is due to the fact that the slipping of a belt causes considerable loss of power, the power so lost passing off in heat. The use of Cling Surface reduces the slipping and consequently reduces the loss of power occasioned by the use of belts that slip. During the past six months I have had occasion to observe the practical use of Cling Surface in a number of instances. In all such cases Cling Surface has improved the belts by softening them, and as far as I can determine in the limited time (seven months) tends to preserve the leather of which they are constructed."

New Publication

The Growing Magnitude of Electrical Industries. Prepared by T. Commerford Martin for J. G. White & Company.

The small brochure bearing this title gives briefly an idea of the advance made in electrical interest and investments during the last few decades. The subject matter is divided into various headings devoted to the different branches of electrical interests, and interesting figures are given of each. For instance, Mr. Martin estimates the gross income of the telephone companies during the last year as about $50,000,000, and gives the number of conversations over the Bell lines as a little over two and one-quarter billions. The central electric lighting and power stations of the United States, have a gross income yearly of about $66,000,000 and are capitalized at about $600,000,000. The isolated and municipal lighting plants represent a capital investment of about $400,000,000. Of electric railway work, the writer says: "The capital liabilities of the street railways of the United States at the close of 1898, were $1,621,820,000, a gain in one year of nearly $150,000,000. A conservative, authoritative estimate made in 1897 was that the street railways were then earning gross at least $150,000,000, a fair figure in view of the fact that in three Eastern States with less than one-third of the mileage, the earnings in 1896 were $64,000,000. It is therefore safe to say, in view of the rapid growth of carrying capacity, that the total earnings in 1898 were not less than $175,000,000. It appears that 220 roads earned $130,000,000 in that year. There are about 900 roads or systems. If the net be taken at around 40 per cent, there was applicable on bonds and stock, the sum of from $60,000,000 to $70,000,000, or from 4 per cent to 5 per cent over the whole capitalization." As a summary Mr. Martin estimates the investments in all electrical industries in the United States at about $3,260,000,000.

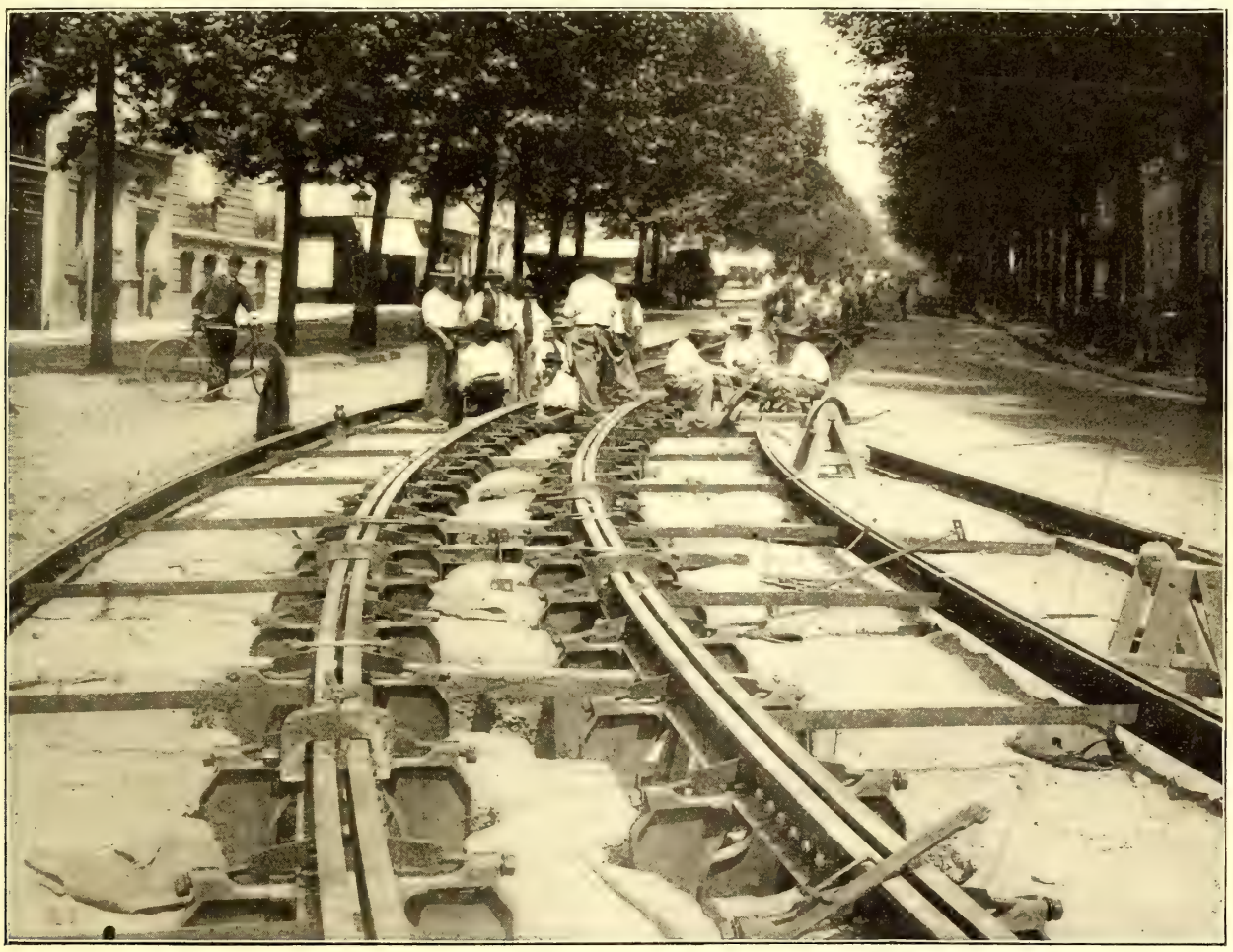
Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, DECEMBER, 1899. No. 12.

ELECTRIC CONDUIT CONSTRUCTION IN PARIS

BY A. N. CONNETT

Your readers are probably well aware of the fact that the "trolley" has taken extremely well in France, and that now all cities are or are about to be equipped with it, Paris being the one prominent exception. In some of the larger cities certain streets have been excepted, and for relatively short districts the trolley is forbidden. The most prominent cases of this partial exclusion of the trolley are in Lyons, Bordeaux and Nice. In these three cities the French Thomson-Houston Company has built or is building the electric conduit system in place of the trolley upon the sections where the latter is not allowed.



CURVE CONSTRUCTION, SIDE SLOT CONDUIT—PARIS

In Lyons 3600 meters (2.23 miles) of conduit track is in operation; in Nice 6000 meters (3.72 miles) will soon be in operation, and in Bordeaux 4000 meters (2.48 miles).

It is not exactly true to say that the trolley lines are excluded entirely from Paris. The Cie. Generale Parisienne de Tramways put in electrical operation in November, 1898, its Bastille-Charenton line, and this is almost wholly trolley. Of its total street length of 6150 meters (3.81 miles) 3520 meters (2.18 miles) are in the city of Paris, and of this 2650 meters (1.64 miles) are trolley; the rest, viz., 870 meters (0.54 miles) in conduit, is divided into two short sections, each of about equal length, one at the Place Daumesnil and the other the Paris terminus at the Place Bastille and the Rue de Lyon.

This line was built by the French Thomson-Houston Company, and has been deservedly very much praised, no expense having been spared in the construction and equipment to make it a model road. In appearance, at least, the overhead construction has never been excelled or even equaled elsewhere, as can be seen from the engraving on page 852. The service also has been excellent, comparing favorably with the best lines anywhere and far superior to any existing line in Paris.

But even with this splendid example of what service a well-built and well-equipped line can give, the prejudice

against the overhead construction still continues, and no other trolley lines are in construction or even projected at this moment. Apparently the question of good street car service must be solved otherwise. It must not be understood that mechanical traction is unknown in Paris, for in reality it is quite the contrary. There are more systems in use here than in any other city, but none of them combines the necessary attributes of a rapid, frequent service to the public, with operating expenses inviting to the shareholders.

The experience of Buda-Pesth, Washington, New York, Berlin and Brussels with conduit construction was not unknown to engineers here, but a natural desire to construct the trolley on a number of lines where the local conditions seemed ideal for this system, has hindered the construction of conduits up to now.

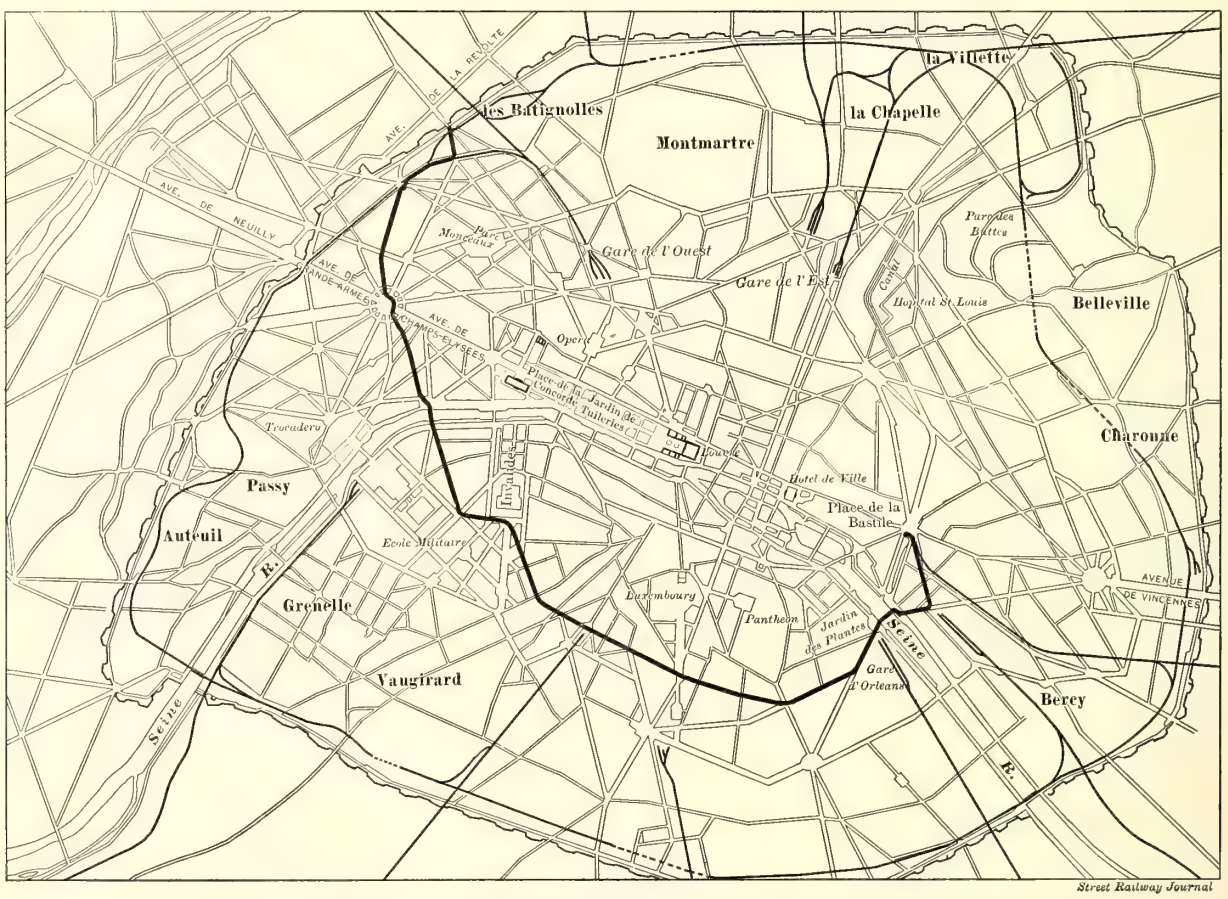
The Cie. Generale Parisienne de Tramways was given a new concession of a line called "St. Ouen-Champ de Mars," which will run from the Porte d'Asniéres to the Ecole Militaire, within the city limits of Paris. The concession being explicit that the system in Paris must be one of "underground electrical conductors" the company decided to equip this section of the line with conduits. The authorities also accorded the company the privilege of extending the conduits to the company's depot beyond the Gare Montparnasse. Lately the company decided to extend the conduit to the Place de la Bastille. The relation of this line to the rest of the system can be seen by reference to the map.

The conduit so prolonged will serve for three lines, viz., the St. Ouen-Champ de Mars, from the Porte d'Asniéres to the Ecole Militaire; the line from the Place de l'Etoile to the Gare Montparnasse, and the line from the last point to the Place de la Bastille. The two latter are at present important horse lines.

It will readily be seen that this is an important piece of work both from its extent, 10.5 km. (6.5 miles) of double track, and from the character of the territory through which it passes.

Some features of the conduit construction differ quite radically from anything yet done, and they may be of interest to the readers of the Street Railway Journal.

The conduits built by the French Thomson-Houston Company (and this is the only company which up to this time has constructed conduits for electric roads in France) have all been with the center slot. The type of construction in the main resembles that of the Metropolitan Railroad Company, of Washington, the important difference being that the cast iron insulator shields are bolted directly to the bottom flange of the slot rail, and the insulator pits are covered with a cast iron plate, this being low enough to allow its being paved over. This avoided the use of manholes in the street in any quantity, the municipal regulations being such in Paris that manhole covers must be entirely suppressed or reduced to a very strict minimum.



MAP OF PARIS, SHOWING LOCATION OF NEW ELECTRIC CONDUIT LINE

While the Thomson-Houston Company made every effort to continue the construction of this central slot conduit in Paris it has not succeeded and this is largely due to the question of pavement. Wooden pavement has been adopted here, as the standard. The wear is excessive, and in consequence it does not take long to leave the rail above the surface of the pavement. This is very hard on vehicular traffic, especially in a city with so many light vehicles as in Paris. Therefore the engineers in charge looked decidedly askance at the proposition of adding another line of rails in the center of the tracks. The wheel rails were regarded as necessary evils, but any other rails than these, which could be avoided, were not to be thought of. The plans of the company were therefore rejected, and it was invited to submit others which would avoid the central slot rails.

Of course there was nothing left but to do the best possible with the side slot conduit. The objections to this are:

1st. The question of slot closure becomes doubly important from the fact that the wheel flanges as well as the plow shank must pass into the slot.

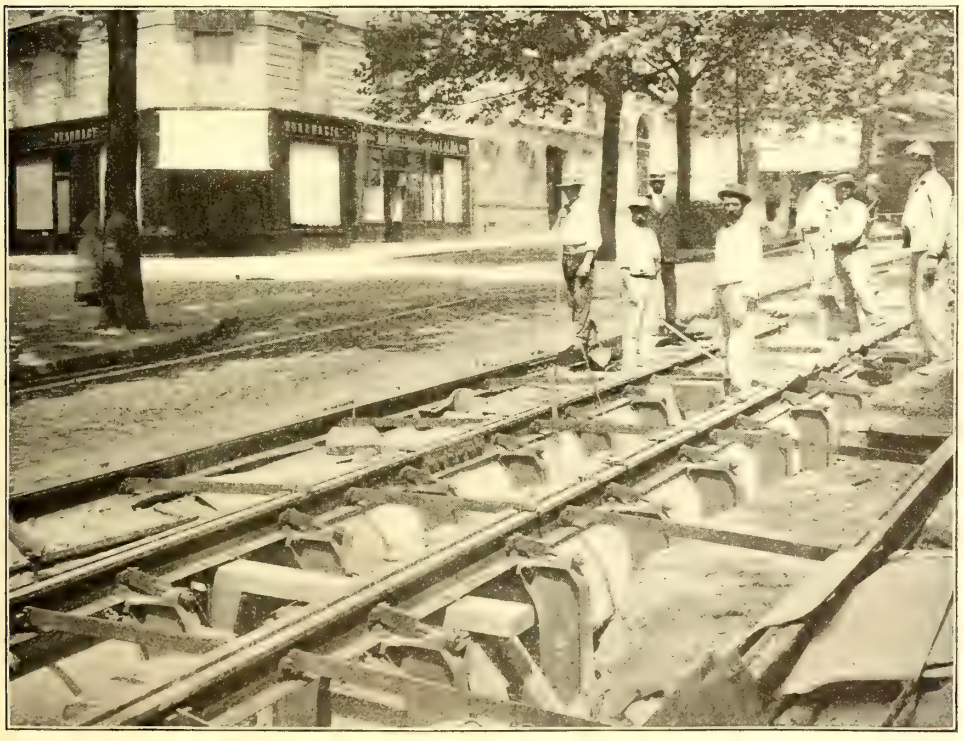
2d. The entire car traffic passing on the overhung yoke seats makes a stronger construction necessary.

3d. The plow insulation is rendered more difficult from the splash of mud and water directly on it from the wheels.

4th. It is fundamentally impossible to make a really satisfactory slot switch.

The last reason is much the most important. A wide slot is of course necessary for the wheel flanges, and the upper surface of the switch must be flush with the rail head because the wheels roll upon it. It must be very strong for this reason also, and have considerable width at the point where it must be supported. With these conditions a mechanically satisfactory switch will give a slot width of from $1\frac{3}{4}$ ins. to 2 ins. at the point. Such a width seems to be admissible in some European cities, but it needs no argument to prove that it is undesirable, and to be avoided if possible. In the Paris construction the difficulty has been avoided by the device to be hereinafter described.

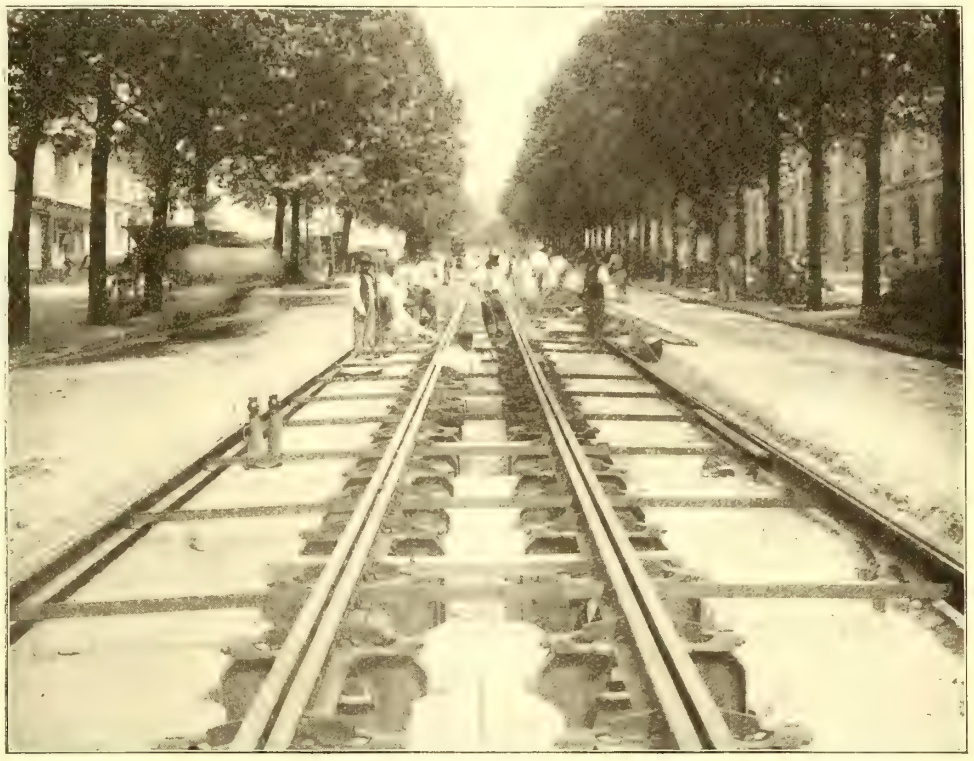
The general type of construction is shown in Fig. 1. The



VIEW SHOWING CONDUIT LINE IN COURSE OF CONSTRUCTION

two conduits are interiorly placed. The wheel rails are held to gage by tie-rods spaced every 2.10 meters (6 ft. 10 11-16 ins.) and the two interior slot rails are tied together in a similar manner. The insulator, conductor rail, the clips for fastening the latter in position to the insulators are, in general, very similar in construction to those of the Metropolitan Railroad Company, of Washington, D. C.

The regular track construction is clearly shown in the engravings herewith. The metal work is tied together by the tie-rods and gaged accurately. The forms are put into



VIEW SHOWING CONDUIT LINE IN COURSE OF CONSTRUCTION

position, and then the conduit walls are formed with concrete. The sheet iron forms are afterward withdrawn through the slot. They are in three separate parts, so that this is done with extreme facility. The use of sheet iron removable forms is to be recommended from every point of view.

The construction of the road bed is extremely simple. The delay in getting material has been a constant source of annoyance, and would not warrant an organization for rapid track laying, but nevertheless, with no effort, the advancement has been about 100 meters (328 ft.) of street per diem, or twice that length of track.

The paving in and between track is wood, and outside principally Belgium block and macadam. The conduit construction has shown every sign of being amply strong. The swelling of the wooden pavement blocks has not affected the slot width. While it has stood this severe pressure well, the same cannot be said of the wheel rails. Not being supported by the concrete base of the exterior wooden paving (the usual condition) these rails have tilted somewhat. The use of wooden pavements adds a most perplexing problem to the engineer. The most unheard of things happen to the track and the engineer never knows exactly what "bizarre" effect is going to result.

To avoid the inherent difficulties of the side slot switch, the device of deflecting the slot to the center at such points

was decided upon. The engravings on page 851 show clearly this construction at the terminus of the "Etoile Montparnasse" line at the head of the Avenue Marceau. The center slot switch is then always used and the difficult problem of the side slot switch effectually avoided by "dodging." The slot switch mechanism is one designed especially for the Omnibus et Tramway Cie., of Lyons, where it has given very good results. Figs. 2 and 3 show this in plan and section respectively. The slot and track

The line crosses the Seine on what is called the Pont Alma. The height over the masonry arches would not permit the regular conduit construction. A special conduit was designed for this; see Fig. 4. It is a continuous cast iron tube, reinforced by an exterior web every 1.05

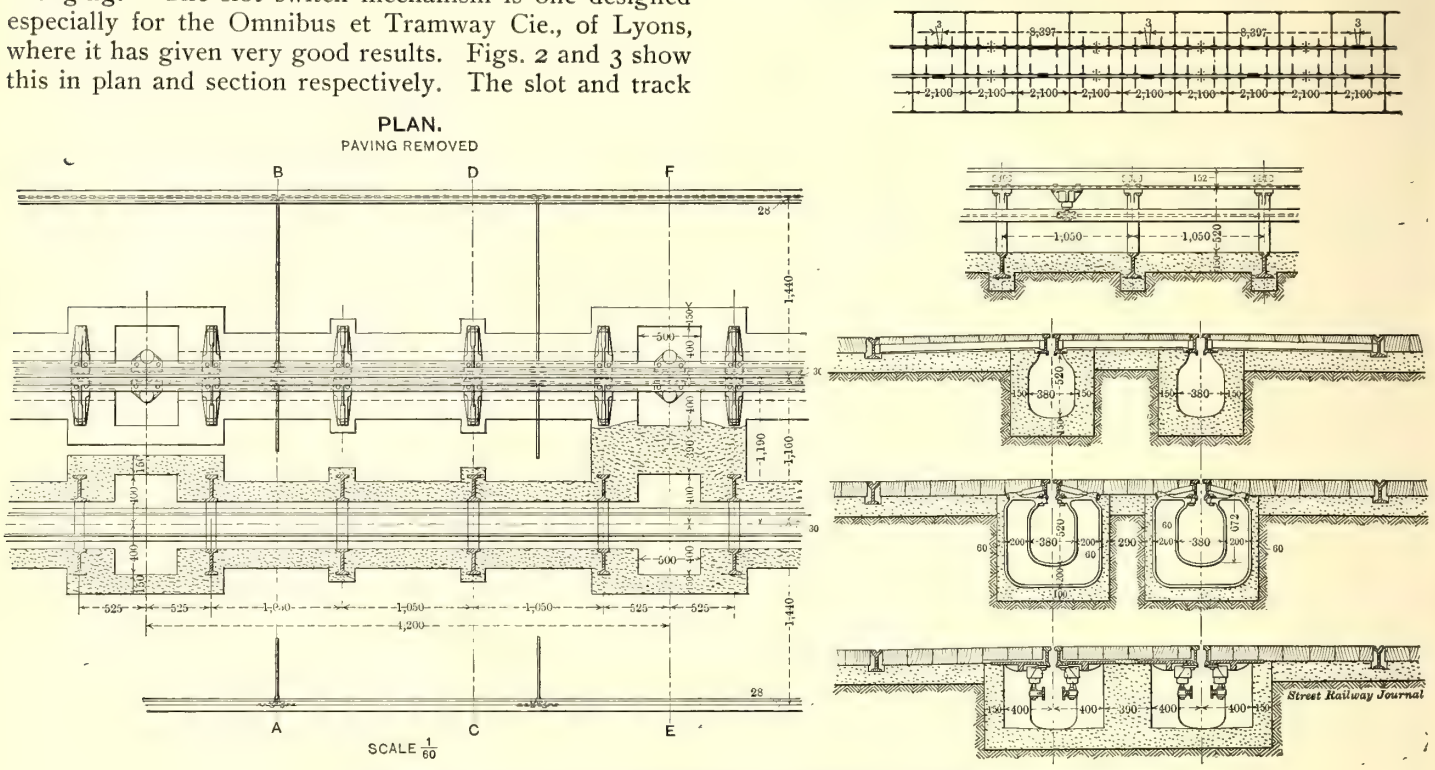


FIG. 1.—PLANS AND SECTIONS OF UNDERGROUND CONDUIT CONSTRUCTION—PARIS

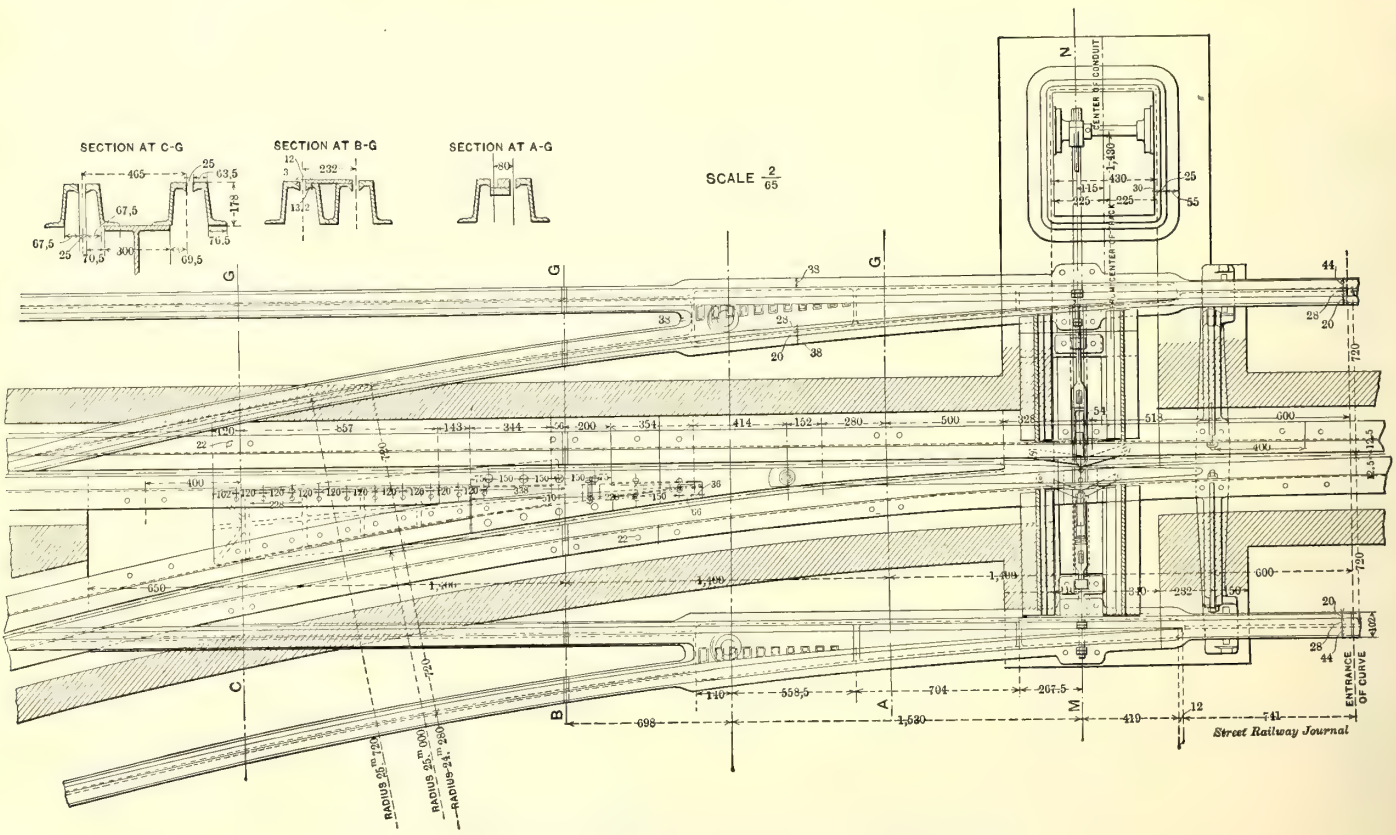


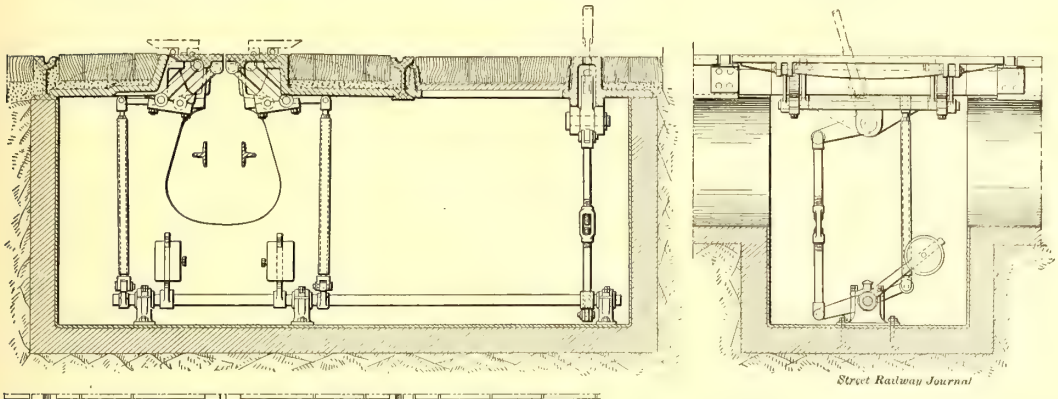
FIG. 2.—SWITCH MECHANISM, WITH SLOT IN CENTER OF TRACK

switches are thrown into position together by a pull on the detachable switch lever placed outside of the track. The arms which push the slot tongue are inclined to the slot. The plow in passing pushes them back under the slot rail. The force required to do this is so very slight that there is no danger of damage to the plow or the plow carrier.

meters (3 ft. 5 ins.). The tubes are covered with steel plates upon which a special Z bar is bolted, this forming the slot rail. Special steel castings act as tie-rods to hold the slot rails in position. This construction requires raising the conductor bars 12 cm. (4¾ ins.) above their level in the normal conduit. Special means to raise and lower

the plow for the passage over this bridge are therefore necessary.

The "St. Ouen-Champ de Mars" line being partly trolley and partly conduit special requirements are necessary at the points of contact of these systems to make it possible. The necessity of cars running at will on conduit and overhead systems is one common to all European conduit roads. This problem has been solved on two unimportant lines in the United States by the crude method of attaching and detaching the plow at these points. For an important line where this manoeuvre must be made many hundreds of times a day the question of making the change without an appreciable loss of time becomes important. The placing of men in vaults under the street is also to be avoided if possible.



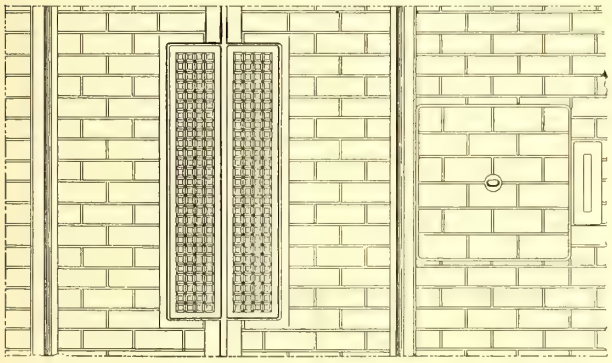


FIG. 5.—ARRANGEMENTS FOR WIDENING SLOT TO PERMIT REMOVAL OF PLOW

The problem has been very ingeniously solved on the Continental roads at Berlin and Brussels, and the latter roads at Buda-Pesth. It has been recognized that the simplest and most practical solution was to carry the plow on the car always, and to provide the proper means on the car of raising it from or lowering it into the conduit. The plows are designed to pass through the normal slot, therefore they can be raised or lowered at will anywhere on the conduit line. This involves a question of permissible slot width which

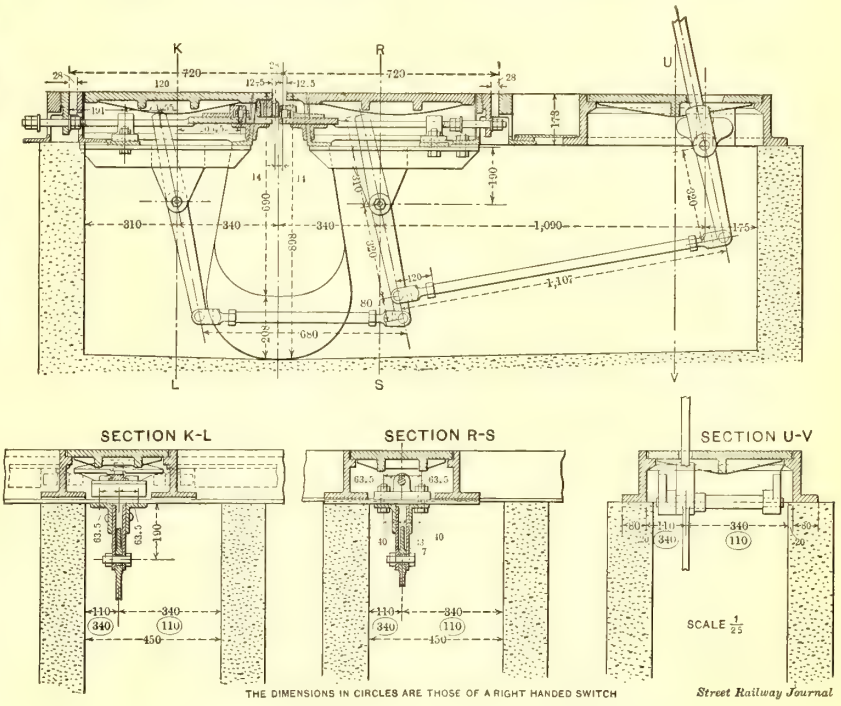


FIG. 3.—SECTIONS OF SLOT SWITCH MECHANISM

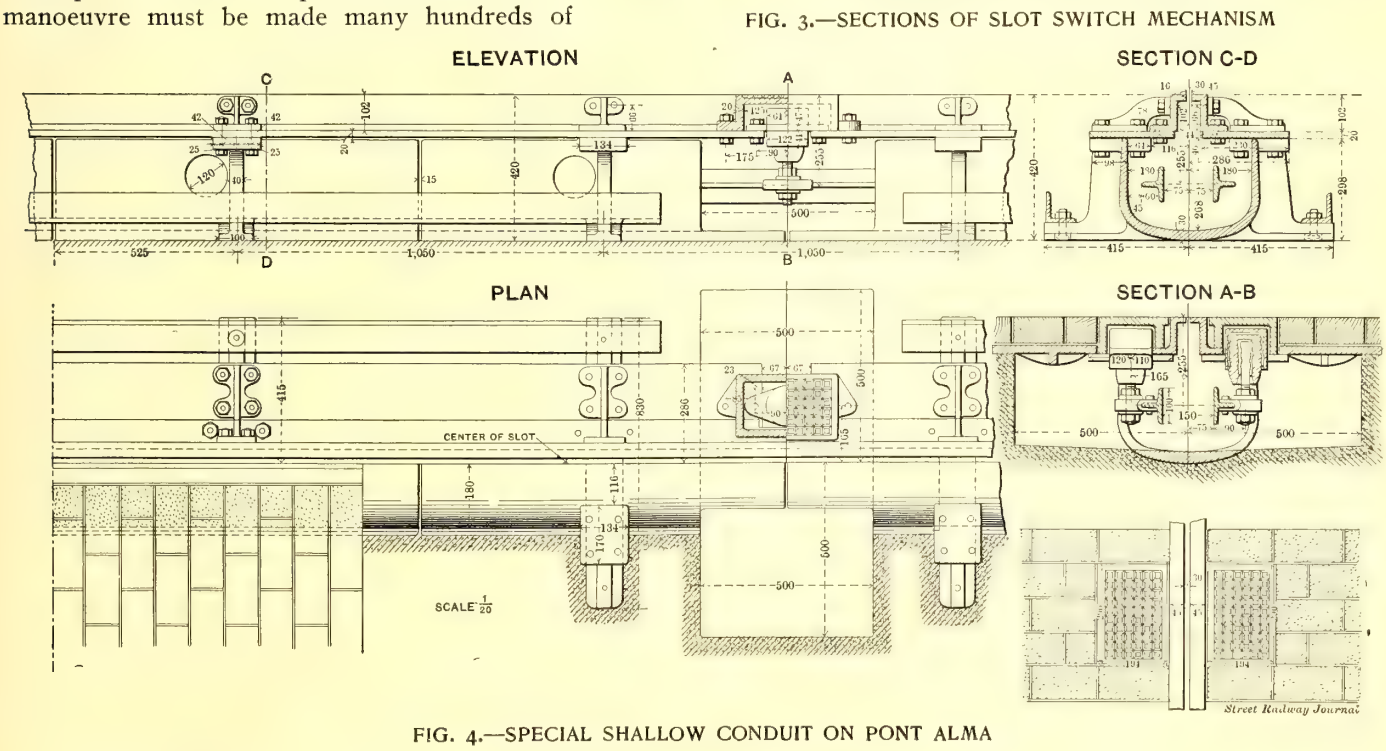


FIG. 4.—SPECIAL SHALLOW CONDUIT ON PONT ALMA

would make it impracticable for all American and many European cities. Besides it requires a form of plow construction of which many engineers would not approve. The writer, after giving the matter much thought, decided to adopt for the conduit lines of the French Thomson-Houston Company the main idea of the plow he had successfully used in Washington, viz., cast iron shoes pressed sideways by light semi-elliptic springs, the shoes being supported by horizontal links which limited their outward play. These links make the question of the mechanical strength of the springs unimportant, as they carry the shoes and resist all of the shocks; the role of the springs therefore is simply to lightly press the shoes against the conductor rail. At the same time he adopted some excellent ideas from the plows designed by the General Electric Company, for New York, which increased very materially the insulation resistance of the Washington plows while retaining the excellent mechanical features of the latter.

But starting from the point that for the best interests of operation such a form of plow was superior, it was necessary to give up the advantages of being able to raise or lower the plow from or into the conduit without a special construction. The advantage claimed by the adherents of the other method of being able to do this anywhere on the conduit line is of slight practical value. But the fact of

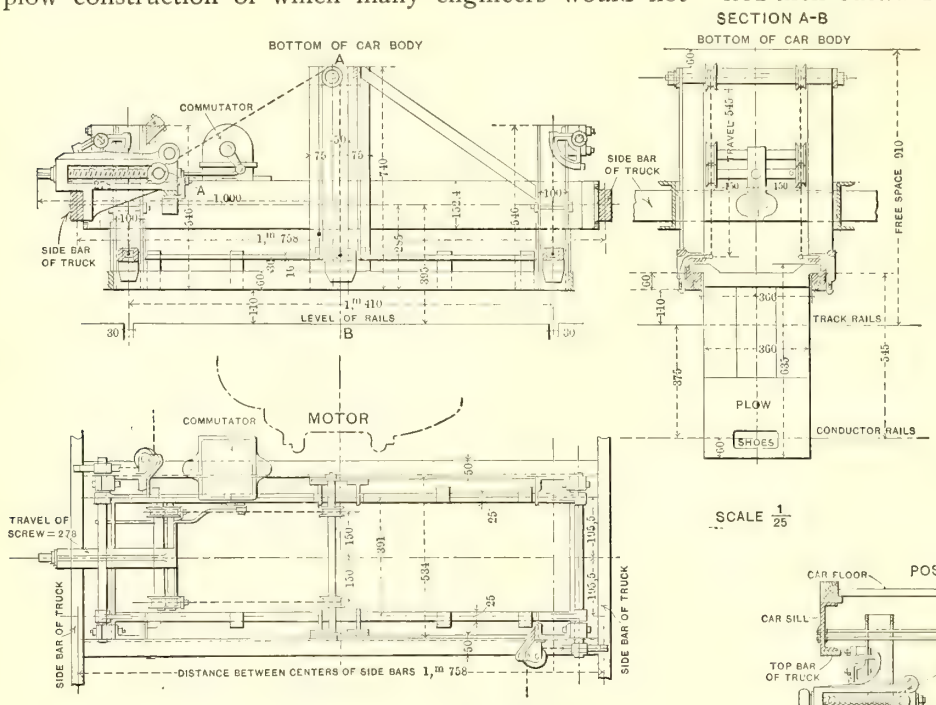


FIG. 7.—METHOD OF SUPPORTING AND RAISING PLOW

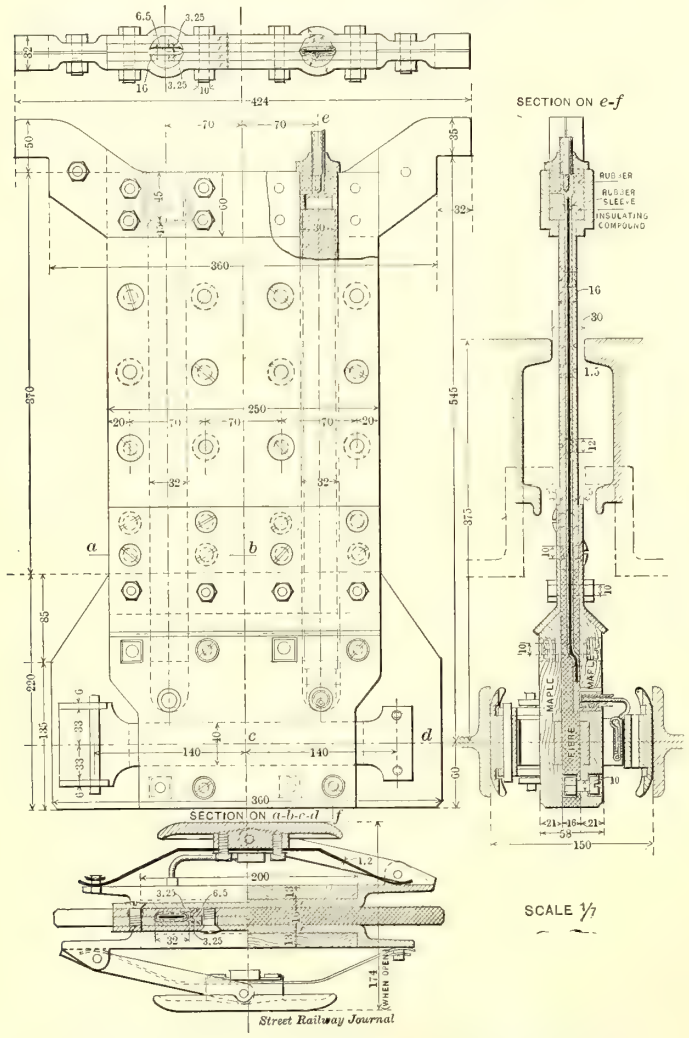


FIG. 8.—SECTIONS AND SIDE ELEVATION OF PLOW

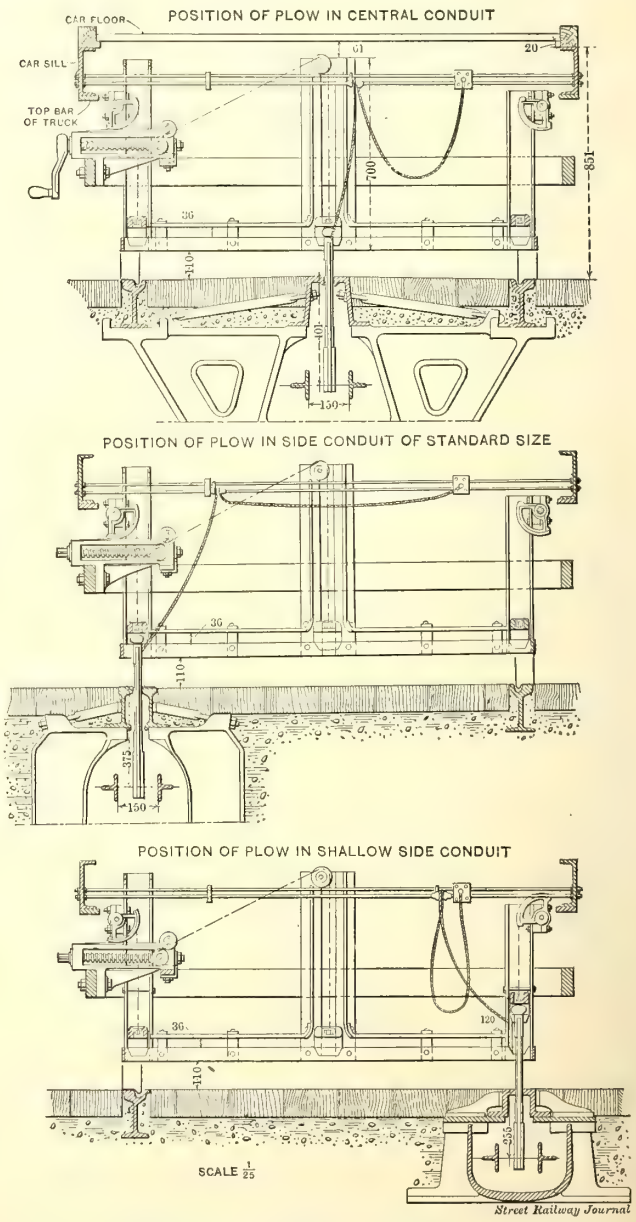


FIG. 6.—SECTIONS SHOWING POSITION OF PLOW IN DIFFERENT TYPES OF CONDUIT

being able to do it at the points of contact of trolley and conduit lines without any special construction is a decided advantage. The problem of making an opening in the slot wide enough to allow the plow to pass through and which could be opened and shut quickly by a sure and simple mechanism was a rather difficult problem to solve. The one finally chosen (Fig. 5) has proved most successful in Paris and Lyons, and has been adopted as the standard of the company. In the slot are placed two cast steel covers, supported on one side by a cast iron frame, and the ends by angle irons bolted to the slot rails.

These covers are raised to the dotted position shown in the drawing by a simple motion of a removable lever placed outside of the track. The use of counter weights makes this operation an exceedingly easy one. Sheet iron guides (not shown in the drawing) are fastened to the conductor rails, and direct the shoes when the plow is lowered. The covers are opened by the conductor, who, at the same time, raises or lowers the plow from the side of the car by the device to be explained. If the car traffic is very heavy it pays to have a man for this who takes care of two traps, one for each track, and placed side by side.

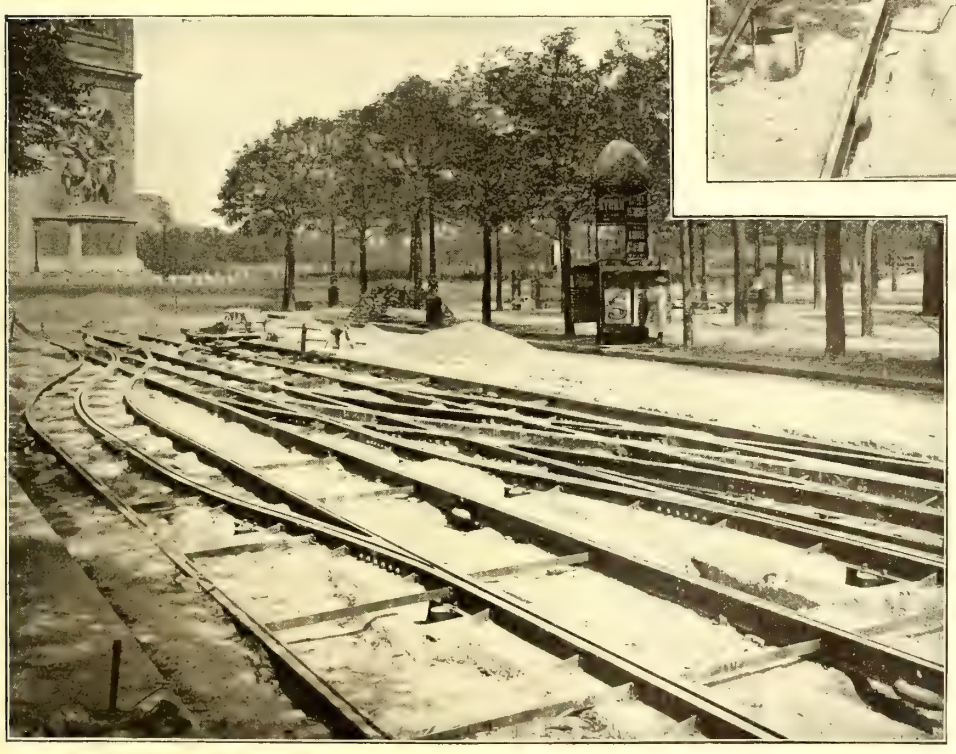
The most difficult problem has been in the design of the plow carrier. The conditions necessary to fulfil were:

First. That the plow should be able to slide laterally the full width of the track.

Second. That at its central position it could be raised clear from the conduit so as to be carried over the trolley section, and vice versa, to be lowered into the conduit.

Third. That it could be raised and lowered from each of its side positions the necessary distance between the height of the conductor rails, so as to pass the shallow conduit of the Pont Alma.

Fourth. That at the contact points of trolley and conduit, the circuits could be changed automatically with the same operation of raising and lowering the plow. This change is rendered necessary from the fact that the conduit circuit is a completely insulated one, while on the trolley the return is by the rails. The advantages of this change being automatic are self evident.



VIEWS AT HEAD OF AVE. MARCEAU, SHOWING METHOD OF DEFLECTING SLOT FROM SIDE TO CENTER OF TRACK AT SWITCHES

Fig. 6 shows the plow in the three different conduits, and gives a general idea in section of the operating mechanism. The plow is deflected to the center, and is raised or lowered by means of the trap already described (Fig. 5). The plow carrier is shown more in detail in Fig. 7.

The plow is raised from its central position by means of the screw bolted to the side bar of the truck. This



screw is turned with a controller handle. The switching of the circuits is accomplished at the same time by the bar attached to the "commutateur." The necessary motion is given to the crank handle attached to the cylinder, at the ends of the course of the block "A," insuring that the switching of the circuits takes place at the proper moment.

This "commutator" is in construction based on a car controller, with fingertips, cylinder, and a spring to make a quick break and so avoid destructive arcs. It is a very important mechanism. With some modifications dictated by the results of experience, it has proved itself entirely satisfactory.

This entire lifting device is the same as that employed on the Bastile-Charenton line, at Lyons, Nice, etc., with the exception that on these lines the lifting chains are attached directly to the plow. This becomes impracticable in this case, where the plow shifts its position the entire width of the track. The chains are therefore attached to a "cage" in which the plow slides. This "cage" must be

fixed mechanically in position, so that it will not be an obstruction to the plow in its side movement. At the same time the movement of the chains should release the "cage" without any additional manoeuvre.

Fig. 7 shows in section the hook for this purpose. The pull of the chain first releases the hook and the "cage" with the plow slides up the ways provided for this purpose. In the casting opposite the hook a hole is drilled (not shown in the drawing) in which is placed a small spiral spring, which acts to engage the hook when the "cage" descends to its seat.

The same apparatus is shown at each end of the slides to lift the plow for the passage over the shallow conduit. As shown on the drawing this is intended to be done by the motorman from the car platform. This operation in reality will be done by another mechanism from the side of the car, it being considered safer to bring the car to a standstill, and release the motorman of any other responsibility than to stop his car at the proper point. The drawings are not sufficiently advanced to show this modified mechanism.



TROLLEY LINE, PLACE DAUMESNIL—PARIS

The plow design needed a special study. The type already in such successful use for the central slot not being at all applicable for the side slot or the shallow conduit, another form had to be adopted. That finally selected is shown in Fig. 8. It offers all of the advantages of the "Bastille-Charenton" type, while being much simpler in construction. This plow should give an excellent account of itself.

This line has numerous other points which have required special construction and perhaps additional information will be given in another article, but for the present enough probably has been said to show that the line is one having some special points of interest.

High Speed Service on Private Right of Way in Buffalo

The International Traction Company has recently put in service a new route for its Buffalo and Lockport branch. On account of the length of this line, high speed and a private right of way are almost imperative. Between Tonawanda and Lockport the cars always have run on the Erie railroad tracks, but heretofore, between Tonawanda and Buffalo, they have used the tracks of the Niagara Falls line, which extend along the highway.

The new route between Tonawanda and Buffalo consists of about 6 miles of track from Tonawanda to Buffalo city line, where the cars turn into Main Street, near Cold Spring, and thence run down town. The new private right of way has allowed a considerable reduction in the schedule running time, which is now seventy minutes between the downtown section of Buffalo and Lockport. The time on the New York Central road is from fifty minutes to fifty-five minutes. Of this seventy minutes, thirty minutes are spent on the streets of Buffalo, the average speed on the private right of way being 45 miles per hour between stops, with maximum speeds running up to nearly 60 miles per hour. The new road is single track, and laid with 85-lb. American Society Standard rail. The whole line is operated by a regular train dispatching system exactly like that of steam roads. The passenger cars run every thirty minutes throughout nearly the whole day.

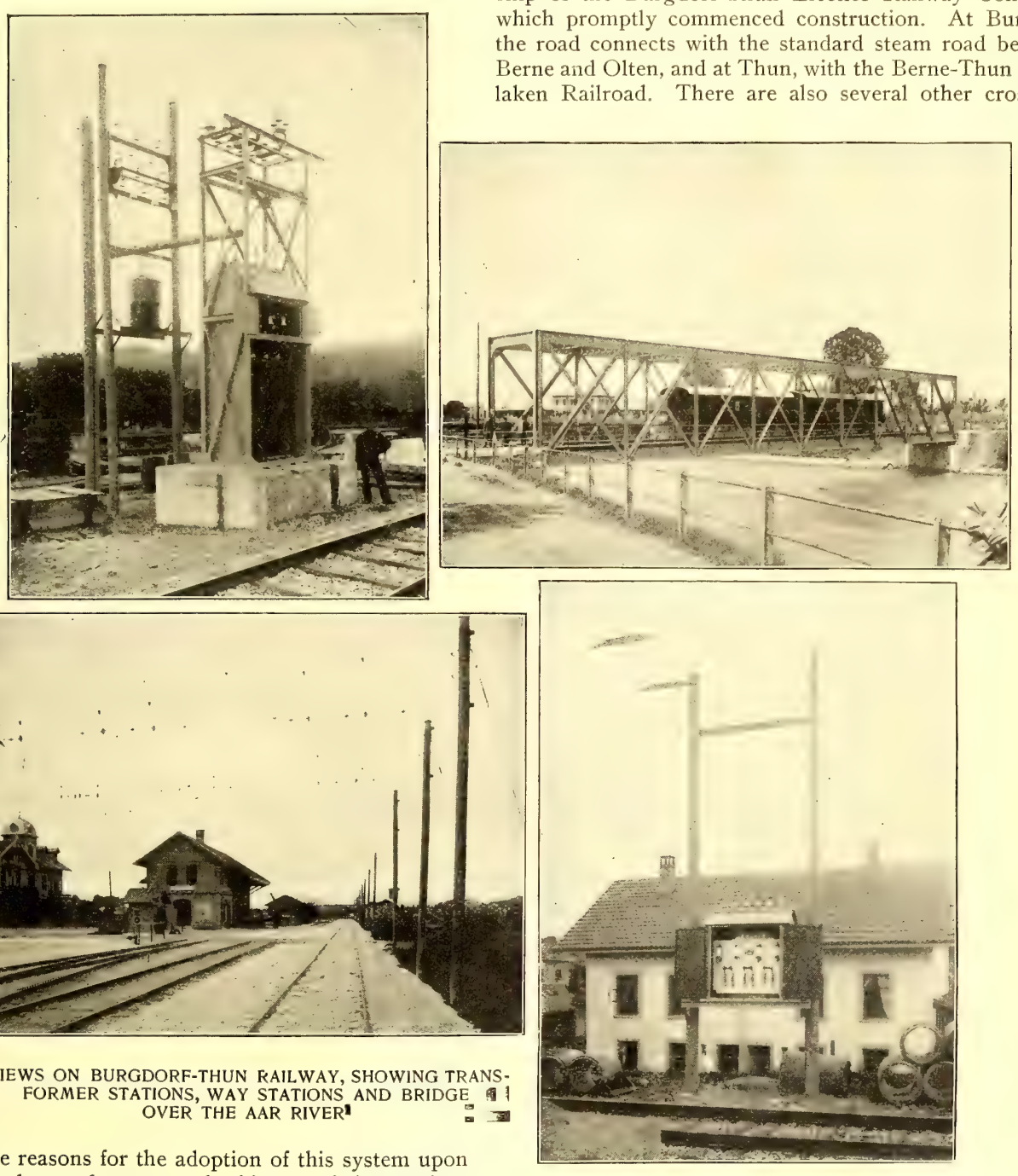
The overhead construction used involves some new features, which were introduced by the electrical engineer, C. K. Marshall. The overhead wire is carried on brackets, but instead of suspending the trolley wire immediately from the brackets, a 7-16-in. stranded steel cable is strung the whole length of the line, and the trolley wire is hung from this cable by means of ordinary straight-line hangers offset on the cable a considerable distance from the brackets. This gives flexible suspension, and in addition prevents any break of the trolley wire from twisting out of shape several brackets. The International Traction Company has also directed the General Electric Company to gear up one of its freight locomotives for experimental purposes to determine its applicability to passenger train service. The locomotive will be geared to give a maximum speed of 70 miles per hour, and if this speed can be attained with a load of 150 tons, electric locomotives will be used on the Erie tracks between Buffalo and Niagara Falls to haul regular Wabash and other passenger trains.

E. G. Tillston, Jacob Mandlebaum, H. R. Newcomb and others, of Cleveland, have acquired control of about four-fifths of the capital stock of the Dayton Traction Company, and have been elected to the directorate of the company. It is said to be the intention of the syndicate to consolidate the property with that of the Cincinnati & Miami Valley Traction Company, and the Cincinnati & Hamilton Electric Railway, which it now owns. Mr. Mandlebaum is quoted regarding the deal as follows: "Our plans are not yet in shape to be discussed. All that I can say is that we now have a line practically completed from Cincinnati to Dayton. When the reorganization is carried out, which will be very shortly, enough bonds will be left in the treasury of the (new) company to pay for the extension of the line through to the northward from Dayton, the whole length of the Miami Valley to Troy. This will, I believe, be the longest trolley line in existence. The valley of the Miami is the richest territory in the State, and I regard Dayton as the best traction town in the State. The road, when completed, will be about 72 miles long, and will traverse a territory having a population of 750,000. Practically the whole enterprise is a Cleveland affair.

Important Three-Phase Electric Railway in Switzerland

BY CHARLES ROCHAT

On July 21, last, a railway was put in operation in Switzerland which will mark an interesting epoch in the history of electric railroading. The road referred to is that connecting Burgdorf and Thun, about 40 km. in length, and is noteworthy from the fact that it is the first extensive line to employ the three-phase current, and is as well the largest road of this type which has ever been installed. To understand the reasons for the adoption of this system upon this road a short reference to the history of the employment of the three-phase system is necessary.



VIEWS ON BURGDORF-THUN RAILWAY, SHOWING TRANSFORMER STATIONS, WAY STATIONS AND BRIDGE OVER THE AAR RIVER.

It was on June 1, 1896, and at Lugano, that the first electric railway to use three-phase current on its trolley lines was put into operation. The experiment, having given satisfactory results, was followed on Aug. 20, 1898, by the three-phase mountain electric railway at Gornergrat, near Zermatt. Sept. 20, 1898, saw the opening of the first section of the Jungfrau Railway, and Oct. 5, 1898, the electric railway from Stanstad to Engelberg. Finally, on July 21, 1899, as stated above, the electric railway connecting Burgdorf and Thun, the most important of all those mentioned, was put in service. The three-phase alternating current has thus assumed within three years an important position in Swiss tramway and railway enterprises, and will certainly be employed on a large number of future lines, where the conditions presented are similar to those where it has already been adopted.

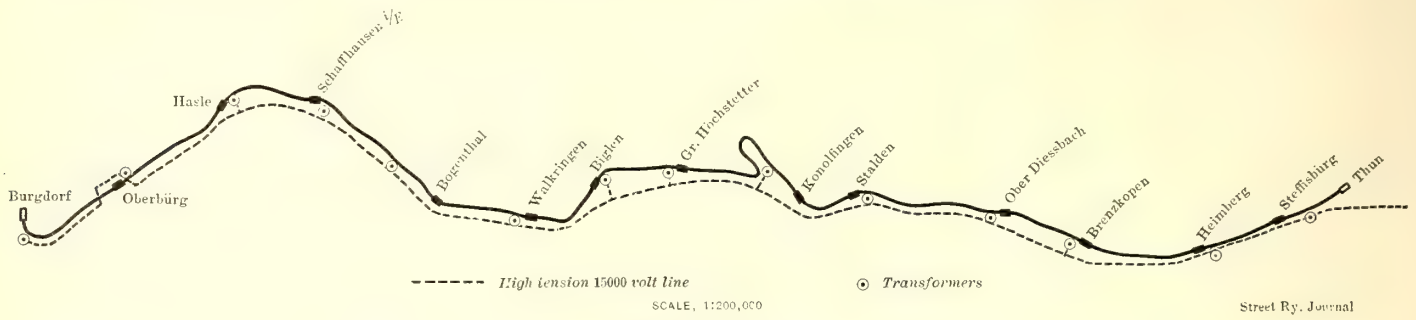
Franchises for the construction of the electric railway from Burgdorf to Thun were acquired as early as the year 1873. After many negotiations the various concessions granted were finally united, and in 1896, came into ownership of the Burgdorf-Thun Electric Railway Company, which promptly commenced construction. At Burgdorf the road connects with the standard steam road between Berne and Olten, and at Thun, with the Berne-Thun Interlaken Railroad. There are also several other crossings with steam railroads. In order to make close connections with each of these lines a larger train service was necessary than would have been possible with steam power; and, again, the grades, though not very steep, would yet have been considerable for steam operated trains. With electricity, on the other hand, the grades could be easily surmounted, and single cars could be run frequently.

The road is single track and of 3-m. gage. The minimum curve radius is 250 m., and the maximum grade 2½

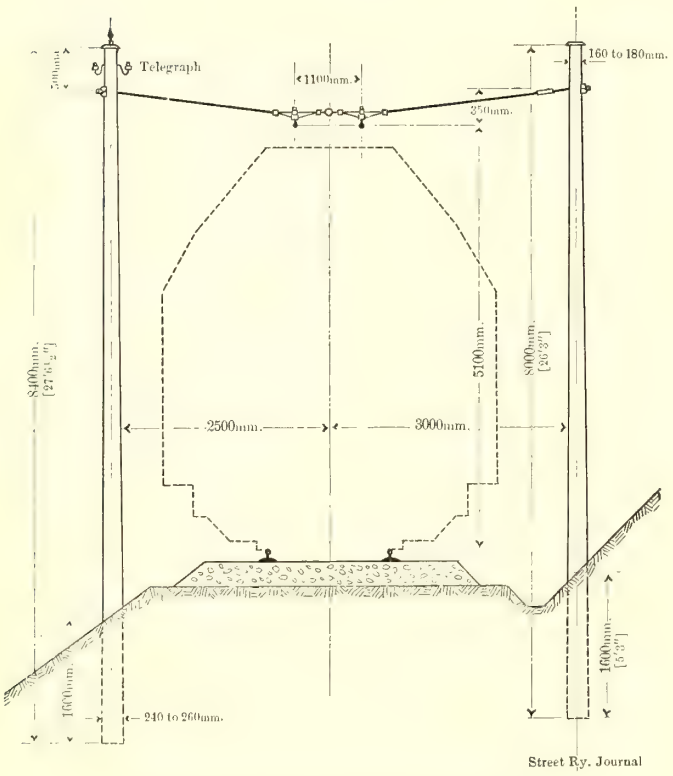
per cent. The sidings are 200 m. in length. The road passes through a number of tunnels, the minimum width of which is 4.4 m., and the height above the ties 5.4 m.

The track is laid with 36-kg. rails in 12-m. lengths. The ties are of metal, 2.4 m. long, weigh 45.5 kg. each, and

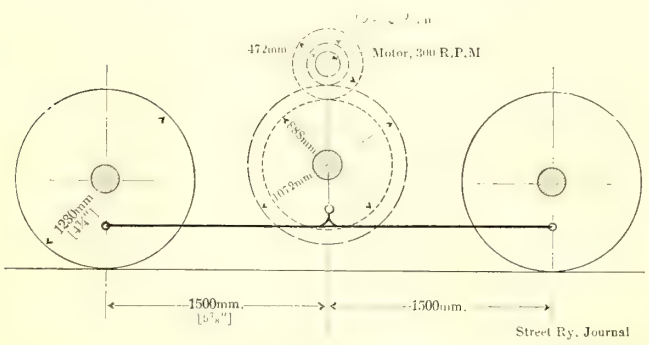
Moreover, about every 100 m. the two rails are cross-connected by an 8-mm. wire. It is premature yet to determine the results of this method of bonding, as a time test only will give correct information, but it is certain that the method has certain advantages.



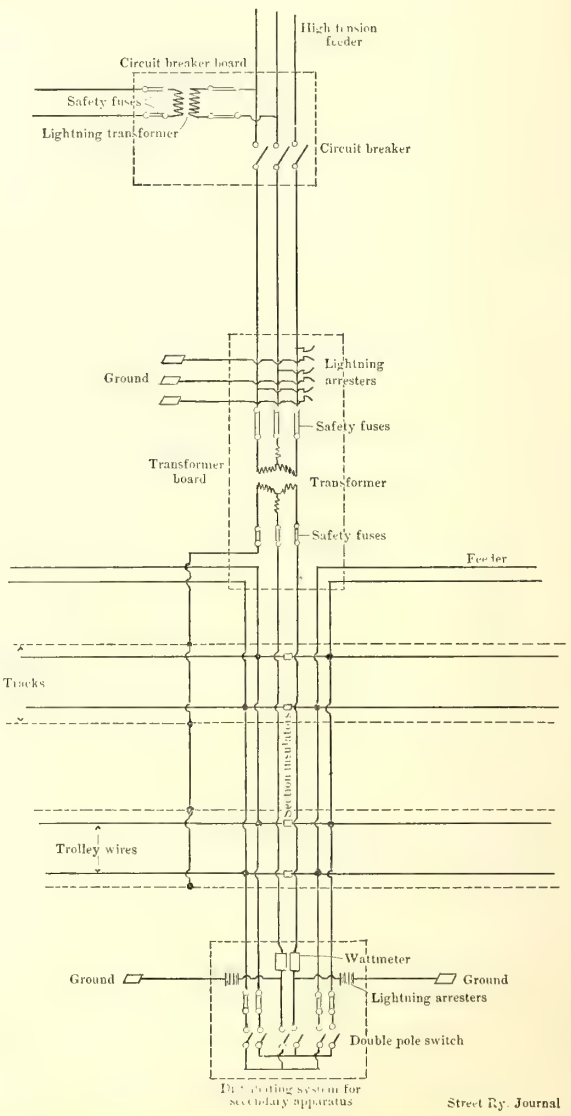
MAP OF ROUTE



STANDARD CROSS SECTION OF TRACK



LOCOMOTIVE GEARING



ARRANGEMENT OF CONNECTIONS AT TRANSFORMER STATIONS

are spaced fifteen to the rail length. The complete track weighs about 110 kg. per running meter. The rails are connected to the ties by lugs and bolts, and the track construction is very similar to that used in the ordinary trunk line railroads of Switzerland, where the running weight is 15 tons per axle. A special kind of bonding is used, the object being to avoid the possibility of the bonds breaking through the vibration of the rails. The under side of the head and the upper part of the base at the end of each rail have been grooved and filled with zinc, as have also the portions of the angle-plates bearing upon these parts.

Commencing at Hasle, going from Burgdorf, the line enters a very picturesque region, where the construction was considerably more expensive than that previously encountered. There are three tunnels, of 150 m., 95 m. and 100 m. length, and two viaducts 20 m. and 54 m. in length. The stations are most attractive, and as complete in all parts as those of standard steam railroads.

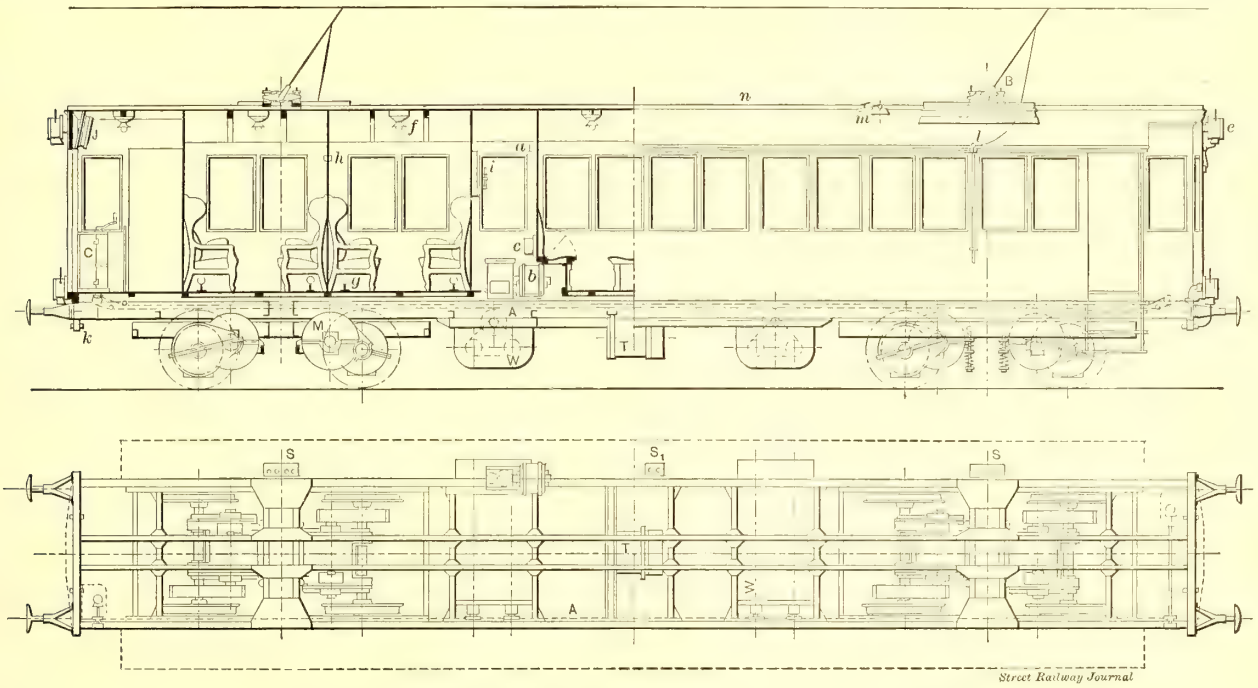
Owing to the use of the three-phase system, two trolley wires are carried over the track, and the transformer stations are fourteen in number.

There was considerable discussion as to whether the

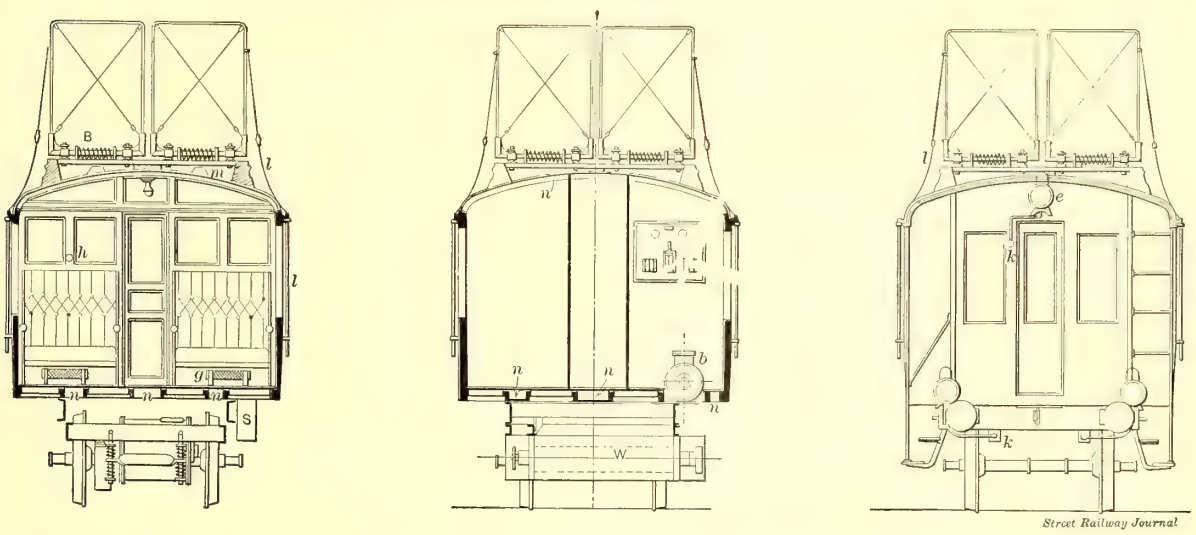
15,000-volt distribution circuit should be located along the track, where, of course, the facility for inspection was better, but where, on the other hand, it would have to follow all the curves of the line. It was finally decided to place the pole line independent of the track, wherever a saving in length could be effected. The primary circuit consists of three copper wires of 5-mm. diameter, carried on porcelain double-petticoated insulators mounted on wooden poles. The maximum span is 35 m. Between the power station at Spies and Thun (about 10 km.) wires are carried on latticed poles set in concrete. The high-tension line is protected at the entrance of the power station and at each transformer station by Siemens lightning arresters. To avoid short circuits to the earth after atmospheric discharges, water rheostats are introduced on the earth connection of the lightning arresters.

The transformers are placed at the side of the track, and are inclosed in metal housings, with wooden shutters, and supported on concrete bases. The housings are surmounted with the overhead construction necessary to receive the high-tension wires, lightning arresters, etc. The operation of all the apparatus is very simple, and is in charge of the station master. The transformers are oil insulated and have a capacity of 450 kw. each.

The contact wires, which are two in number, are of copper, 8 mm. in diameter, and are carried 5.1 m. above the track and 1.1 m. apart. Double insulation is employed between the trolley wires and the poles. The latter are

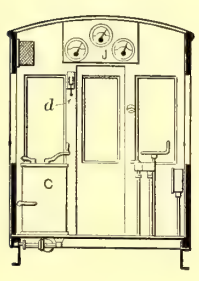


PLAN, HALF SIDE SECTION AND ELEVATION OF MOTOR CARS



REFERENCE.

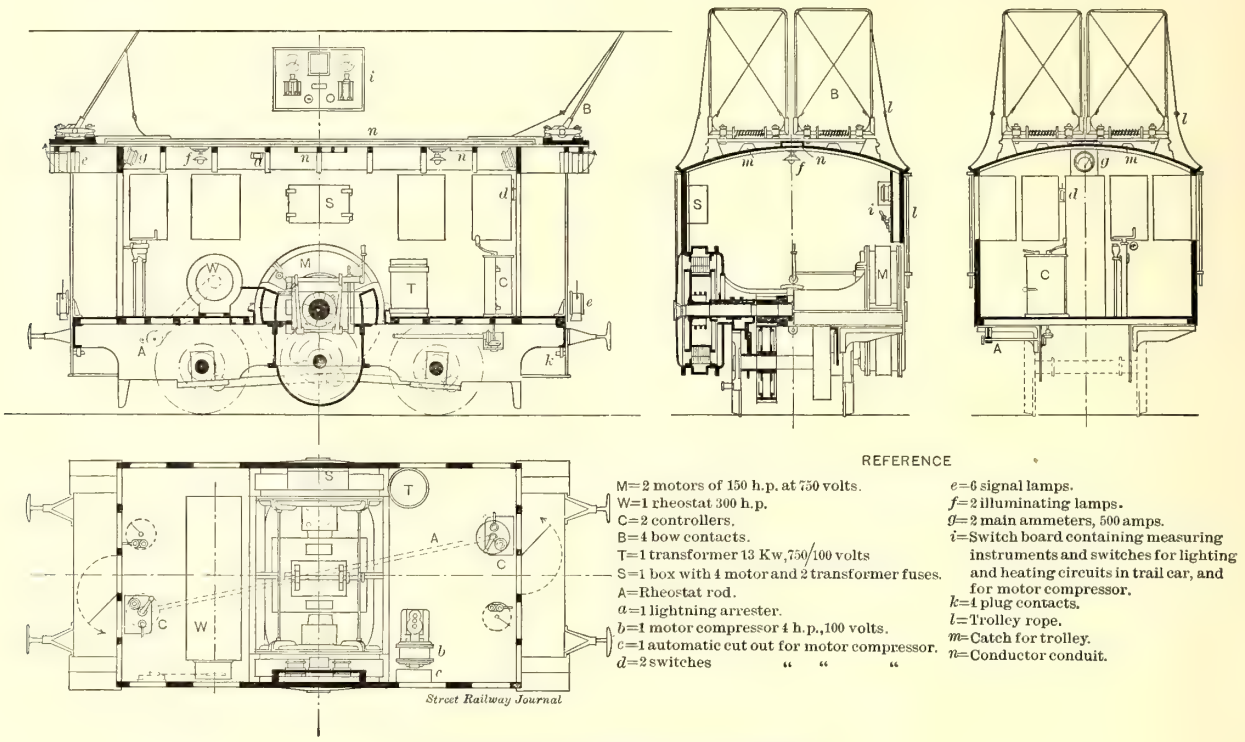
M = 4 motors of 60 h.p. 750 volts.
W = 4 rheostats.
A = Rheostat rod.
C = 2 controllers.
B = 4 bow contacts.
T = 1 transformer 18 Kw. 750/100 volts.
S = 2 boxes each with 4 motor fuses.
S_1 = 1 " with 2 transformer fuses.
l = Volt and ampere meters.
a = 1 lightning arrester.
b = 1 motor compressor 4 h.p. 100 volts.
c = Automatic cut out for motor compressor.
d = 2 switches for motor compressor.
e = 6 signal lamps.
f = 10 illuminating lamps.
g = 14 electric heaters.
h = 6 heater switches.
i = switchboard with switches for lighting, heating and motor compressor circuits.
k = 6 plug contacts.
l = trolley rope.
m = catch for trolley.
n = conductor conduit.



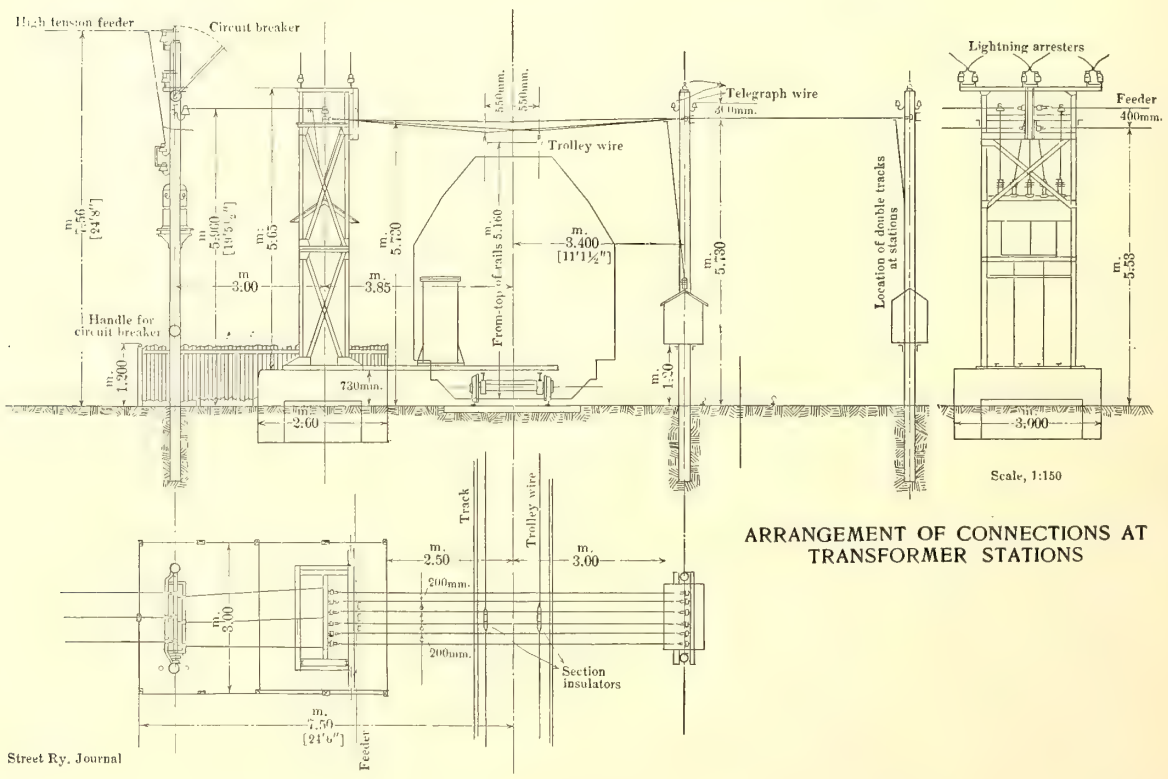
CROSS SECTIONS OF MOTOR CARS

generally spaced 35 m. apart, but at a shorter distance at the curves. The principal difficulty so far experienced has been the overhead frogs. For this reason the firm of Brown, Boveri & Company, who made the installation, decided to install the bow sliding trolley, as this had been employed with success on the Gornergrat and Stanstad installations, as described in the Street Railway Journal

The power station is located at Spies, on the Kander River, and contains four groups of turbine generators. The turbines operate under a fall of 63 m., with an average volume of 10,000 litres of water per second, from which a maximum power of 6300 h.p. is obtainable. The current is produced by generators at 4000 volts, which is raised to 16,000 volts by means of transformers similar to those



PLAN AND SECTIONS OF LOCOMOTIVE



ARRANGEMENT OF CONNECTIONS AT TRANSFORMER STATIONS

for February, 1899. There are properly no overhead frogs except at the turnouts. At these points, where the wires cross, section insulators have been installed, and, as the motor cars always carry four trolley poles, two at each end, contact with at least one set of trolley wires is always secured. The normal position of the poles is vertical, although they take a slight inclination as the car moves. They are kept rigid by the use of cross-braces.

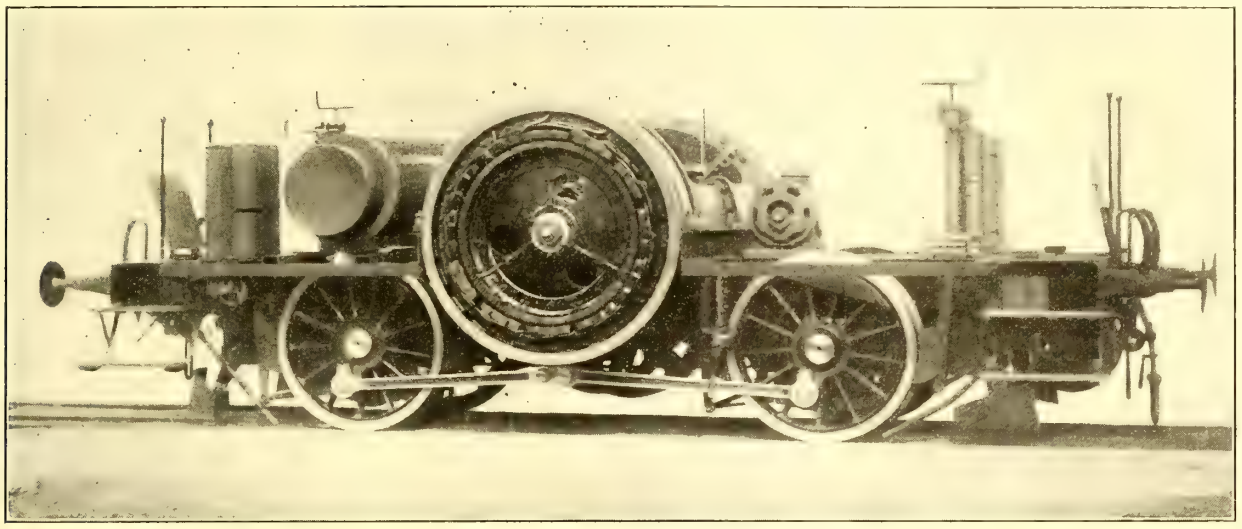
placed along the line. The lighting circuits are kept distinct from the power circuits, so that there are no fluctuations in the lighting voltage from variations in load on the power wires. Each generator has a capacity of 900 h.p., and the station when completed will have a capacity of 6000 h.p.

The company owns two electric locomotives, six motor cars, seven trail cars of different types, and three combina-

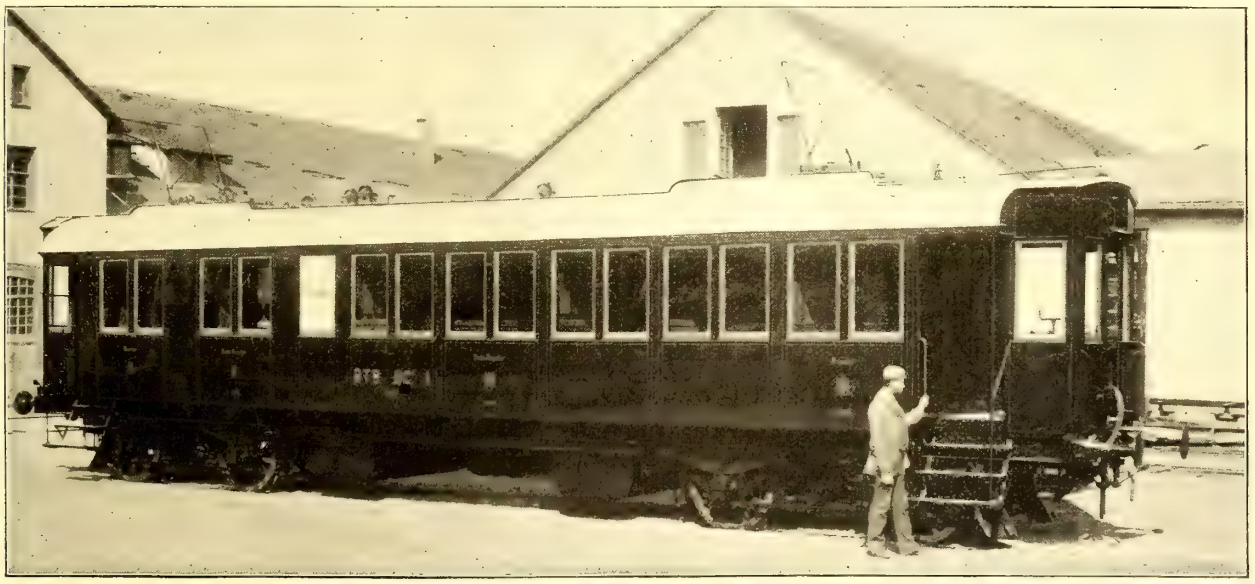
tion baggage, postal and passenger cars. The electric locomotives are principally employed for freight traffic, but are also used for passenger service. Each has a capacity of hauling 100 tons at a speed of 18 km. per hour on a grade of 2½ per cent, or 50 tons at a speed of 36 km. per hour on the same grade; the latter when hauling passenger cars. Each locomotive is equipped with two motors of 150 h.p., running 300 r.p.m. at 750 volts. They are placed in the middle of the locomotive and at either end of the same shaft. The rotors are keyed to the shaft, while the stators are mounted on the frame-work of the locomotive. The rotor shaft can be thrown into gear with either of two trains of gears connected with the axles. One of these is for use at the slower speed of 18 km. per hour, and the other for the higher speed of 36 km. For facilitating the mounting and dismounting of the rotors the sides of the locomotives are supplied with openings, through which the shaft can be removed. The collector brushes and rings can be inspected from within the locomotive.

The starting rheostat is composed of helical coils of ribbon, separated into three sections corresponding to the three phases, and connected to a commutator fitted with carbon brushes, by which the resistance can be cut in and out of circuit. At each end of the locomotive are two switches, of which one is for making and breaking the circuit, and the other for transposing the connections. The handle for operating the former also controls the starting resistance. This arrangement is to prevent the admission of current unless all resistances are in circuit.

Each locomotive also carries a transformer for reducing the voltage from 750 volts to 100 volts. Part of this low tension current is used for operating a motor compressor for the use of the air brake, and part for lighting the car. The lower tension is preferred first, since it was hardly possible to build so small a motor for 750 volts, and, second, to avoid introducing into all parts of the cars and locomotive a voltage of 750. Current for light and heat is taken from two phases only, although the compressor motor is connected across all three phases. The motor compressor is of 3 h.p., and is cut in and out of circuit, as the needs of the pressure in the air reservoir require.



LOCOMOTIVE WITH CAB REMOVED



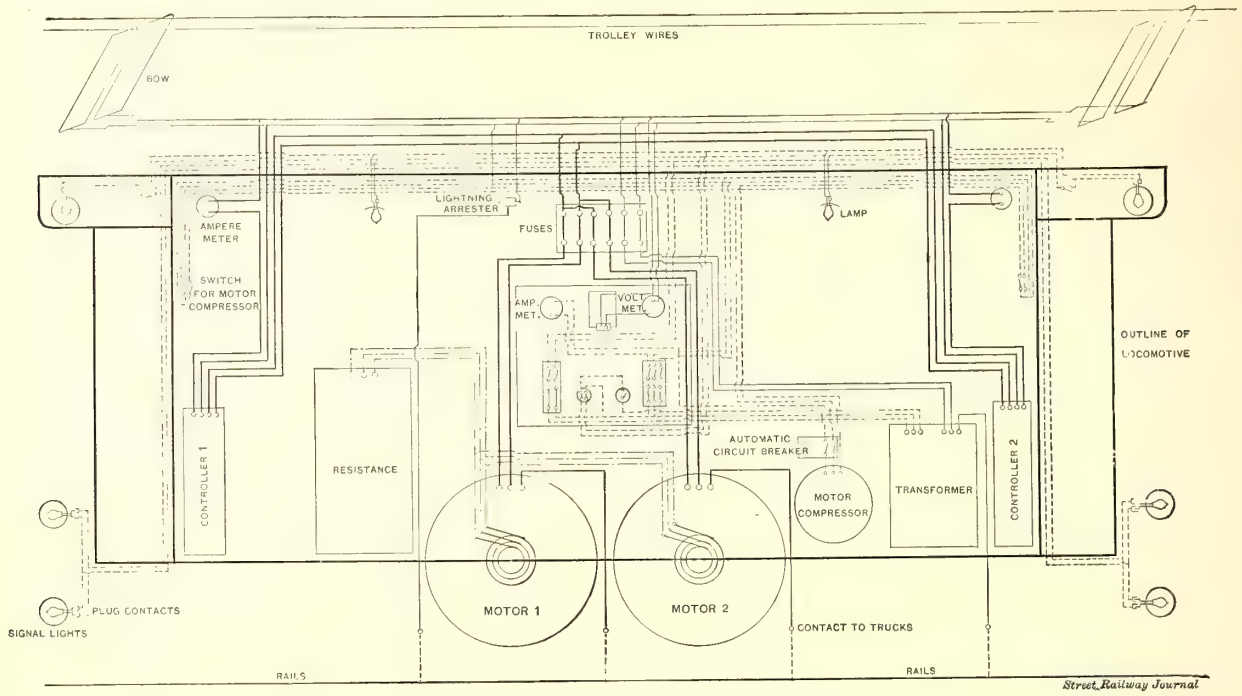
STANDARD DOUBLE-TRUCK MOTOR CAR

To measure the current used each car carries an ammeter for the motor circuit, one for the motor compressor circuit, and a voltmeter for the 750-volt circuit. This apparatus is carried on a panel on one side of the locomotive.

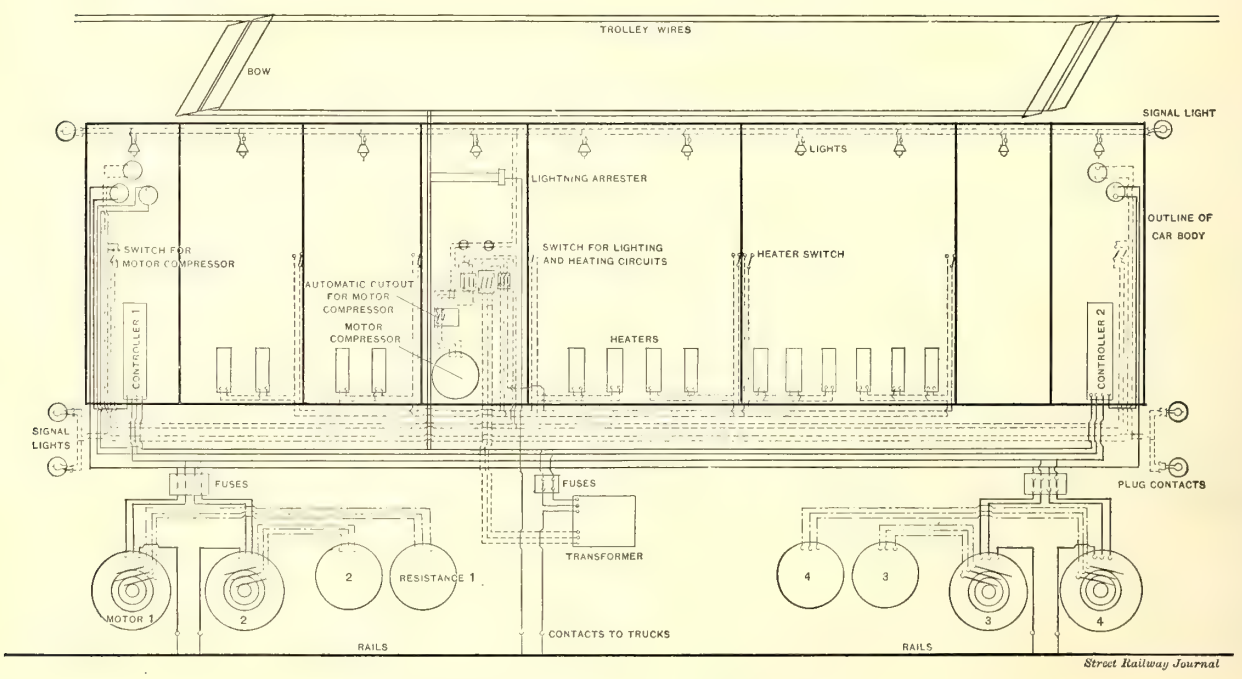
Lightning arresters are placed on both trolley circuits where they enter the cars, and are of the Wurts type. Electric headlights, made up of three lamps, are used, but the

cars also carry oil headlights for emergencies. The principal dimensions of the locomotives are as follows: wheel base, 3 m.; length of body, 6 m.; length between buffers, 7.2 m., and diameter of wheels, 1.3 m. Weight of locomotive equipped, about 28 tons.

The motor cars are six in number, are of the double-truck type, and have the following principal dimensions: length of body, 12.2 m.; width of body, 3.05 m.; distance between centers of trucks, 9.5 m.; wheel base, 2.2 m.; diameter of wheels, 1.02 m., and length over all, 16.3 m. Four 55-h.p. motors are carried on each car, one for each axle. The motors run without load at about 600 r.p.m., and with load at 586 r.p.m. Each motor is equipped with a starting rheostat and controllers similar to those on the locomotives. On the platform are also a hand-brake handle, the triple valve operating the air brake, and above the motorman, about on a level with his head, is a small panel carrying the ampere meters and voltmeter, connected with the 750-volt circuit. Close at hand also are the switch for controlling the motor compressor and pump, and a handle for operating the whistle from the air reservoir. The electrical equipment of the motor cars is similar to that of the locomotives, and includes a 750 100-volt transformer for operating the motor compressor, the lights and the heaters. The motor compressor, its automatic cut-off and the motor fuses are carried in boxes under the cars, and adjoining the body sills.



ELECTRICAL DIAGRAM OF LOCOMOTIVE



ELECTRICAL DIAGRAM OF MOTOR CAR

To lower the sliding contact bows a short cord is fixed to the upper end of the bow, and connected at its lower end to a short wooden pole, which is normally carried against the side of the car in spring clips. In the middle of the cord is a strain insulator, making it perfectly safe to draw the bow down, even in wet weather. When in a horizontal position the end of the bow catches in a small pawl on the roof, which holds it in position.

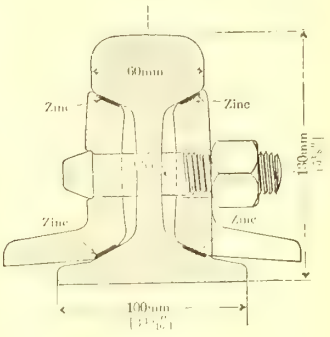
The cars have a central aisle, and are divided into four

compartments, of which two are second-class and two third-class, and carry a total of sixty-eight passengers. The weight of the cars fully equipped is 32 tons.

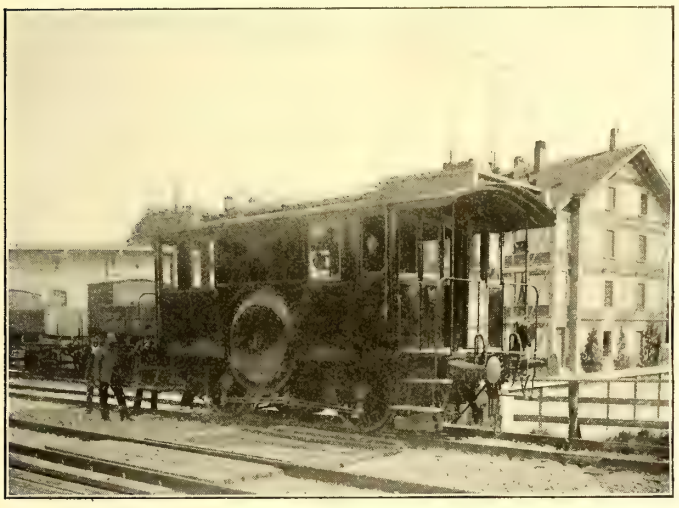
cars, carrying forty passengers, and one two-axle combination passenger, postal and baggage car, carrying twenty passengers. The several engravings herewith show the



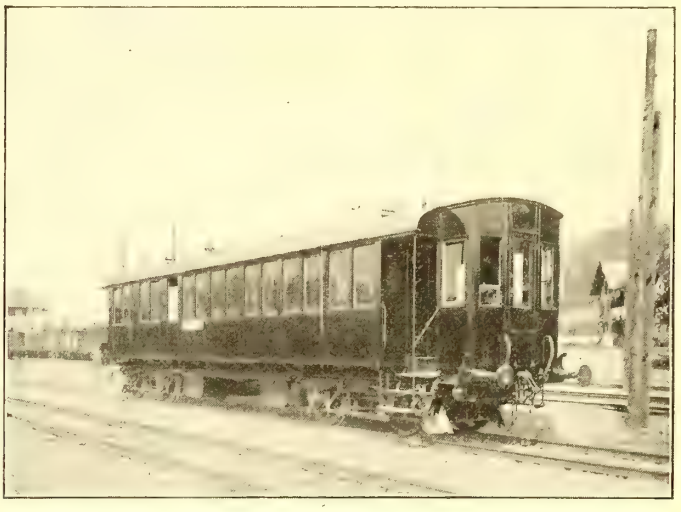
COMBINATION BAGGAGE, MAIL AND PASSENGER CAR



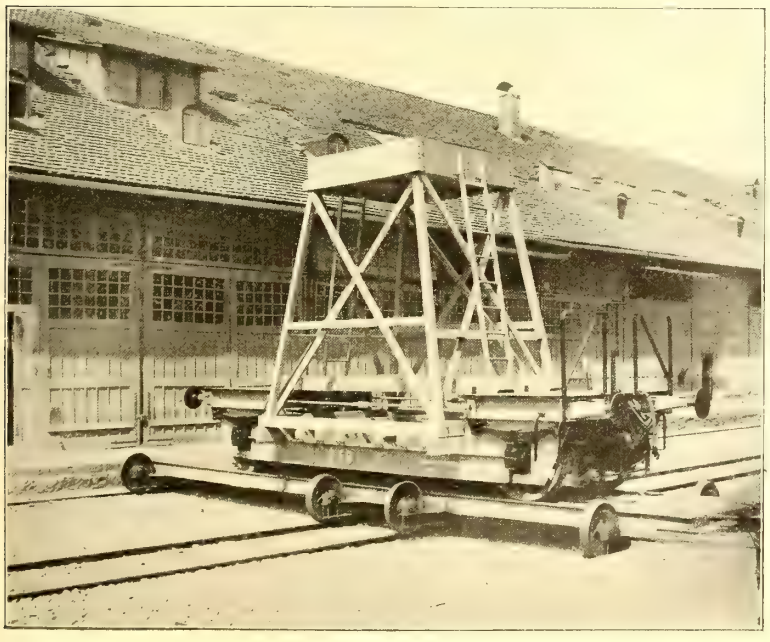
SECTION OF RAIL, SHOWING METHOD OF BONDING



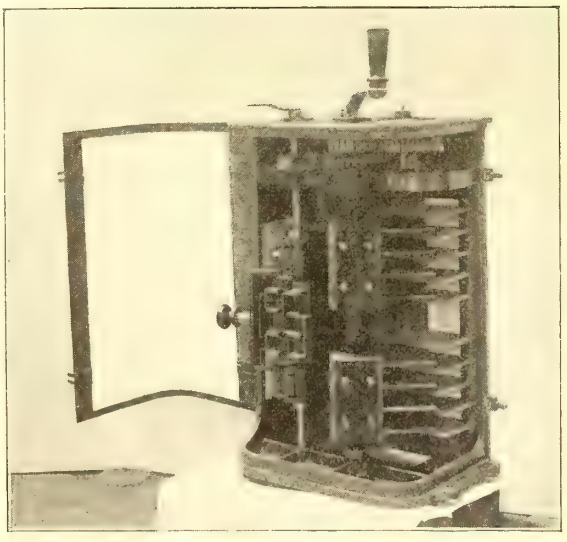
LOCOMOTIVE



MOTOR CAR



CONSTRUCTION CAR

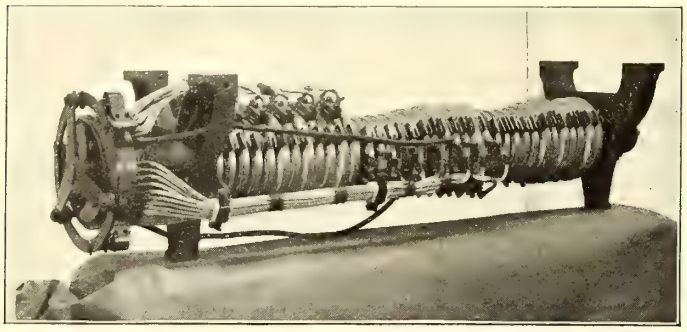


CONTROLLER FOR MOTOR CAR AND LOCOMOTIVE

The trail cars are of five different types, as follows: two two-axle cars for second and third-class traffic, carrying fifty-five passengers; two two-axle cars, third-class

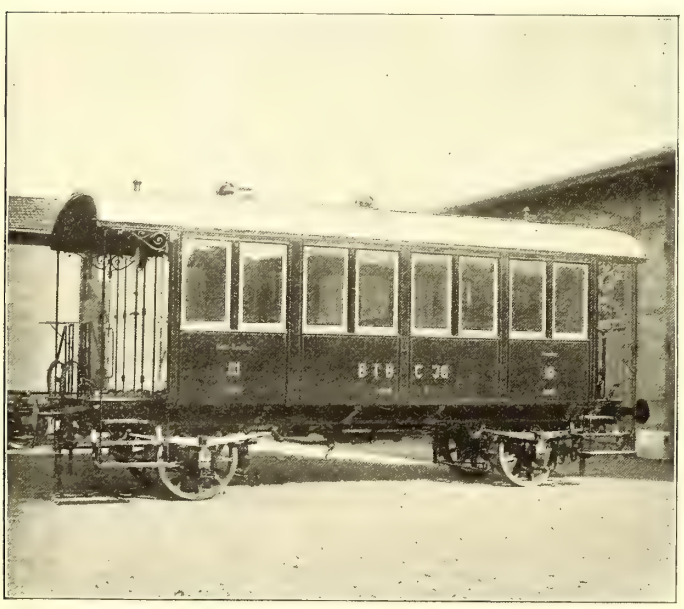
different types adopted. A special car for construction work, as well as for the transportation of transformers, is also illustrated.

As the cars are operated on a three-phase system, a constant speed of 36 km. per hour is maintained. The cars



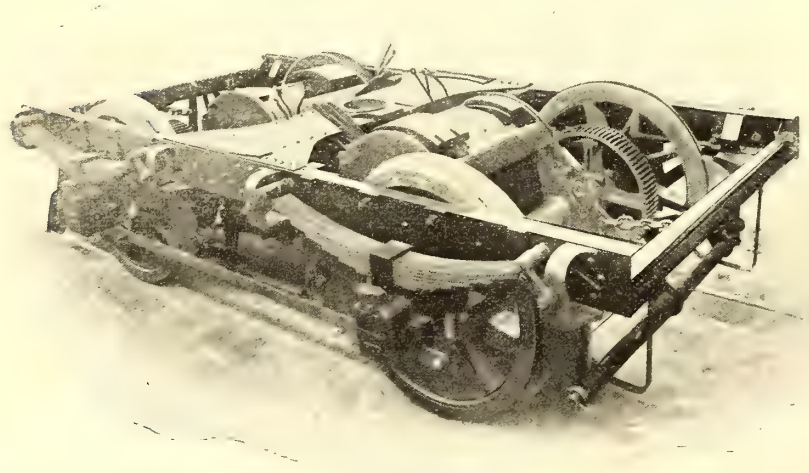
RESISTANCE FOR 60-H.P. MOTOR FOR MOTOR CAR

can be braked quickly, and stop in from three-quarters of a minute to one minute. The train service is conducted by



TRAIL CAR

ordinary steam railroad methods and on the block system. The stations are connected by telegraph, the wires of



STANDARD DOUBLE TRUCK WITH MOTORS

which are carried on the same poles with the trolley wires. Each train consists usually of one motor car and one trail car. If the traffic is too great to be accommodated on these two cars a second motor car is added, because one motor car will not draw more than one trailer. The freight trains operate at 18 km. per hour. In descending grades, the motorman is permitted to let the train speed up to 40 km. for passenger trains and 20 km. for freight trains per hour, when behind time.

Before the opening of the line the system was thoroughly inspected by the federal inspectors, who made tests of the braking system. These seem sufficiently interesting to be reproduced, and are given below.

Train Made Up of	Brakes Applied	Grade in per Cent.	Speed in km. per Hour	Distance Run Before Stop, in Meters
2 motor cars and 1 trail car.	2 hand brakes.	2½	36	100
" " " " "	" "	2½	40	122
" " " " "	Air brake.....	2½	35	53
" " " " "	" "	2½	38	61
" " " " "	" "	...	30	38
2 motor cars and 2 trail cars.	2 hand brakes.	2½	40	125
" " " " "	4 " " ..	2½	30	76
" " " " "	Air brake.....	2½	36	64
" " " " "	" "	2½	38	77
" " " " "	" "	2½	38	76
1 locomotive and 100-ton train	4 hand brakes.	2½	18	80
" " " "	" "	2½	18	85
1 locomotive and 50-ton train	" "	2½	36	128
" " " "	Air brake.....	2½	36	90
" " " "	" "	2.1	36	108
" " " "	" "	2.1	36	76

The power consumption for starting gave the following results: with one motor car and one trail car, on a 2½ per cent grade and a straight track, the current reached 260 amps. with 760 volts, although on a curve of 250-m. radius and a 2½ per cent grade the same trial took 330 amps. at 850 volts. The maximum consumption of the electric locomotive during the time of trial, with a complete train of 50 tons, at 36 km. per hour, never exceeded 300 amps. at 700 volts. It has been found not advisable to run two trains of cars at the same time in a section fed by one transformer. With two trains, the trains should be six minutes apart, and with three trains of the same size the headway must be about ten minutes.

In conclusion, I will mention the principal contractors. All the electrical apparatus for the railway was furnished by Brown, Boveri & Company, of Baden. The locomotives, so far as the mechanical construction is concerned, were supplied by the Fabrique Suisse pour le Construction de Locomotives, of Winterthur. Finally, the rolling stock was supplied by the Société Industrielle Suisse, of Neuhausen. The turbines at the power station were furnished by Escher, Wyss & Company, of Zurich. The credit of having carried this work through to a successful completion belongs principally to Mr. Dinkelmann, of Burgdorf, a member of the Federal Council and manager of the Ementhalbahn, who gave great personal attention to the construction of this line, of which he is now the manager.

The terminal station of the Staten Island Electric Railroad Company, adjoining the ferry house and station of the Staten Island Ferry and Staten Island Rapid Transit Railroad Company, at St. George, was destroyed by fire Nov. 11. Five cars, which were in the building at the time of the fire, were gotten out without damage.

Subway at Kingston

A very interesting piece of construction work, by which a five-track grade crossing with a steam railroad was avoided, has recently been completed by the Colonial City Traction Company, of Kingston, N. Y. The work is unique so far as is known in the history of small electric railways in the country, for the Colonial City Traction Company owns only fourteen cars, and may be an important suggestion to other companies placed under somewhat similar conditions.

The circumstances which led up to the construction of this subway were as follows: The city of Kingston is intersected by the West Shore Railroad, and possessed up to a few years ago but one railway company, whose line crossed the railroad tracks on grade at right angles. The Colonial City Traction Company was organized as a competing line. Franchises were secured and about two miles of track were built on each side of the city down to the crossing. An effort was then made to secure the right of crossing the West Shore tracks on the tracks of the existing company for a distance of 800 ft., but this was refused by the latter company. The Colonial City Traction Company then (in 1896) went to the Supreme Court for privilege to condemn the right of way over these tracks, and won the suit. The case was appealed, however, by the existing railway company, and carried to the Appellate Division of the Supreme Court, which decided that the consent of the municipal authorities and of the abutting property owners were prerequisites to the action, in this way reversing the decision of the lower court. The question was then carried up by the new company to the Court of Appeals, which sustained the last decision. The Colonial City Traction Company then secured the permission of the authorities, but were unable to obtain that of the property owners. Under these circumstances a request was made to the Appellate Division to appoint commissioners to decide whether the property owners for these 800 ft. were unreasonable in withholding their consents; the commissioners found in favor of the new road. These suits created much interest at the time, as deciding important legal questions, and were commented upon in an extended way in the STREET RAILWAY JOURNAL. During the final litigation, however, a compromise was reached between the two railway companies, by which the Colonial City Traction Company, instead of crossing the West Shore tracks on the tracks of the existing company, agreed to divert its route a short distance to the north, and build a subway under the West Shore tracks, thus connecting its two existing sections.

The covered part of the subway is 220 ft. in length, with approaches of 130 ft. on the east side and 160 ft. on the west side. The sides of the subway under the West Shore Railroad tracks are of first-class bridge masonry, and elsewhere are first-class rubble masonry. The subway station is faced with white enameled brick; the roofing is of open-hearth steel troughs, with a tensile strength of 60,000 lbs. per square inch. The plates and angles composing the troughs of the solid floor system were covered with asphalt, mixed ten parts asphalt and thirty parts coal tar pitch. The bottoms were then filled with a binder composed of ¼-in. clean, sharp gravel and No. 4 asphalt paving composition,

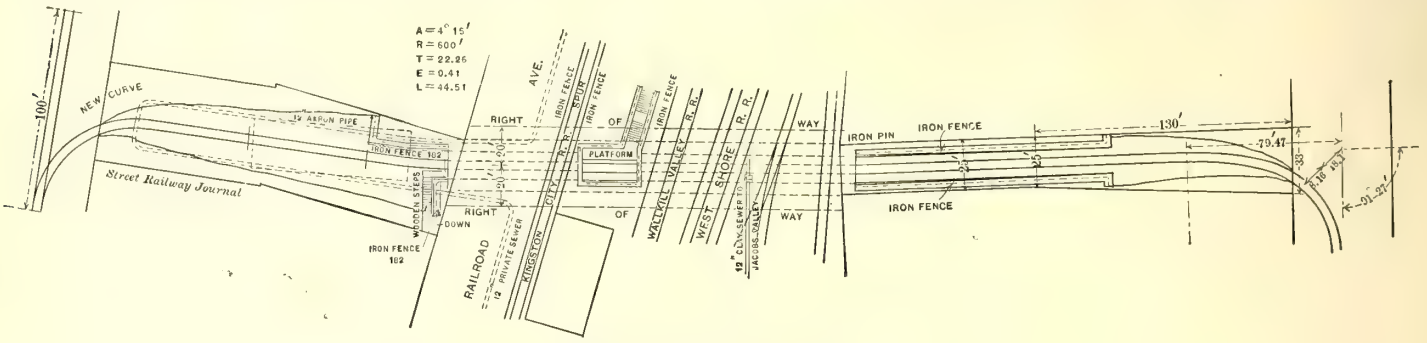


STEPS TO ELECTRIC RAILWAY PLATFORM



ENTRANCE TO SUBWAY FROM WEST SHORE STATION, KINGSTON

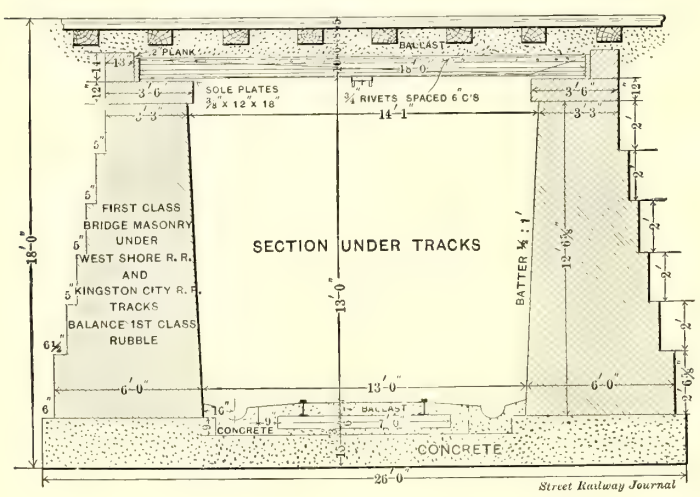
in the proportions of 1 cu. ft. of gravel to 1 gal. of paving composition. There is an entrance to the subway from the platform of the West Shore Railroad Company. This has proved a great convenience to passengers and a means through which the company has added greatly to its traffic, as will be described later. The entrance to the West Shore station is fitted with handsome hand-rails of heavy brass pipe of 2 ins. in diameter, and all stone work is of North River blue stone.

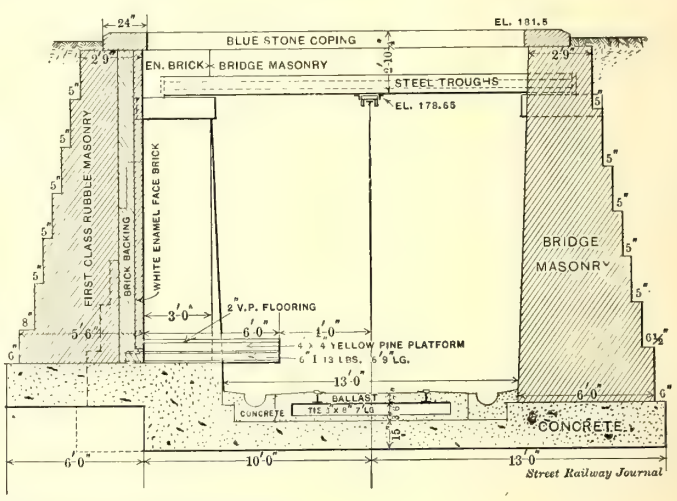


GENERAL PLAN OF SUBWAY

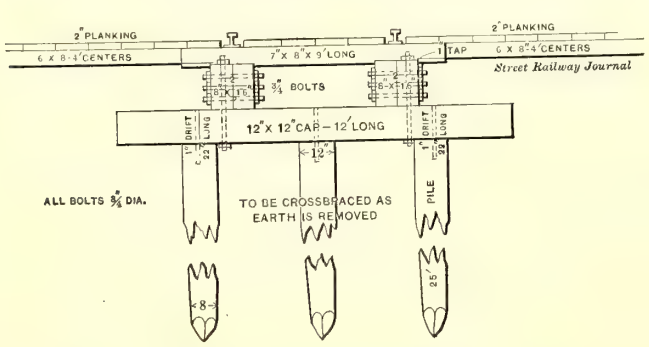
Work on the subway was commenced Aug. 22, 1898, and the first car ran through it on March 19, 1899. The work was carried on without any delay to the traffic on the West Shore Railroad. The method of supporting the tracks on the latter is illustrated on this page. Before any excavation was made within the West Shore right of way a temporary trestle was constructed by driving 25-ft. piles between the tracks. These piles were white oak and not less than 8 ins. on the top and 12 ins. diameter at the butt. After being driven they were capped by 12-in. x 12-in. yellow pine caps, secured to the piles by wrought iron drift pins 1 in. square and 22 ins. long. On these caps were laid the track stringers, which were of yellow pine 8 ins. x 16 ins., and long enough to cover two bents in the trestle. Two stringers were placed under each rail and decked with cross-ties. The entire deck was then covered with 2-in. yellow pine plank, as shown in the sectional view. This supported the tracks while the excavation for the subway was being made.

The method of conducting current to the cars in the subway was another problem, and that first employed is illustrated in section on page 863. It consisted of T iron, 2¼ ins. x 2¼ ins. x 5/16 in. thick, lag-screwed to an 8-in. x 1¾ in. white pine plank, which was held to the roof girders by angles. The plank was protected on the edges by 1-in. x 3-in. timbers, held to the upper plank by wood screws, making a trough to catch the trolley in case it should jump from the conductor. A rubber cushion 3 ins. x 3 ins. x 3/16 in. was used between the conductor and the trough. This construction proved, however, to be too rigid and noisy, in spite of the precautions taken to prevent trouble of this kind, and has since been changed to ordinary trolley wire carried on hangers.

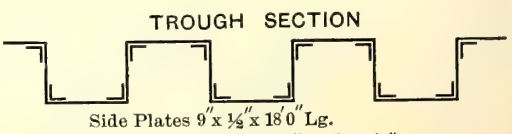




SECTIONS OF SUBWAY UNDER TRACKS AND AT ENTRANCE



SECTION OF TEMPORARY STRUCTURE FOR SUPPORTING STEAM RAILROAD TRACKS

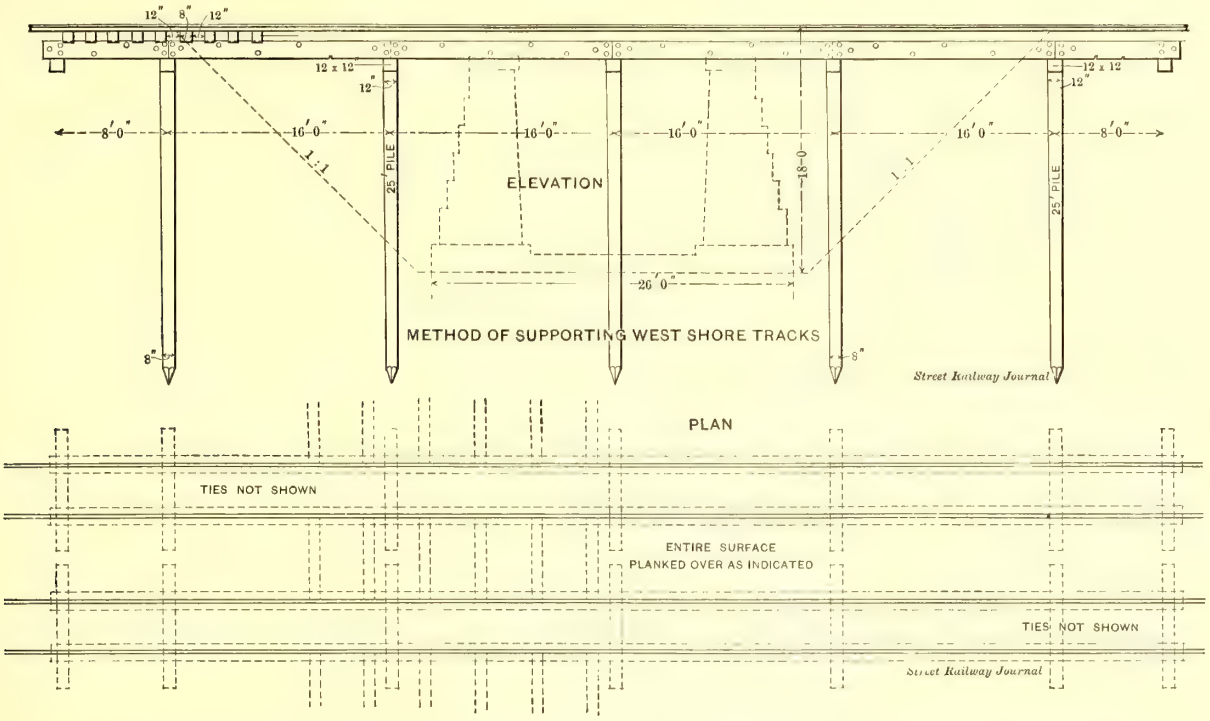


Side Plates 9" x ½" x 18′ 0" Lg.
Top and Bot. Plates 14" x 9/16" x 18′ 0" Lg.
Angles 3" x 3" x ½" x 18′ 0" Lg.
Rivets ¾" D. and 6" Centers.
Troughs Filled with Asphalt Comp.

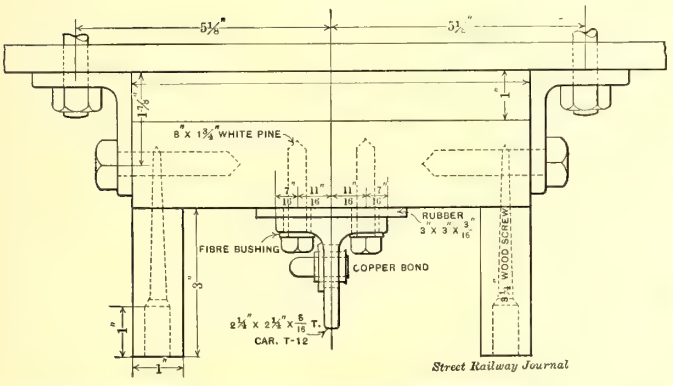
SECTION OF ROOFING

Before the subway was completed and during its construction passengers were transferred from one section of the road to the other, across the West Shore tracks, by bus. The completion of the subway was naturally fol-

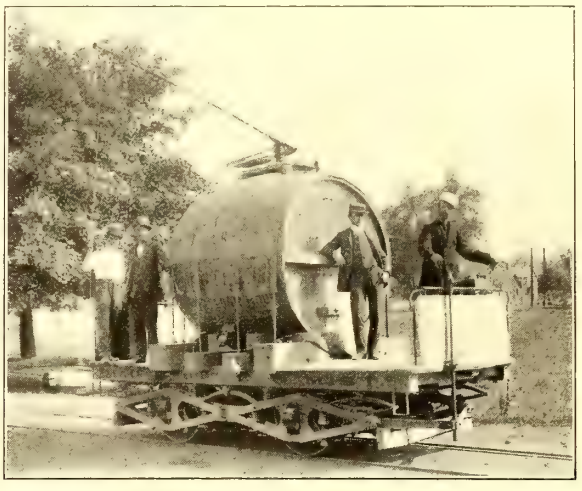
lowed by large increase of traffic, partly because the line was now a continuous system and also partly because of its corresponding period a year ago. The entire cost of the subway was about $28,000.



SIDE ELEVATION AND PLAN SHOWING METHOD OF SUPPORTING STEAM RAILROAD TRACKS



ORIGINAL METHOD OF ATTACHING CONDUCTOR TO ROOF



HOME MADE SPRINKLING CAR



STANDARD 18-FT. CROSS-SEAT CAR

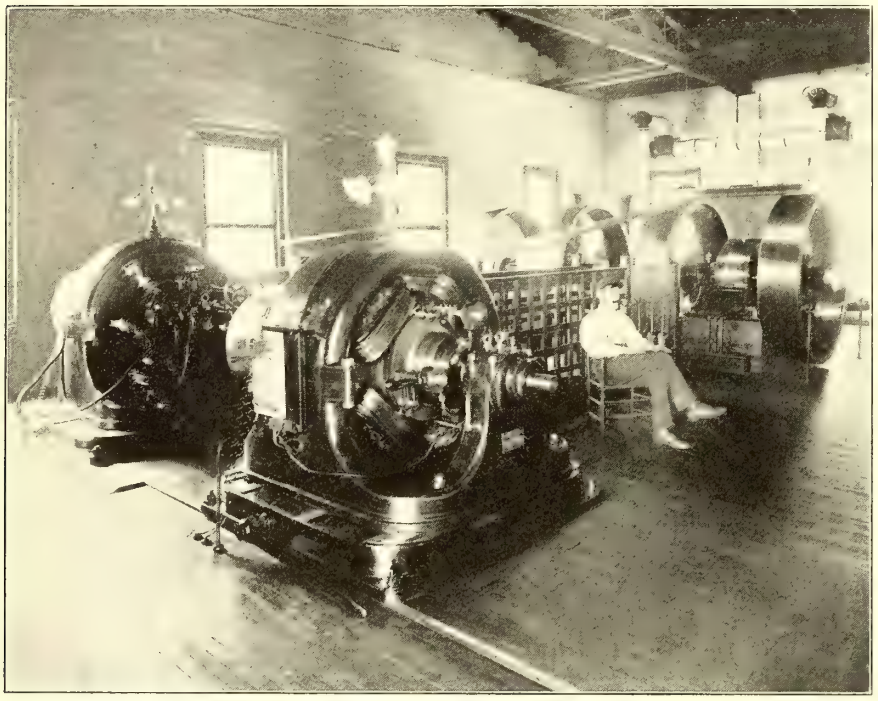


ENTRANCE TO SUBWAY

proximity to the only railway station in the city. As a result, the gross receipts of the company have increased 75 per cent during the past six months, as compared with the

The system of the Colonial City Traction Company has interesting features besides the subway. As Kingston has a population of only about 30,000, and there are two lines

in the city, the keenness of competition makes each company put forth every effort to secure as much traffic as possible. Considerable popularity has been secured by the Colonial City Traction Company through the opening of its subway. Another step to secure traffic was the introduction of cross-seat cars, which have proved very popular. The amount of traffic did not require long cars, so the experiment was tried of using cross seats in an 18-ft. closed car. There are six seats on a side, and a view of one of these cars, which were built by the Pullman Company, is illustrated herewith. The company has in all seven closed and six open cars, mounted on Peckham and Diamond trucks. G. E.-800 motors are used under the former and Westinghouse 49 motors under the latter. The open cars



INTERIOR OF ENGINE ROOM

are of the ten-bench type, and were built by Jackson & Sharp.

Another novelty in car construction is the sprinkler car illustrated. This was gotten up by the superintendent of the company, C. Gordon Reel, at a cost of $65, and consists of a large beer barrel holding 1600 gals., purchased of a local brewer for $10, and mounted on a platform car. The cost of the sprinkler, fittings, etc., which were all home-made, brought the cost up to that stated. In winter this car is fitted with nose plows and used for a snow plow.

The power station is located at the eastern end of the line on the Hudson River, and contains two 150-h.p. Ball & Wood tandem compound condensing engines belted one to a 125-kw. and one to a 150-kw. Westinghouse generators; the two generators are run in parallel. The condensers and pumps are of the Worthington type, and there are two Sterns tubular boilers of 300 h.p. each. Eighty-lb. girder rails are used. The improvements described had an excellent effect on the increase of traffic of the railway.

The road is now in the hands of and operated by a reorganization committee consisting of John I. Waterbury, Chas. M. Preston and August Belmont, with C. Gordon Reel as superintendent. Mr. Reel was formerly connected with the Lindell Railway, of St. Louis, but assumed control of the Kingston road in November, 1896. The receipts have increased 75 per cent during the last year, with an increase in car mileage of 15 per cent and a decrease in operating expenses over 1898 of $6,000 (from $35,000 to $29,000). The cars are now earning about $20 a day on an average of fifteen hours each. The electrician of the company is C. J. McNelis, and Francis Gaffney is the chief engineer of the power station.

Result of Low Fare Experiment on the Chicago General Railway System

The Chicago General Railway Company has been for some time past trying some very interesting graded fare experiments on certain portions of its system. By reference to the colored map of Chicago in the Street Railway Journal for October it will be seen that this company's lines consist of one main stem, running from Wabash Avenue and Twenty-second Street, a distance of about 2 miles from the general postoffice in Chicago, through Twenty-second Street west to Fortieth Avenue, together with a number of comparatively short branch feeders running south from this main stem on Lawndale Avenue, Kedzie Street, Throop and Laurel Streets (to the Union Stock Yards), etc.

A single fare of five cents, with full transfer privileges, is charged on the entire system, or tickets, six for a quarter, are sold with the same privilege. On the branch lines a 2-cent fare without transfer privilege is charged, and twelve tickets are sold for 20 cents. These branch lines are little less than 3 miles in length. Transfer tickets are issued at the time that the fare is paid.

For the first eight months of the present year the Chicago General Railway system was operated on a straight 5-cent fare. The graded fare system has since been in use, and in September and October the gross business showed an increase over the average for the eight previous months of 28 per cent, without materially increased expenses. It is further stated as an interesting fact that on the four lines the company now receives a larger number of 5-cent fares than were taken in before the tickets were sold.

The Berlin Elektricitäts Werke, which supplies current for all the electric railways of Berlin, is the largest electric power company in Europe, and one of the largest in the world. It owns five separate power stations with a total of 43,000 h.p., which will be raised to 61,000 h.p. as soon as the extension, which is now in course of erection, is completed The central stations in the Spandauerstrasse, Mauerstrasse and Schiffbauerdamm form only a part of the electrical supply system. An idea of the total capacity of the system can be obtained from the following table, which gives the maximum capacity of the several stations, all of which are connected together by a net of feeders:

	H.P.	KW.
Central station at Schiffbauerdamm	14,500	9,500
Central station at Spandauerstrasse	11,200	7,400
Central station at Mauerstrasse	9,300	6,100
Central station at Markgrafenstrasse	2,100	1,400
Central station at Oberspree	6,000	4,000
	43,100	28,400

According to these figures the capacity of the Schiffbauerdamm station alone is nearly as great as that of the largest German central station at the present time, and as soon as the 30,000 h.p. additional equipment is installed, the capacity will exceed even that of the power station at Rheinfelden, also installed by the Allgemeine Elektricitäts Gesellschaft.

Overhead Line Construction IV

BY ALBERT B. HERRICK

Erecting and Testing Feeders and Setting Poles

It is usual to run two feeders from one circuit breaker in the station to each continuous section, but considerable money can often be saved by combining two feeders into one, giving one equivalent cross section of the two. For instance, 2 miles of triple braided No. 0000 wire weigh 8184 lbs., of which about 1600 lbs. is insulation. If now, a single 450,000 c.m. cable were used instead, it would weigh 8992 lbs., of which only 1000 lbs. is insulation, and the drop of this mile transmission would be lower by 8 per cent than with the two No. 0000 feeders. The tendency in modern line construction is to use larger and fewer feeders, both on the score of line cost, location of weight on pole, and copper economy.

The insulation generally used on wires is known as weatherproof, and it consists of two or three braidings of jute, which should be thoroughly impregnated with a water-proofing compound. The covering and compound should be tough enough to resist considerable abrasion, and there should be no decrease in insulation resistance with 110 volts, after several hours immersion in water.

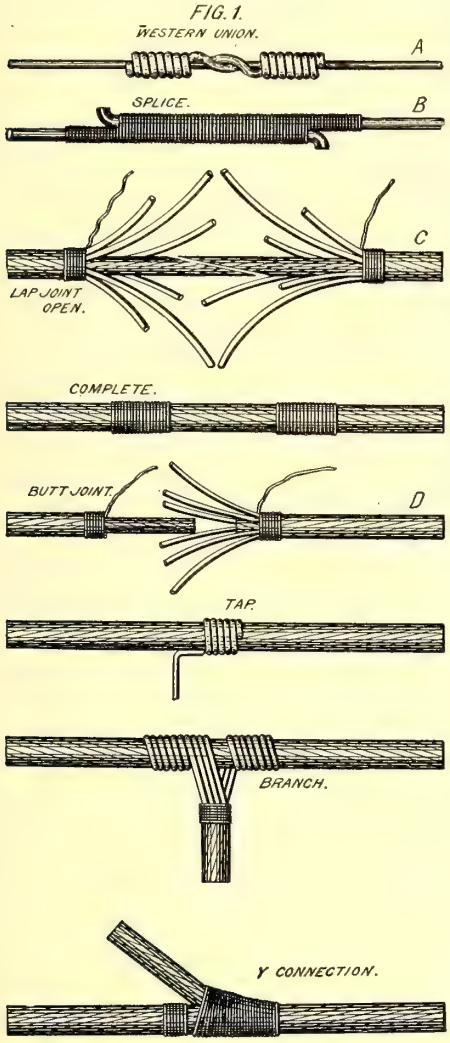
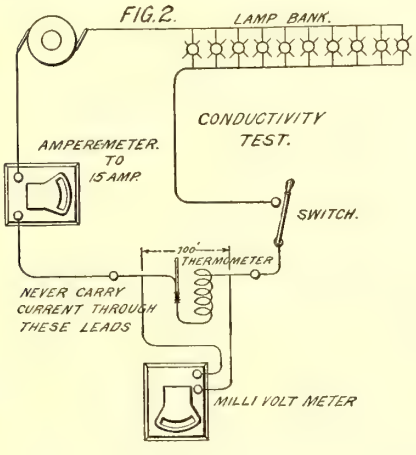


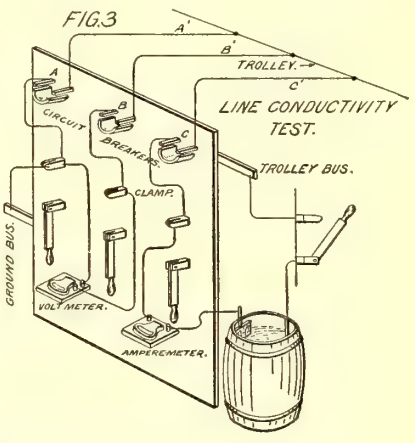
FIG. 1.—METHODS OF MAKING FEEDER JOINTS

It has been the practice in the past to tin the wires of stranded cables. Tinning increases the resistance of the wire, for the tinning combines with the surface copper, and the effect is to slightly reduce the conductivity of the wire. There is no reason for tinning copper where weather-proof covering is used, except where the feeder is exposed to salt sea air, and in mining districts where the air is laden with corrosive gases. Where cables are spliced it is very easy to tin the strands before making the splices.

The ordinary Western Union joint, shown at A in Fig. 1, is satisfactory where the wires are No. 0 or smaller. Good results, however, are not obtained with this joint when the wire is larger than No. 0. The best joint in such cases is made by turning the ends sharply at right angles, paralleling two wires, wrapping with No. 12 copper wire, and then soldering the joint, as shown at B. Solder is usually poured over a joint of this kind, but care should be taken that the wire is hot when the soldering is done. The best way to heat the joint is to use blow lamps, placing the joint on a board. With a little experience the best results may be obtained with resin as a flux, but soldering acids and compounds are generally used. The lap of the two wires on this splice joint should be at least twelve times the diameter of the wire. If properly soldered, this joint will then be as strong as any other part of the cable. Exposed joints should be served with at least four layers of adhesive tape, so that the joint will be as well protected as the insulated wire. A splice in stranded cables is usually made by interweaving the strands of the two cables Several methods often employed are shown at C and D (Fig. 1), but to make the joint electrically satisfactory each wire should be separately tinned before the two cable ends are interlaced. The connection is then served with No. 20 copper wire, as shown.

The conductivity of the copper is of vital importance, of course, and, if desired, it may easily be tested to a fraction of 1 per cent. The necessary instruments are a reliable amperemeter, reading by 50 amps., a millivolt meter, and a thermometer, see Fig. 2. If we produce a flow of 10 amps. through a conductor 100ft. long, the millivolt meter should read 481 millivolts in measuring a No. 0000 wire, or under these conditions each .0001 of an ohm will produce one millivolt deflection, provided the temperature of the wire is 60 degs. F., and the conductor has 100 per cent conductivity of pure copper. In case the temperature of the air is below 60 degs. the thermometer should be placed in contact with the wire, then pass the current through it for a few minutes until the thermometer records slightly above 60 degs., then cut the current off. The thermometer should then be watched until it falls to 60 degs., after which the millivolts drop with current flowing again may be read. To make this method a success, it must be borne in mind that the current should never be carried into the conductor through the contacts taking the drop for the millivolt meter.





FIGS. 2 AND 3.—CONNECTIONS FOR TESTING CONDUCTIVITY OF LINE

As the conductivity of copper changes .00226 for each degree F. the readings for any other temperature of the conductor than 60 degs. F. can be reduced to the standard temperature resistance. We may then divide the standard resistance of the copper by the measured resistance obtained, and thus get the percentage conductivity required. For methods of setting up these tests, see Fig. 2, and for standard resistances see eleventh column of copper table, August issue STREET RAILWAY JOURNAL.

The conductivity test is, of course, useful for the pur-

chase of conductors and to see whether the specifications have been complied with, but the actual line resistance is often of value. The apparatus required for this test is a water barrel rheostat, an ammeter reading about 100 amps., a voltmeter reading about 250 volts, and two connectors that will fit the jaws of a feeder switch and be capable of carrying a load of about 50 amps. The connections are shown in Fig. 3. It will be noticed that the current

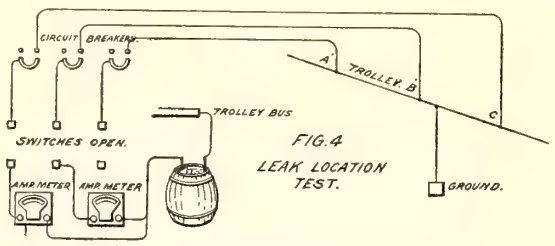


FIG. 4.

LEAK LOCATION TEST.

FIG. 4.—CONNECTIONS FOR LEAK TEST

passes from the water rheostat through the ammeter, out through feeder C to C', along the trolley line to A', and back to the station to the ground bus through the jaw of switch A. Now, if the voltmeter pressure between A and B and the current flow are known, then the volts divided by the current will give the resistance of the feeder C and

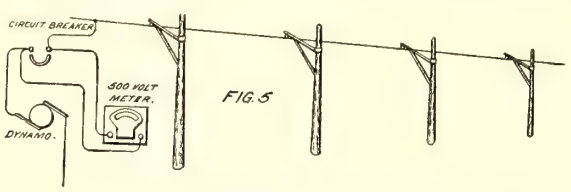


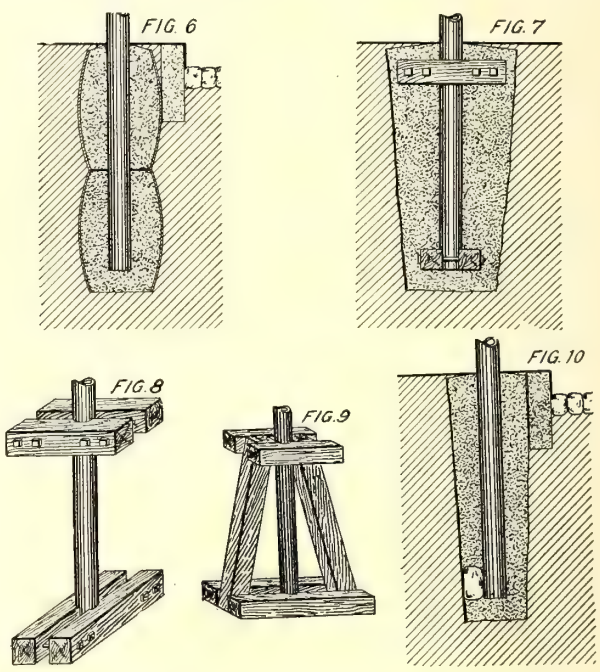
FIG. 5.

FIG. 5.—CONNECTIONS FOR LINE INSULATION TEST

that of the trolley line from C to B. Similarly the pressure between B and C, when divided by the current flow, will give the resistance of the trolley wire from B' to A', and the resistance of feeder A. By shifting the ground bus to the jaw of switch for feeder B, and again putting the load on the system, the volts dropped between A and B, divided by the current flowing, will give the resistance of feeder B. This principle can even be applied to complicated overhead feeder systems which can be temporarily tied together by putting jumpers around the line circuit breakers, and all the electrical data from the overhead line to the power station, can be determined. It is then easy to locate also from the power station grounds or leaks on the line. This requires the use of the water barrel rheostat, the two ammeters and the connections to fit the switch jaws, as in the previous test. The connections used are those shown in Fig. 4. If the leak is considerable, the feeder ammeters will show its approximate location by the irrelative readings, but if the current is slight, low reading ammeters will have to be used.

As an example, supposing it be found that the resistance of feeder A was .15 ohms, that of feeder B .3 ohms, and the trolley wire between A and B .25 ohms; the total resistance of this circuit would then be .7 ohms. It will be noticed that the current can take two paths to the leak, but the resistance of the leak is common to both circuits, consequently the current will pass to this leak through the circuits in the proportion that the resistance of these two circuits bear to each other. Suppose the readings on the two ammeters show that for the circuit A 20 amps. pass, and that for the circuit B 12 amps. pass, the total current flow being 32 amps. Then for A we have the proportion, 32 amps. is to 20 amps., as .7 ohms (the total resistance of the circuit) is to X, (the resistance to the point of leak). For the B circuit we have, 32 is to 12 as .7 is to X. Solving these gives for the circuit through A, .437 ohms, and through B, .2625 ohms. Subtracting the known resistance of B feeder from the resistance of B circuit gives .0125 ohms, from the end of B to the ground, and subtracting from the A circuit the resistance of A feeder (.437—.15) leaves .287 ohms, beyond the end of A feeder to the ground. If we know that the length of the trolley from A to B is (say) 2400 ft. and of uniform cross section, we may divide the resistance of this length by its length, or .3 ohms by 2400 ft., which is equivalent to .000125 per ft. If this resistance per foot is divided into the found resistance from B to ground, or .0125 ohms, we have 102 ft. from B. The same calculation on the A circuit would give 2296 ft., which is the distance from A. Any other leak on the system can be located by removing the ground connection from the ground bus, and applying it to any other feeder terminal with all the feeder switches open. A connection to each independent section will then show if there is a leak.

The practical test for line insulation resistance is to make the test after the line is erected, by the method shown in Fig. 5. Open the station circuit breaker and across the terminals of the open breaker place the leads to a 500 volt



FIGS. 6-10.—METHODS OF SETTING POLES

meter. Of course all circuit breakers feeding in this section must be opened, and all lamp circuits on this section disconnected, otherwise the voltmeter continues to read bus voltage. The voltmeter will show when all circuits are open (this also makes a good method of determining in an unknown system of wiring, which feeders are connected together). When a steady deflection of the voltmeter is obtained on connecting across the open breaker the resistance of the line can be found by multiplying the voltmeter resistance by the bus-bar voltage at the time of making the observation, dividing this product by the volts shown by the voltmeter when connected across the open circuit breaker, and subtracting from this result the voltmeter resistance. It must be remembered that the leakage is that of the total connected system, and not that of the feeder connected.

These tests can be made to determine the differences in resistance due to dry, rainy or foggy weather. Tree grounds can also be detected on rainy and windy nights, by the violent variation of the line insulation resistances.

In previous articles we have considered poles, feeder insulators, and feeders, their proper size and character. In

natural order the next question is that of setting the pole. With wooden poles the depth of setting is determined by the line strains, but roughly the pole is set 18 per cent of its length in the ground. For wooden poles the hole should be dug of as small diameter as possible with convenience in digging. In clay ground it should not be larger than 15 ins. at the bottom and 20 ins. at the top. A foot-stone is generally placed at the bottom of the pole on the side opposite from where the strain will fall on the pole. The earth should be well tamped around the pole, and only a few inches of earth should be thrown in at a time. The life of a pole can be considerably prolonged by treating it with creosote. Painting the butt of the pole with pigment, which does not enter the pores of the wood decreases, rather than increases, the life of the pole. Where sandy ground is encountered, such as will not well support a pole, barrels may be buried one upon another, and the pole set in these barrels, as shown in Fig. 6; where iron poles are to be set in concrete in very sandy soils, the same method can also be used.

Poles buried in marshy grounds have to be provided with a structure which will increase their bearing areas; Figs. 7, 8 and 9 show common methods of these constructions. The support of the pole in soft ground has also to be assisted by head guides or brace studs.

In case of iron poles the surface presented does not give a sufficient bearing area against the soil to carry the strain which the pole is designed to resist, so concrete is used around the base to enlarge the foundation area between the earth and the pole. Fig. 10 shows the standard setting.

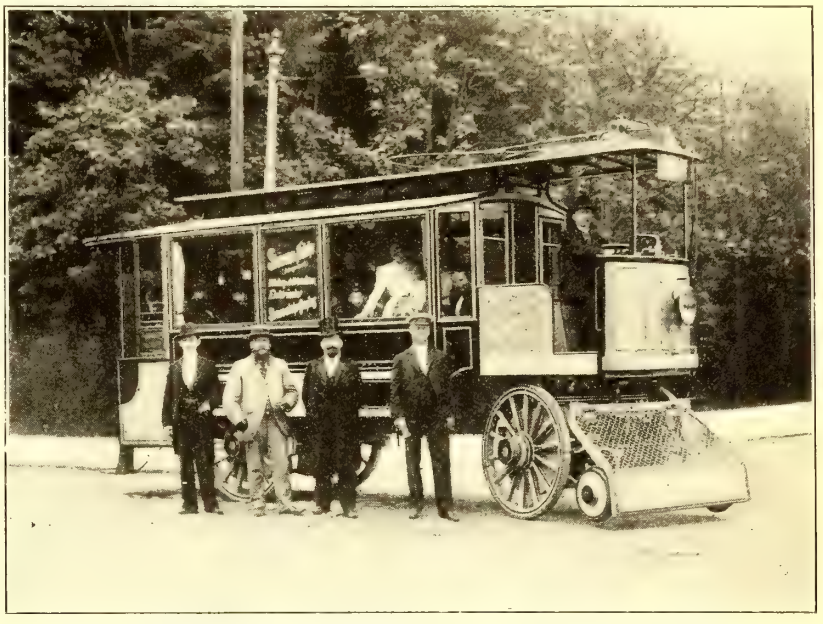
The concrete should be composed of one part Portland cement, two parts sharp sand, and four parts broken rock of the size to pass through a 2-in. ring in any direction. The sand and cement should first be thoroughly mixed together while dry, then enough water added to dampen the material and then turned until entirely mixed. The stone is then added and the whole concrete mixed together. Care should be taken that the hole in which the pole is set has fairly smooth sides, so that in tamping the concrete in place, dirt will not be knocked down and mixed with the concrete, and so destroy its usefulness. The setting of iron poles in marshy or loose ground requires about the same special structure as shown in Fig. 6.

Where hard stone is met in a few holes only, and in not sufficient quantity to warrant the use of a steam drill or dynamite, a piece of iron pipe slightly larger than the butt of the pole can be filed with teeth at one end, and by rotating this and feeding with emery and water, the hardest rock can be cut to the depth of 4 ft. in a few hours; the core can then be broken out with a chisel. Where concrete is mixed at one place and carted to the pole line it should be made very wet, and the slow setting variety of cements only should be used. Concrete should always be tamped until a smooth surface shows on the top.

The general standard of street railway employees for faithful service and fidelity to their trust has more than kept pace with the wonderful changes and improvements that rapid transit has brought about, and they will be found vying with their brethren in other pursuits in their devotion to the best interests of their employers.—From address at the Montreal Convention, 1895.

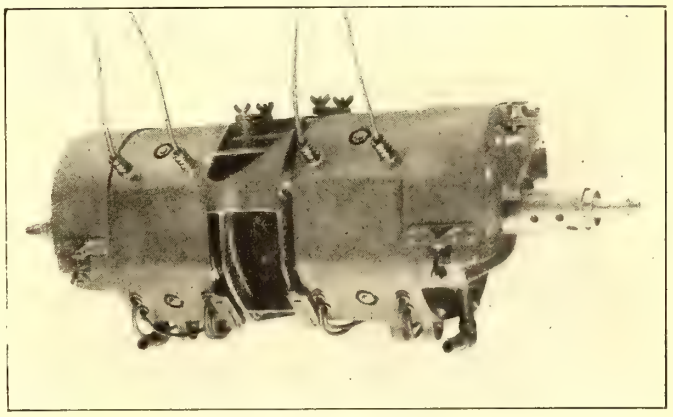
Combined Trolley Car and Omnibus

An exceedingly novel type of vehicle has recently been put in operation in Berlin, Germany, by the Siemens & Halske Aktien-Gesellschaft. The vehicle, as illustrated in the accompanying engraving, possesses the characteristics of both a trolley car and an omnibus. It is in reality an automobile omnibus, fitted with a trolley pole for taking current while running on the railway track and storage batteries, so that it can turn off the track or run in parts of the city where there are no tracks, if desired. It is therefore particularly useful in those cities where the importance of certain streets is such that tracks are not permitted upon them, or where by reason of their narrowness or the enormous traffic in them, the construction upon them of railway tracks is not feasible. The advantage of using the trolley circuit in places is, of course, that the storage battery can be made much lighter than if the omnibus was entirely an electric automobile, that when running on the tracks the traction resistance is less, and also that the batteries can be stored from the trolley circuit during this time, making it unnecessary to change batteries.



COMBINED TROLLEY CAR AND AUTOMOBILE OMNIBUS

To keep the vehicle on the tracks when operating as a trolley car, it is fitted with two guide wheels which run in front of the front driving wheels, and being flanged, keep the regular wheels on the rails. When the vehicle is turned



MOTOR FOR OMNIBUS

off the track these guide wheels are raised and the trolley pole is tied down, as shown in the engraving. The car can then be run in any direction desired. In outward appear-

ance, the vehicle differs from a horse omnibus only in that the rail wheels are close together, conforming to the gage of the front wheels, and the latter, to secure greater mobility, are directly under the platform with the motorman.

The usual steering gear is used, but runs in ball bearings, allowing the front truck to be turned at an angle of 90 degs. to the direction of motion. This makes it possible to turn the vehicle in very narrow streets. Ordinary shoe brakes acting on the rear wheels are employed with an electric locking brake on all four wheels for emergency use. Four motors are employed, one for each driving wheel. The motors are 4 h.p. each and are illustrated in the accompanying engraving. The wagon empty weighs 6500 kg. (14,300 lbs.), which is evenly distributed on all four wheels. Of this weight 1500 kg. (3300 lbs.) is that of the storage batteries which consist of 200 cells.

Large Installation of Special Work in Boston

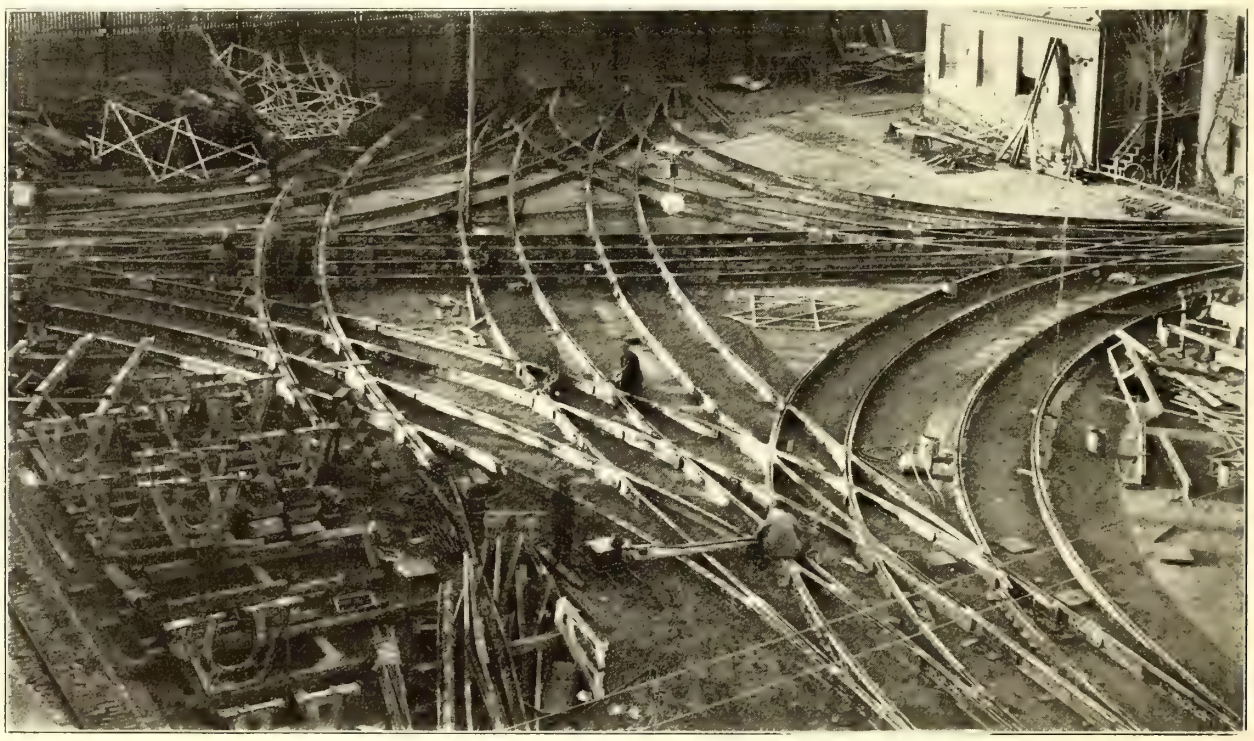
William Wharton, Jr. & Company, of Philadelphia, have recently completed for the Boston Elevated Railway Company the most important piece of track construction ever laid in that city, which is noted for its many and complicated track lay-outs. The installation referred to is that at Dewey Square, and is right in front of the South Boston Terminal steam railroad station. It consists of a double street railroad crossing with two of the tracks on a curve, and both connected with double curves, together with a third track, that shown at the left hand side, which is a freight track used by the Union Freight Railroad Company, and crosses six of the trolley tracks.

All of the curves are provided with spirals on the end, making the engineering work in connection with the lay-out exceedingly difficult and tedious. There are 183 intersecting points of the track lines and the lay-out itself comprises 190 crossings and switch pieces and rails. The design, the steam railroad track being formed of a special crossings for the Union freight track are made of a new very heavy guard rail of the same depth as the girder rail for the street railway track. The intersecting points of the street railway crossing are provided with manganese steel centers, as are, in fact, all of the intersecting parts of the crossing. The weight of material used is about 170 tons.

An especially interesting feature of the work was the promptness with which the order was filled. The entire crossing was manufactured and delivered within ten weeks after the receipt of the order. This time, considering the enormous size of the lay-out and the state of the iron market, is certainly remarkable. The material for the lay-out had to be transported on seven railroad cars of large capacity, and by special arrangement this train of cars was rushed through Boston, reaching there in two days, in spite of the immense accumulation of cars and freight blockade now existing in Jersey City. It was taken in hand at once by the engineers of the Boston Elevated Railroad. Work was commenced on Saturday, Nov. 18, and by the following Tuesday the entire lay-out was practically down and finished and cars running over it.

Another interesting feature of the installation is that in spite of its size it was all laid down complete in the works of the Wharton Company before shipment, every piece being in its place.

The contract price is said to have been in round numbers $15,000. This low price was secured by contract last February before the recent rise in the steel market, otherwise the cost would have been considerably higher.



LARGE PIECE OF SPECIAL WORK AT DEWEY SQUARE, BOSTON

Street Railways in Para

In a recent letter from a friend in Para, Brazil, he says: "This is a city of from 125,000 to 150,000 people, and is growing very rapidly. It has a street car system which threads the city in every direction, and it is patronized to perfection, almost every one being willing to wait fifteen or twenty minutes for a tram car in preference to walking. The equipment is, however, unmentionable. The little mules can fairly fly down hill, but up grade they are always in trouble with the heavy loads they have to haul. There is a great opportunity for the spare capital and spare engineers of the United States to come down here and put in an electric system. Please send them down, and the sooner the better."

Interview With John A. Brill on Foreign Practice in Rolling Stock

John A. Brill, vice-president of the J. G. Brill Company, of Philadelphia, returned to this country last month from a trip to Europe. A representative of the STREET RAILWAY JOURNAL called upon him, shortly after his arrival, and in response to questions obtained some very interesting information in regard to European practice in rolling stock, and the reasons which have led up to the large export movement from America in tramway rolling stock.

Mr. Brill was first asked whether as much electric railway construction projected abroad as in the United States, that is, whether the business is opening up largely at the present time.

In reply, he said: "The countries of Europe are in about the same condition that this country was six or eight years ago, that is as far as the urban railways are concerned. As yet there has been little done in interurban lines. The development is likely to be more rapid in European countries than in the United States, owing to the greater density of the population and the greater amount of wealth which can be used for the building of roads, and no doubt urban, suburban and interurban electric railroading will become as important an industry in Europe as in America."

"What countries are taking up this matter most vigorously?"

"Up to the present time Germany has completed the most electric railways, with France second and Great Britain third. There is considerable now being done in Italy, which is probably a good fourth. The other European countries straggle far in the rear, with the exception of little Belgium, which has done considerable for its size."

"In what countries do you think there is the best field; that is, what countries possess the best local conditions?"

"This has been probably answered by the foregoing, as the qualifications of the respective countries have placed them in the above mentioned order. The local conditions of none of the European countries are quite as good as they are here, so far as the local aspect is concerned, for the reason that in all European countries there are greater or less restrictions and difficulties, first as regards charter rights, second as regards the quality of work done, and lastly, which is probably the greatest obstacle, the restricted width of cars, together with the limitations as to loads and other details of operation. In many of the larger cities the speed limit hampers the profitable operation of a road and has brought the mileage down, in some cases, as low as ordinary horse travel. There is a scheme proposed now in England that the Board of Trade, which controls all of the tramways, shall compel them to equip their cars with a speed meter which will show the rate of speed, and will be inspected from time to time while the cars are in operation by men appointed for the purpose. I understand that the authorities of the city of Dover, Eng., have placed a speed restriction of 4½ miles per hour in the center of the city. These restrictions are so foreign to what exist in the United States that to an American railroad man they seem greatly to handicap the operation."

"Is the electric railway work abroad being done under municipal or private ownership?"

"In Great Britain the majority of the roads are under municipal ownership, as in Liverpool, Leeds, Hull, Southampton and Glasgow. On the Continent they are very largely under private ownership."

"In what respects does European and English practice in rolling stock differ from that of this country, especially in such features as length, width, height, seating capacity, length of platforms, single and double-deck cars, California types, etc.?"

"The practice differs in many respects. In England, at the present time, the double-deck car has largely the 'call,' and although a few single-deck cars are being ordered, they are very few as yet, and are greatly in the minority. The universal practice in Europe is to restrict the load of the car to the number of passengers that can be seated, except that a certain number of persons are allowed to stand on the platforms, which number is always specified by a sign on the car. In consequence, the disposition is to get very large platforms; in some cases they are as long as 6 ft., which allows standing room for nine persons. This length is 50 per cent greater than the practice in America. As regards the length of cars on the other side, they do not as yet appreciate the advantage of large units as we do in this country. The great majority of the cars are of the four-wheel type and in very few instances longer than 18 ft. in body, which gives a seating capacity for twenty-four people."

"What are the conditions which lead to the differences in types?"

"In France the double-deck car is largely in demand for the reason that the outside seats are for second class passengers and the inside for first class passengers. In Paris the rate of fare for outside passengers is one-half of that for the inside. In England the reason for the large demand and use of double-deck cars is because many people prefer the outside seats where they can smoke and get the fresh air. Open cars are very little used on account of the width restrictions and the briefness of their hot season. I think that these conditions are likely to continue."

"Is it probable that ultimately different standard types will be developed for French, English and German Railways?"

"Everything indicates, to my mind, that they will ultimately fall into the American types, which are certainly in the lead, and of the double-truck class."

"In the matter of brakes and wheels, what are the peculiarities of European practice and what are the prospects for the future of cast-iron wheels as they are used in this country?"

"As regards wheels, when we first began to ship trucks abroad our customers almost invariably demanded a steel-tired wheel with wrought-iron centers; later on we were allowed to put in cast-iron centers, and now about 75 per cent of our orders call for chilled-iron wheels. This, I think, is largely due to the fact that they have found that the chilled-iron wheels, when made with proper flanges, have given very good satisfaction. In conversation a short time ago with one of the employees of the Liverpool Corporation Tramways, I was informed that the wheels that we had furnished on a lot of cars had already made 24,000 miles, were in very good condition and looked as if they would make at least 16,000 miles more. Considering the additional wear engendered by the narrow-grooved rails, this is very good service. It might be well for me to say here that to P. H. Griffin, of the New York Car Wheel Company, is due very largely the fact that American chilled-iron wheels are now looked upon with favor. He has personally studied the subject on the ground and his agents have carefully looked into any complaints which have been made and rectified such troubles as have been called to their notice, and as a consequence we have many calls for wheels of this make. As regards brakes, the conditions are nearly the same there as they are in this country, although it is quite an interesting item historically that on a lot of trucks which we built for Rome, Italy, the authorities required that cars riding on the Seven Hills

should be fitted with the extra precaution of track brakes, in addition to the wheel brakes. I found that air brakes were used more extensively in Germany than anywhere else in Europe, and that they were of the Standard Air Brake Company's type with the axle-driven compressor, which is rather remarkable considering the fact that the axle-driven compressor is not at all in favor in this country."

"Will the high rate of speed and the long distances between their stops enable European roads to use steel-tired wheels with economy?"

"In answer to this question I would say positively, no, because I am a firm believer in the American chilled-iron wheel, as regards the economy of their use over steel-tired wheels. Steel-tired wheels, if used on T rails and well up out of the dirt and dust of the highway, will probably prove more economical than on an ordinary street railway track, but if used on the ordinary street railway track, in competition with the cast-iron wheel, there is more abrasion from the dust and grit, from the fact that their composition is much softer and more easily worn away than the chilled-iron rims."

When asked about the use of heaters abroad, Mr. Brill said: "We have not had electric heaters in the specifications of any of the cars that we have built for Europe, and I do not recollect seeing them in any of the cars in the European countries. Naturally, they must come into use in countries where the climate is sufficiently cold to call for a heater."

"Is there a favorable prospect for the introduction of American registers on European roads?"

"No, I do not see that there can be much of a field for American registers on European roads for the reason of the multiplicity of fares. At the present time the system mostly in vogue is the ticket system, which compels the conductor to give each passenger a ticket recording the amount of fare he has paid and the destination, and at regular stations along the road are inspectors who are supposed to look at them. In other places they have the bell punch system."

"How do foreign built cars compare with those built in this country in weight, cost, durability, style, etc.?"

"With the exception of the products of one or two manufacturers, the foreign built cars do not compare favorably with the American cars in the cost of construction, which is somewhat less than the transportation together with the duties taken into consideration. They keep their prices just low enough to meet these two items, so that the price is rather a high wall or bar to the selling of many cars in European countries. As regards the weight of European cars compared with that of American cars, I think that there is very little difference, as the American builders have been gradually increasing the weight of their cars to a considerable extent within the past few years owing to the increased speed, and I really think that we have arrived at a point now where our cars are heavier than European cars, because of the demand occasioned by the increased speed and loads. As regards the durability and style, I do not think the foreign builders approach us. There are a number of things that the best American builders do, that are recognized as good practice, to increase the strength of their cars without adding additional material, which as yet the European builders have not followed. As to the style and finish, there is absolutely no comparison between the average European car and the average American car. It is all in favor of the American car, notwithstanding the fact that European builders are living in the atmosphere of the old masters and high art and we are surrounded by the crudities of a new country."

"Are the German builders likely to be successful in building cars in which iron largely takes the place of wood?"

"I do not know that the Germans use iron largely in place of wood, with the exception of the panels. These are made of sheet-steel instead of thin poplar. As regards the under construction of a car, that is, the bottom framing, I think that we use about as much iron as they do."

"Is there any information available in regard to the kinds of woods used in England and on the Continent for car building?"

"They are following the American practice in this direction to a great extent and are using American lumber the same as the American car builders do, that is, oak, yellow pine and ash; but for the interior finish I find that in Germany and in France they are using a much cheaper grade of wood than we are, largely yellow pine, and they are not as careful of the selection as we are. It is not an uncommon thing to see knots of good size both in the panels and in the rails."

"Are foreigners building reasonably successful types of trucks, and what types are they employing?"

"This is rather a delicate question for me to answer, because I think that not only are the foreign builders, but that many of the American builders as well, are far from making such successful trucks as are made by my company. In the first place, the foreigners, like the American builders of trucks, are making a composite truck with numerous rivets, bolts, etc., which, when operated or shown beside our solid wrought-forged truck, makes a very poor comparison."

"Has the recent exportation of cars from America been due principally to our natural advantages in climate, material and workmanship, or simply to the fact that we have the plants and experience and can turn out the material cheaper and better than foreign countries; in other words, is the export movement a permanent one, or will it decrease with the increase of electric railway business abroad?"

"Unquestionably, it is due to the natural resources of America and the established factories for the construction of cars, but while we do make them better than those made in foreign countries, we do not make them cheaper, and it seems to me that it is only a question of time when this export movement will fall off."

In conclusion, Mr. Brill was asked how the foreign methods of business in the matter of credits, terms of payment, etc., compare with those of America?

He said: "This question embodies a little more than you have distinctly stated, probably your intention is to ascertain my opinion of the desirability of foreign business. The foreign business involves considerably more outlay at the factory in material and time for the same number of cars and trucks than does the American, for the reason that all of the cars must be taken apart and boxed in sections or boxed whole, and the same treatment is given to the trucks, which makes a delay in the output which is not met with in work for America. In addition to this, the shipping facilities for such bulky articles are so meagre that it is quite difficult to get, on the northern seaboard of the United States, transportation for a large quantity of tram cars unless the shipment is spread out for a considerable length of time. At the same time there are incidental expenses attending foreign sales which add greatly to the cost; I refer to the matter of frequent and costly cablegrams, and to the very much greater cost of selling there either direct or through local agents. The great wealth of European countries and the great competition for business has led to the giving of very long credits, and in many

cases the companies hold back a percentage for a period anywhere from twelve to twenty-four months to insure first-class work, so, ordinarily, the terms of payment are not as satisfactory nor as favorable as in this country. Again, the handling of cars and trucks for foreign account seriously interferes with the total output or capacity of a factory.

New Elevated Railway in Berlin

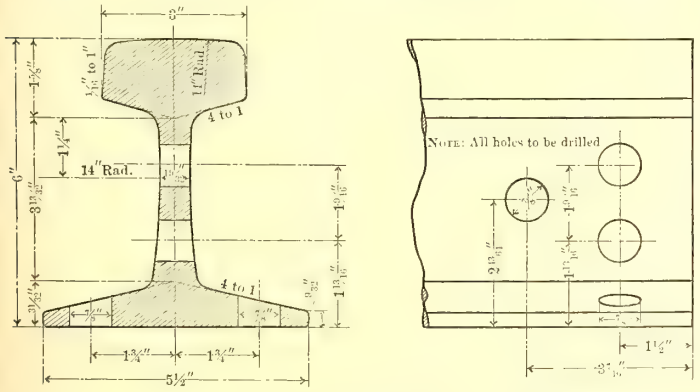
Trial trips are now being made with the first two cars on the Berlin electric elevated road. They were constructed by the firm van der Lypen & Charlier of Koln-Dentz, according to entirely new designs, and were kept for some time at the experimental station of Siemens & Halske in Gross-Lichterfelde. In exterior and interior finish the cars resemble those of the Prussian State roads, and the private imperial cars.

The two cars now in operation are motor cars, and one will be in front and one in the rear of each electric elevated train, with two trailers between them. Such a motor car is 11 meters in length, 2.3 meters in width, and is 3 meters high. It has a seating capacity for thirty-six persons, and a total weight of twenty-one tons. The two ends are fitted with semi-circular plate glass windows, by means of which the air pressure against the platforms is somewhat reduced.

The Berlin public, however, seems to be much dissatisfied with the appearance of the elevated road which is now in course of construction. The taxpayers, particularly in the West End of Berlin and Charlottenburg, demand that the still unfinished portion be built underground, which the builders refuse to do on account of the increased cost. Where the road passes the new Kaiser-Wilhelm Memorial Church, built at a cost of 10,000,000 marks, it has, however, been decided to use sandstone in the construction instead of steel. Two more years will probably be required before the road will be opened to the public.

Third Rail for Manhattan Elevated Railway

The third rail for the Manhattan Elevated Railroad Company's electrical equipment has been selected and is shown herewith in section and side elevation. It weighs 100 lbs. to the yard and will be supplied by the Lackawanna Steel Company. The rail ends are being drilled for two kinds of bonding, through the web and through each side of the base. The contract for bonds has not yet been awarded.



THIRD RAIL FOR MANHATTAN RAILWAY

The Boston Elevated Railway Company has a man in its employ who wears eight service stripes, denoting forty years of service with the company. This is undoubtedly a record.

CORRESPONDENCE

Arrangement of Swing Runs

DETROIT, Nov. 25, 1899.

EDITORS STREET RAILWAY JOURNAL:

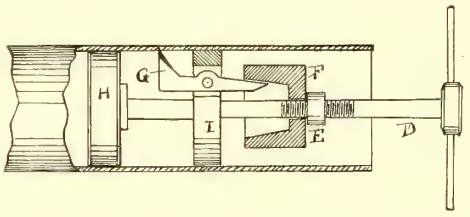
I notice in the proceedings of the American Street Railway Convention, at Chicago, one speaker advocated shorter hours for employees. I believe he was right, and particularly so in the case of swing runs, that now require work for twelve hours or more, that is until 12 o'clock to 1 o'clock at night, and beginning again anywhere from 5 A. M. to 6 A. M. I believe ten hours work would be very much better for both the company and workman. In all cases where a man is over-worked and his rest and sleep broken he is very apt to be cross, to pay less attention to business, and not be so polite and civil as when he is refreshed and well rested. If the time tables were so arranged that the last cars in were the last ones out, and ten hours constituted a day's work, except under extraordinary conditions, the company, men and the public would be better served. A. CARR.

Pipe Thread Cutting

BOSTON, Mass., Nov. 10, 1899.

EDITORS STREET RAILWAY JOURNAL:

It is often necessary to cut an inside pipe thread in repair shop work, and for doing this I have found the home-made cutter, illustrated below, exceedingly handy. The parts are mounted on a shaft *(D)* which turns in a disc *(I)*, which fits in the pipe as shown. A head having radial slots



is fitted on the shaft at *(F)* to turn with it, the levers carrying the cutter *(G)* being pivoted at *(I)* and operated by the head. This head piece is conical in shape and when moved forward by means of the nut *(E)* is made to expand the cutting tool and cut the interior of the pipe shell as the cutter is turned by a crank keyed on the end of the shaft to turn it. The inner end of the shaft is kept straight by the cylindrical piece *(H)*. F.

Special observation of the interior of the cars will show that the varnish commences to disappear first around the sash—moisture from the windows gathering around the molding which holds the window sash, first discoloring it and gradually working into the sash itself. A car cleaner which is made up largely of oil and dryer, if used about once a week on the window sash and molding, will be found to be a great advantage. From paper at the Boston Convention, 1898.

In the selection of designs for painting of cars, the plainest and neatest design should be selected as a rule. No lettering should be done on the panels, as this increases greatly the cost of maintenance in the paint shop department. In all cases the signs should be put upon sign boards made especially for the purpose. From paper at the Boston Convention, 1898.

STREET RAILWAY JOURNAL

DECEMBER, 1899.

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, BEARD BUILDING, 120 LIBERTY STREET.
Chicago Office: Monadnock Block.
London Office: Hastings House, Norfolk St., Strand.

Long Distance Telephone, "New York, 4044 Cortlandt."
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / 25/ / 31 fr

Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

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Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

Address all communications to

The Street Railway Publishing Co.,
Beard Building, 120 Liberty Street, New York.

In a recent communication to the "Electrical World and Engineer" John Lundie suggests a new method of power rating for electric railway motors, which will be most valuable to engineers as a basis for specifications. Mr. Lundie proposes to rate railway, and other motors intended for intermittent service, on the basis of the *average* electrical input in kilowatts which the motor can take care of within the commutation limits, and with a given maximum temperature difference above the surrounding atmosphere. A 30-kw. motor, for example, would be one which would, at 500 volts pressure, take without excessive heating 60 amps. of continuous load, 100 amps. for 60 per cent of the time, 250 amps. for 24 per cent of the time, etc., the maximum limit being determined generally by commutation. In other words, Mr. Lundie claims that, with a well designed motor, however much the current may vary, the sum of the percentages to total input of the C^2 R and core losses can be made to be nearly a constant at all inputs throughout the range of practical operation. The correctness of this theory is challenged editorially by the "Electrical World and Engineer," which states that the sum of a constant and square function cannot be a first-power function, overlooking the fact that the second power of C disappears when the *percentage* losses are considered, i. e., $\frac{C^2 R}{C} = CR$, a first-power function. In his reply Mr. Lundie points this out, and also states a fact shown by examination of many motor curves, that the sum of the percentages of copper and iron losses through a range of from 40 amps. to 200 amps. does not vary 2 per cent, and that in one of the best motors ever built the efficiency is practically a constant within working limits. He believes that this is an ideal to be aimed at in designing motors intended for intermittent fluctuating work, and under these conditions the proposed method of railway motor rating completely applies. The convenience of this method is very great, and even if there should be slight variations from exactness it would seem that results would be quite close enough for commercial use—certainly much better than obtained by the present methods of rating. Motors may be thus most easily tested in regular service to see if they comply with specifications, the process simply consisting of taking volt and ammeter readings in regular service of car, together with final temperature of coils after one or more hours' service. Moreover, with a knowledge of the average power requirements of motors on a given railway line, the rated power of motors to be specified immediately appears, though the maximum and minimum operating currents ought also to be specified.

Two novel methods of foreign practice in electric railway construction are described at considerable length in this issue, one a side slot conduit recently installed at Paris, and the most important conduit line in that city; the other the Burgdorf-Thun three-phase electric railway in Switzerland, the longest and most important three-phase electric railway in the world. Both differ so much from American engineering practice that considerable space has been devoted in this issue to their description. This does not necessarily mean that we believe that the methods followed will obtain wide adoption in this country, but being on entirely new lines they will undoubtedly suggest certain points which can perhaps be utilized to advantage, and as they represent the best engineering practice in these directions in the countries in which the installations have been made, they are undoubtedly of great interest. The side slot conduit in Paris is avowedly patterned in most particulars after that of the Metropolitan Railroad Company, of Washington, with the exception of the position of the conduit, and was, in fact, installed by the same engineer, Mr. Connett. The use of the side slot was obligatory, but as Mr. Connett points out, has a number of disadvantages as compared with the center slot conduit. These are practically insurmountable at switches, so much so, that the conduit had to be diverted to the center of the track at these points. Even under these conditions the necessary width of the slot would, to American eyes, make the system impracticable in American cities. The width of slot admitted by the authorities in some of the foreign cities seems to us almost incomprehensible when we consider that in New York, Chicago and elsewhere, where cable and electric conduits are used, the slot rails form a favorite path for bicyclers, while in Buda-Pest, for example, a bicycle wheel with even a $1\frac{1}{2}$-in. tire would pass through the slot without

difficulty. The slot in Paris is only 1 in., but this is considerably wider than New York or Washington practice.

* * *

The three-phase railway seems to be peculiar to Switzerland. Of the four roads which have been built, in which three-phase motors are employed, three have been within the boundaries of that country, and the fourth, that at Lugano, is practically so, being but a few miles beyond the boundary, in Italy. The reason for this fact is that all of the pioneer work in this direction has been carried on by Brown, Boveri & Company, and they should receive the credit for undertaking this advance work at a time when the proposition was looked at askance by other builders. While the alternating system possesses certain advantages it is noticeable that American practice limits the use of the alternating current to the distribution system. There are plenty of railways in this country with operating conditions very similar to the Burgdorf-Thun line described elsewhere, and others are projected, but in every case where the current is distributed at high potentials, rotaries are used for rectifying the current and reducing it to the standard railway voltage before placing it on the trolley wire. Of course, one more conversion is required, and the economy of the entire system is reduced by the loss in the rotaries; on the other hand it is thought here that the practical benefit is more than made up by the convenience afforded in a simplified overhead system, a more flexible control of the motor speeds, and finally, and most important of all, in the ability to use standard railway apparatus. While the electric motor of to-day may be far from perfect, its ailments and weaknesses are thoroughly understood, and can be guarded against or the apparatus repaired in case of disaster, by men who have gained their experience on any of the existing electric roads. Again, practically every high-speed road which has been built or is projected in this country, runs into some large city over existing city tracks, and as this condition is likely to continue, railway managers would not regard with much favor a proposition to employ one electric system and kind of motors for suburban service, and another for city service, so that, until alternating current engineers are ready to supply an alternating current railway motor and system which would be more desirable for city service than the present direct current motor and distribution system, we do not look for any extended use of three-phase work on interurban railways outside of distribution circuits.

Will the Proposed Underground Railway in New York Pay?

With all legal obstacles removed, the Board of Rapid Transit Commissioners of the City of New York has issued invitations for bids upon the proposed rapid transit tunnel railway. This railway is to run through a 50-ft., four-track tunnel from a southern (loop) terminal at City Hall Park, north to the Grand Central Station on Forty-second Street, thence west a short distance to Broadway, and thence north through upper Broadway (formerly the Boulevard) to Ninety-seventh Street. From this point two double-track branches will run, one, by combined tunnel and viaduct, north on the west side of the city to a point above 230th Street on Washington Heights, and the other, by tunnel and viaduct, east and north on the east side of the city to Bronx Park.

In laying out this route the Rapid Transit Board has evidently, and perhaps quite rightly, had in mind the upbuilding of the city rather than the construction of an immediately profitable transportation system. In other words, it is proposed to build a "real estate road" on a large scale. For many years past, upper Broadway, or the Boulevard, has been in a languishing condition, and a great disappointment to over-enthusiastic real estate speculators. The upper West Side, which the Boulevard nearly bisects, has been given over almost entirely to the better class of residences, and business interests have been confined to the supply of local trade requirements. Real estate in the "Annexed District" above the Harlem, now to be served by the East Side line, has also been "quiet" through lack of adequate transportation facilities. Unquestionably the new rapid transit railway will, if built in its entirety, add enormously to property valuations along and nearby its routes, and will be of great benefit to the city.

The questions which capital will have to face in acting upon the invitation of the city to build this tunnel are, however, of a different order. It is true that a syndicate may be formed which shall combine the functions of building and operating this railway with those of investment in real estate in this district which the railway is to serve, and such a syndicate may hope to reap either a triple profit, or a profit from the real estate ventures large enough to wipe out possible losses from the building and operation of the railway. Primarily, however, it is certainly desirable that the railway shall be at least self supporting from the start, and shall eventually, through the seventy-five-year lease which the city offers to the constructors, become profitable in an increasing ratio. What are the chances that this may be done?

The entire route is divided into four sections. Section I. comprises the portion below Fifty-ninth Street; section II. the portion north of Fifty-ninth Street to 137th Street on the West Side, and from Ninety-seventh Street to 135th Street on the East Side; section III., the portion north of 137th Street to Fort George on the West Side, and north from 135th Street to Melrose Avenue on the East Side; and section IV., the portion north of Fort George on the West Side, and north of Melrose Avenue on the East Side.

The city, being desirous of limiting its total liability, proposes to reserve by contract, the right to determine whether sections II., III. and IV., either or all, shall, or shall not be built. The bidders, now necessarily ignorant of the city's decisions, which may be made one, two or three years hence, are expected, therefore, to see a profit in the construction and operation of section I. alone, and of the entire road. Otherwise they cannot bid with safety on the present specifications and proposed contract.

They must, therefore, first face the problem: Will section I. alone be profitable?

We have no doubt whatever upon this point—it will never be profitable to operate this section alone until the time comes when both surface and elevated cars operating in the lower end of the city shall be so overcrowded that passengers are absolutely forced, in self-defense, to take the underground as a third alternative route.

Consider the situation. The lower end of Manhattan Island, from Fifty-ninth Street to the Battery, is but 5

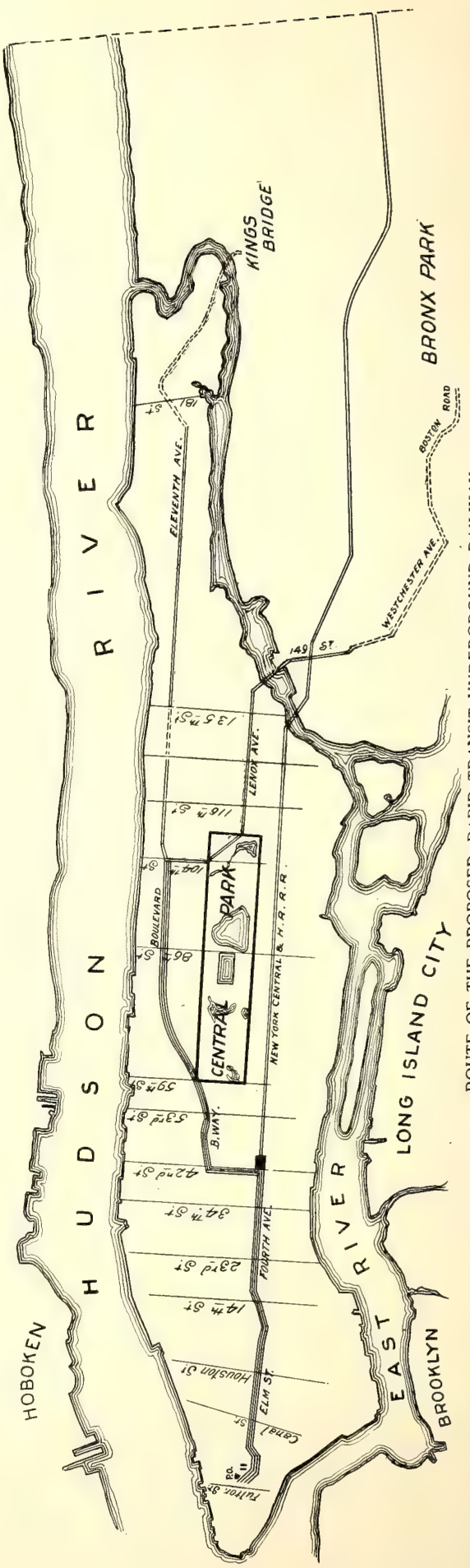
miles north and south, and 2 miles wide at the widest portion. While there is still a large residential population in this territory, it is being steadily crowded northward out of the district by the increasing demands of business, and it will be more true in the future even than now that the great residential areas of the city will be north of Fifty-ninth Street. It follows, therefore, that the entire traffic below Fifty-ninth Street must necessarily be "short distance," and that a tunnel railway limited to this area will not have a large morning and night travel. It cannot possibly compete with the surface lines, or even the elevated in securing short distance riding, partly because people do not like to go up and down stairs, particularly to a dark, and perhaps a noisy tunnel; partly because the tunnel railway runs to City Hall Park only, and does not serve the lower end of the island, nor has it any large attraction at the northerly end; but chiefly because the most generous system of transfers known probably in any city of the world, prevails on the surface lines, and makes it possible for a would-be traveler to go east and west and north and south between any points by the payment of a single fare. We repeat, therefore, that section I. alone for the proposed terminal railway is a proposition likely to be wholly unattractive to capital.

Will sections I. and II., taken together, be profitable?

That portion of Manhattan Island north of Fifty-ninth Street and west of Central Park and Lenox Avenue has been built up during the past ten years with myriads of private, and apartment houses of the better class. It is generally considered to-day the most desirable portion of the city in which to live, except for upper Fifth Avenue along the Park, given over chiefly to the residences of the extremely wealthy. The density of population in this West Side area is not large, however, for the class of people who inhabit it are those who desire more breathing room than can be had in other parts of the city. The East Side of the city, for example, from 125th Street to the Battery, is of enormously greater value from a railroad point of view than is the West Side, for it is here that the "tenement houses" proper are found, together with a busy, humming industrial life, which forms a great contrast to the quiet, peaceful streets of the West Side district.

Now, this West Side district to be served by section II. of the tunnel railway is less than three-quarters of a mile wide, except at the part above the park, where it is approximately a mile and a half. This narrow area is now served by a three-track elevated railway on Ninth Avenue, running rapid express trains night and morning, and soon to be equipped for a vastly superior and more rapid electric service; two electric lines on Eighth and Amsterdam Avenues, now in operation and giving an exceptionally perfect service; a cable line in Columbus Avenue, soon to be converted to electricity; a horse line on upper Broadway, immediately over the proposed tunnel line, electrical operation of which by the underground conduit system will begin within a few weeks, and a horse line on Amsterdam Avenue to be run by electricity in due time.

An independent tunnel railway will hardly get from this district more than the through, or long distance, travel. In competition with it will be the surface lines giving free transfers to any part of the city below Fifty-ninth Street, and the elevated lines, giving a service almost as rapid as the underground, with 3-cent transfers over the upper



ROUTE OF THE PROPOSED RAPID TRANSIT UNDERGROUND RAILWAY

Broadway surface line, and many others in the city. The tunnel railway will miss the profitable short distance riding entirely, including the major part of the ladies shopping travel, and if the city insists upon express train service throughout the day, as appears probable, it will unquestionably be conducted at a heavy loss.

The only salvation for sections I. and II., as a railroad proposition, is that through their construction upper Broadway from Forty-second Street north will become a great business street similar to lower Broadway. We doubt if this will happen, for many years to come, at least, for the "feeder district" to such a street is narrow and is populated by a class of people who would resent the introduction of the business element into this region. Eventually, perhaps, when some outlet above the Park has to be given for business development, the existence of such a railway as this would determine the march of progress, and the city would be better balanced than would otherwise be the case. We believe, however, that sections I. and II. of the proposed tunnel railway, taken together, would be unprofitable for a number of years to come.

Sections III. and IV. would be of immense benefit to the "Annexed District" and the upper end of Manhattan Island, and in a comparatively short time after the completion of the road this whole area would form another city. It is probable that the tunnel railway could secure practically all of the business from this area to the lower end of Manhattan Island, and that its morning and evening trains, both express and local, would be crowded. But consider a 5-cent fare for such long distance travel! If a business of this kind is profitable for such an enormously costly railway as is the proposed tunnel line, surely the surface and elevated railways of New York must be Golcondas indeed!

Passing now from the consideration of the details of the project, let us summarize the general financial requirements of this railway, assuming it to be independent of all other transportation systems in the city. The tunnel railway will probably cost as a whole not less than $40,000,000, and its equipment not less than $10,000,000. The rental, and a fair interest on cost of equipment would be not less than $1,500,000 per annum for the first five years. On this railway, built avowedly for long distance traffic on a uniform 5-cent fare, it can hardly be expected that operation at less than 70 per cent of the gross receipts can be achieved. If this is so, the railway must earn $5,000,000 per annum during the first five years in order to save the operating company from loss—to say nothing of leaving it any profit. The network of present transportation lines shown in the map on page 881, a network consisting of four trunk elevated railways from the Battery to the Harlem River and beyond; twelve trunk surface lines north and south on Manhattan Island; innumerable crosstown feeders to these elevated and surface trunk lines; and a widely ramified surface railway system above the Harlem—is earning only about $25,000,000 per annum gross. Can a single line through and to territory such as has been described, and without feeders or crosstown connections, earn one-fifth of this grand total? Frankly, it does not seem to us probable, at least until, as said before, the city shall have so fully outgrown its surface and elevated facilities of travel as to be forced to take to the underground for short distance riding.

We have spoken so far of the tunnel railway as a wholly independent proposition. There remains for consideration the question as to whether or not it will be a profitable adjunct to any of the existing surface or elevated systems. Will the Manhattan, Third Avenue or Metropolitan syndicates see an opportunity for strengthening their grip upon the transportation industry of New York, and of making additional profits for themselves?

It is hard to see how ownership of the tunnel railway by the Manhattan Company would strengthen either property, as there is little chance of cross connection or valuable transfer arrangements. What the Manhattan Company needs to-day more than any other privilege is that of building short connections for its four trunk lines on various important streets across the island. The rapid transit tunnel must be essentially a competitor to Manhattan for long distance traffic, and it is not the long distance traffic which the Manhattan Company needs, or is seeking.

Were the tunnel railway owned by the Third Avenue or Metropolitan Companies a transfer system might be introduced which would be of benefit to both tunnel and surface lines. In this case, the surface lines would be distributing and collecting agencies—the tunnel railway would be one only of the through lines. But the questions arise, first, why either of the great surface companies should go to great pains and enormous expense to give to the people a long distance combined surface and underground ride for 5 cents on a free transfer plan, or, second, whether a sufficient amount of traffic could be secured on a 7-cent or 8-cent joint rate to warrant the arrangement of a costly through service of this kind. The function of the surface lines of New York City is, and always will be, to handle the short distance traffic, and their interests lie in the direction of forcing to the elevated or underground lines the less profitable long distance riding, thus freeing their cars for the better class of traffic. Are they prepared to accept the financial responsibilities of "the other end," i. e., assume the burden of catering to the long distance riders of the city on a 5-cent fare?

It is with the greatest reluctance that we have been forced to the conclusion that the Rapid Transit Commission's present plans and proposed contract do not afford sufficient inducement to capital to warrant the confident hope that the tunnel will be built. We sincerely hope that our view of the case may be a mistaken one, and that the risks may be assumed, for certainly New York City needs now, and will in the future even more urgently need, every transportation agency which can be crowded into Manhattan Island. If responsible parties can be found to undertake the task upon the present basis, we shall be heartily glad, and will be first to congratulate the Rapid Transit Board on its success, though we should not advise the "widows and orphans" to invest their money in securities representing such a railway. If capital says "no," we should strongly advocate a more liberal proposition, such as, for example, the right to charge graded fares up to 10 cents for the longer distances, or the right to charge a 10-cent fare for express train service, with a 5-cent fare for local. We all want better transportation facilities in New York City, and, within reasonable limits, the time saving is of more importance than is the saving of the last penny of transportation cost.

Transportation Earnings and Profits on Manhattan Island

The changes brought about during the past fifteen years in the transportation conditions of New York City, and particularly of Manhattan Island, are hardly yet fully understood by the people, or even, perhaps, by many of the capitalists interested. A mere examination of the city railway reports from year to year does not convey an adequate idea of the results of the intense struggle for traffic which has been going on, or of the true influences at work, and a retrospect of at least ten or twelve years is necessary if this understanding is to be gained. There were then found on Manhattan Island no less than twenty operating companies, surface and elevated, each working in its own special, but limited, field, and each at peace with its neighbors save for an occasional quarrel over the replacement of a crossing or some small question of trackage rights. Horses were used on all the surface lines except on a single cable road "away out in the country," on 125th Street in Harlem, and no disturbing thoughts of radical improvements in service or the introduction of new motive powers were troubling either the railway companies or the people.

From the standpoint of our present knowledge we can see that the most important event in the transportation history of Manhattan Island, and perhaps in its recent general history as well, was the purchase in 1886 by a small group of Philadelphia capitalists of a controlling interest in the Chambers Street and Grand Street Ferry Railroad Company, and the Houston, West Street and Pavonia Ferry Railroad Company. There was then introduced into the local situation an element of progressiveness and aggressiveness which was destined in a few years to leaven the whole lump, and to turn a comparatively sleepy Dutch city into a modern American metropolis.

For five or six years this long-headed "Philadelphia Syndicate" laid its plans and carried them out quietly but most effectively. Control of one after the other of the local horse railway properties was purchased at prices then deemed extraordinary—even extravagant. The former owners congratulated themselves heartily, and with reason, upon the excellent bargains which they made in disposing of their stock holdings. Purchases were not infrequently made on a 4 per cent or even a 3 per cent basis. These bargains were, in truth, of a kind advantageous to both purchaser and sellers, inasmuch as the latter could never do with their isolated properties what could be accomplished were they welded into one great system, while the purchasers, with a largeness of conception and a wealth of financial resource never before found in street railroading in this or any other country, were able to consolidate into a single great property no less than three-fourths of the entire surface railway mileage of Manhattan Island.

It is not to be supposed that these purchases and consolidations were effected without the opposition of powerful rivals in the field. It was not, however, until the principal work of purchase had been done that this opposition crystallized into any definite form. The Third Avenue Railroad Company, though more than once approached by the Philadelphia syndicate, with a view to purchase, resisted all blandishments, and eventually, though very "late in the game," purchased on its own account control of the two horse railway properties on Manhattan Island, left in independent operation by the Philadelphia syndicate, the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company and the Dry Dock, East Broadway & Battery Railroad Company, while, a little later, control of the Union Railway Company, with its connections, operating under most valuable franchises through the entire "Annexed District," above the Harlem River, was also secured by the Third Avenue Company. Prior to these purchases the Metropolitan Street Railway Company, into which had been consolidated or to which had been leased all the properties purchased by the Whitney-Widener-Elkins syndicate, had built a new cable line on Lexington Avenue, paralleling the Third Avenue main line on the west, and had secured control of the Second Avenue Railway paralleling it on the east, and soon afterward a lease to the Metropolitan Company of the Fourth Avenue line of the New York & Harlem Railroad Company was effected. At the same time general transfers were introduced all over the Metropolitan Company's system, from cross town to north and south lines, and the Third Avenue Company finding itself surrounded by sharply competing lines and in an uncomfortably isolated position, made the purchases referred to in order to obtain outlets and feeders for its main line.

The Manhattan Railway Company, operating all the elevated lines in the city, seems never, until recently, to have taken any interest in the surface railways of New York, and it did not see until too late the tremendous influence which was to be exerted upon its own gross and net earnings by the intelligent competition below its tracks. This competition began to be felt by both elevated and Third Avenue systems even while the Metropolitan syndicate was still operating its purchased lines by horses, and before the great work of improving the motive power was commenced, for what had been at first a mere agglomeration of individualized horse railway lines, each run by its own superintendent, upon different policies of management, were unified in such a way that economies could be effected and the service greatly improved. New routes were laid out for the better handling of traffic, and transfers were introduced, while it will be remembered that the Broadway horse cars were the best equipped and the fastest in the city, in spite of the great congestion of that thoroughfare.

In 1890 the Metropolitan syndicate determined to cable its Broadway line from the Battery to Fifty-ninth Street. At about the same time the Third Avenue Railroad Company obtained the long-sought right to cable its main line on Third Avenue. It was then generally believed by engineers and street railway managers that for a traffic of such enormous density as that of Broadway and Third Avenue—a density greater perhaps than that of any other lines in this country—the cable system was far superior to any form of the electric, and would never be superseded. Following the equipment of the Broadway line, the Lexington Avenue and Columbus Avenue cable lines were built as branches to the main Broadway stem. Thus was the work commenced of improving the motive powers on New York City railways, the Third Avenue Company really taking the lead in the building of its 125th Street cable line in 1886, and the Metropolitan syndicate taking the lead in main line work.

The attempt was next made by the latter to secure the right to introduce the overhead wire electric system on Sixth Avenue under the elevated structure, but the people of New York had just gotten rid of overhead electric wires, literally by main force, and were determined to have no more, so that this attempt completely failed. The situation confronting the syndicate was now most puzzling, and disaster stared it in the face. All plans had been based upon the securing of these overhead electric rights, as had been done with comparative ease in Philadelphia and other large cities of the country. The purchases of horse properties had been made at high prices with this in view, and if they were forced to continue operation by horses or to go

to the enormous additional capital expenditure required for the cable system, success was by no means assured.

In this emergency it was determined, with characteristic courage, to undertake an elaborate experiment with the underground conduit electric system, which had until that time a record of uniform failure wherever tried in this country, though it was claimed to be partly successful in a single European city. The Lenox Avenue line was built with a conduit of such size that if electricity should prove a failure, the cable could be installed. The success of this initial experiment was so pronounced that the decision was made in 1897 to adopt the underground conduit electric system in somewhat modified and cheaper forms for all the north and south lines owned by the Metropolitan Company, the decision regarding motive power for the cross-town lines being left till a later date. As a consequence, there have been put into operation during the past two years the Second Avenue, the Madison Avenue, the Sixth Avenue, the Eighth Avenue and the Amsterdam Avenue lines, all by the underground conduit electric system. The instant success of the new electric cars in winning popular favor and the great increase in traffic over the old horse lines which they replaced, has been so marked that it has been determined to convert all the present cable lines of both the Metropolitan and Third Avenue Companies to underground conduit electric, and in accomplishing this the Third Avenue has led, its complete line from City Hall to Harlem having just been put into operation, while work upon the Broadway system is going on as rapidly as circumstances will permit, and it is expected that the change will be completed next year.

For reasons which will presently appear, the Manhattan Railway Company has determined to make a change of motive power from steam to electricity, and ground has been broken for its new power station, for which a portion of the equipment has been ordered, while contracts for its car and other equipment will shortly be placed.

Having thus briefly reviewed the street railway history of Manhattan Island during the past twelve years, and further referring to the map on page 880, showing the lines of the three competing systems, we are now prepared to examine the diagram, Fig. 1, which shows how all these changing conditions have influenced the relative traffic secured by these systems. In 1888 the Manhattan Company and its later acquisition, the Suburban Rapid Transit Company, the latter operating in the "Annexed District," showed passenger earnings of $8,695,347 gross. The company's earnings steadily increased until 1893, when they became a maximum at $11,070,360. From this point on the record is dark, the falling off in earnings being precipitous for two years, and then more gradual until in the year just ended (June 30), the company is back to almost the starting point in 1888, with but $8,703,996 passenger earnings.

The Third Avenue system on Manhattan Island (by which we mean here and elsewhere in this paper a combination of the Third Avenue Railroad, the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway, and the Dry Dock, East Broadway & Battery Railroad, excluding, therefore the Union Railway and its allies in the "Annexed District") earned in 1888 from all sources $2,693,874, and for the next two years these earnings were slightly increased. Then followed a four-year period of but little change, after which the traffic winning influence of its new main line cable system became evident, a maximum of earnings being reached in 1896, when $4,097,268 was obtained. For two years following this the Metropolitan competition is seen in slightly declining earnings, and in the year just ended this decline is decided, owing no doubt in part to the interruption to traffic caused by conversion from cable to electricity, but in part also to the competition of the Madison Avenue and Second Avenue electric lines, which have been most popular means of surface transportation on the East Side.

What have the Metropolitan syndicate lines been doing meanwhile? In 1888, the fourteen companies then in existence which were later merged into the Metropolitan system, were earning $7,268,901. Now, the Metropolitan system, including the mileage of these fourteen original companies and that of several others built from time to time since 1888, is earning nearly double the income of that year, or $14,133,810.* The course of the line of growth in the earnings of the Metropolitan system may be traced in the diagram, and is sufficiently indicative of the reward given by a great city to enterprise and generosity, in the management of a transportation system.

In examining the course of gross traffic, however, we

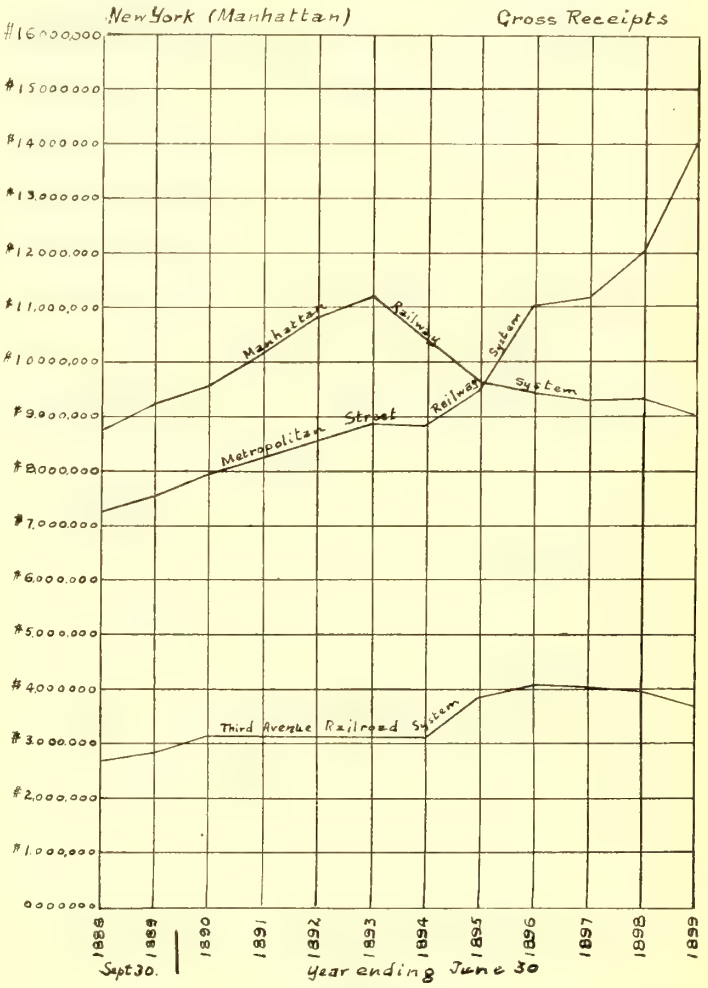


FIG. 1

are taking a merely superficial view of the whole question. The investment and operating costs necessary for obtaining new traffic or for keeping that which is retained are of deeper interest and in some aspects really reach the heart of the transportation problem of this great city, having a bearing upon the possibilities of the new rapid transit railway perhaps to be constructed, and indicating the probable future of the existing systems in competition. We may pass then to the consideration of the financial history of the three great systems, as expressed in the diagrams, Figs. 2 to 7, in which are exhibited in graphical form the relations of capital stock, funded and floating debt, and the disposition of gross earnings.

* This figure includes the operating and other income of the Metropolitan Street Railway Company proper, the Central Crosstown Railroad Company, the Thirty-fourth Street Crosstown Railroad Company, the Twenty-eighth & Twenty-ninth Streets Crosstown Railroad Company, and the Fulton Street Railroad Company.

The Third Avenue Railroad System

The Third Avenue Railroad system on Manhattan Island consists (a) of the main stem on Third Avenue, now a double track electric railway; (b) of a crosstown line on Forty-second Street from North River to East River, now running by horses, but in process of change to electricity; (c) connecting with this, a line through upper Broadway to Fort Lee Ferry, also running by horses now but to commence electric operation within a few weeks; (d) a crosstown line on 125th Street from river to river, now in operation by electricity; (e) a line from 125th Street to Fort

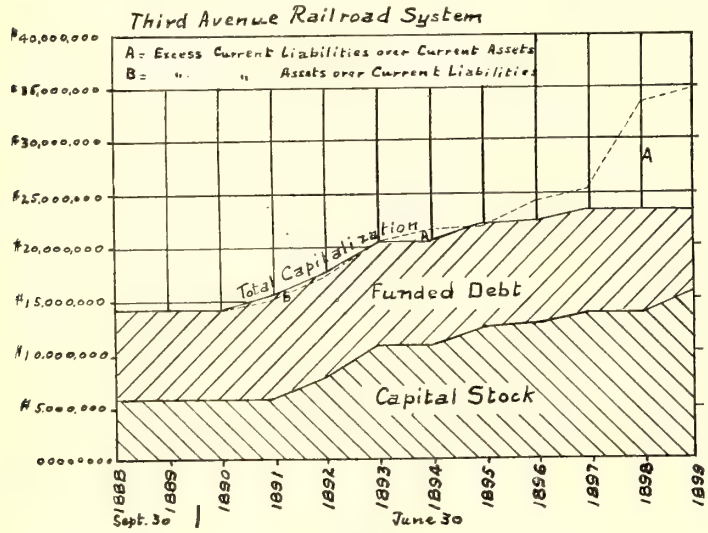


FIG. 2

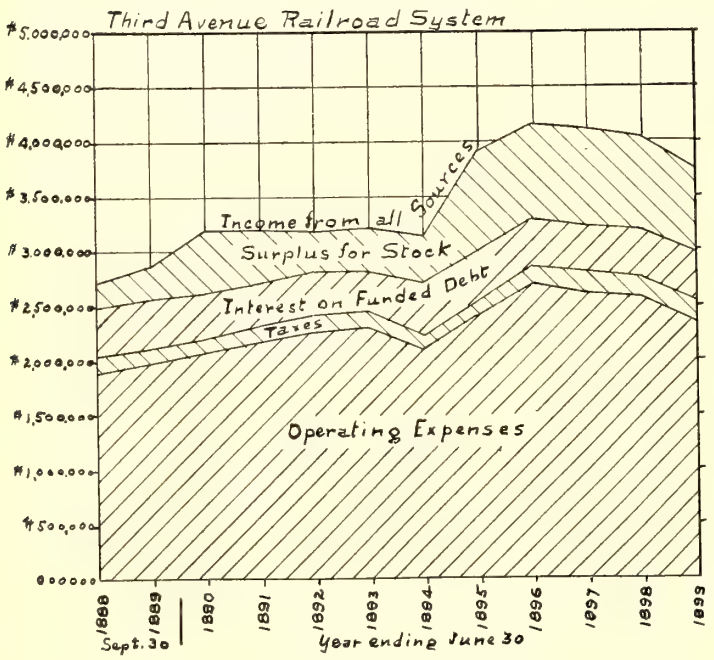


FIG. 3

George, at the upper end of the island, now running in part by electricity and in part by horses; (f) a crosstown horse railway line from the East River through 110th Street and St. Nicholas Avenue to Fort Lee Ferry; (g) a crosstown horse railway system in the lower part of the island, and (h) a line on Amsterdam Avenue to be run by electricity. The following figures and the diagrams do not include the Union Railway and its connections in the "Annexed District," control of which is owned by the Third Avenue Railway. This latter system is nearly self-supporting on an interest paying basis, but is not now adding to the dividend earning capacity of the Third Avenue system, though there is no question that in course of time the Union Railway Company's lines will be of great value, from the large growth of population expected in this comparatively new section of the city.

Referring to Fig. 3 the proportion of the total income paid out by the Third Avenue system in operating expenses, taxes and interest on funded debt for each year since 1888 are clearly seen, and surplus earnings for stock are shown to be at a maximum in 1895. In the three following years they fell off slightly, and in 1899 the reduction is considerable, owing in part, no doubt, to the difficulties incident to the period of reconstruction. The capitalization, both in stock and funded debt, has increased but gradually, but a large floating debt has lately been created, as is seen by the diagram, Fig. 2, so that the total stock and debt at the present time amounts to about $35,000,000. This floating debt doubtless represents in large part the cost of stocks of controlled companies purchased, together with the not yet capitalized cost of electrical construction, and the stock and debt outstanding should be reduced by the par value of the controlled stocks in the Third Avenue treasury, whatever this value may be. For various reasons not connected with the present discussion, the company has chosen to finance its electrical reconstruction by the proceeds of stock sales instead of bonds, and the entire capitalization (in stock and funded debt) of the whole Third Avenue system will probably be eventually about $50,000,000.

If, now, a return of 5 per cent is to be made on both stock and bonds of the Third Avenue consolidated system, a gross earning power of between $5,000,000 and $6,000,000 must be reached in order to obtain the necessary $2,500,000 for stock and bonds. The present earning power of the whole system, including not only the lines on Manhattan Island, but those in the "Annexed District" and Yonkers, is approximately $4,500,000.

The Manhattan Railway System

In the diagram, Fig. 5, is seen the disposition of the income from all sources of the Manhattan Railway system, including the "Suburban" extension in the "Annexed District," whose earnings cannot now be separated from those of the system on Manhattan Island. It will be seen that the surplus left for stock was large in the earlier years of the enterprise, and reached a maximum in 1893, since which time it has fallen to comparatively small proportions, and is now (year ending June 30, 1899) smaller than ever before in the twelve-year period, except in 1896, when it was but $2,000 less.

There is another most significant feature of the Manhattan diagram. It is here brought out in the clearest and most unmistakable way how the fact that the Manhattan Company has lost its short distance riders to the surface lines, and has retained only the long-distance traffic, affects profits. It is seen that in spite of the great reduction in gross income, the operating expenses have been reduced but slightly, while the expenses and taxes combined have been on an almost constantly increasing scale. Ordinarily in railroading expenses are increased and reduced in some proportion to gross income, but the Manhattan Company has been apparently unable to do this. The well known fact that a seat can now be generally obtained in the elevated cars except in the rush hours, is collateral evidence that the Manhattan Company is keeping up its train service with diminishing traffic, and it is probable that were this not done the falling off in traffic would be even more serious than now.

It goes without saying that the short distance riding on any railroad where uniform fares are charged is the profitable traffic, the long distance the less profitable or unprofitable. If the proportion of the short distance riding is large,

the percentage of operating expenses to gross receipts will be small. If the long distance riding predominates the percentage is larger. The Manhattan Company's experience is instructive, and the following table, showing the percentage of operating expenses to receipts from operation during the past twelve years, is even clearer evidence as to how great is the loss of short distance riders.

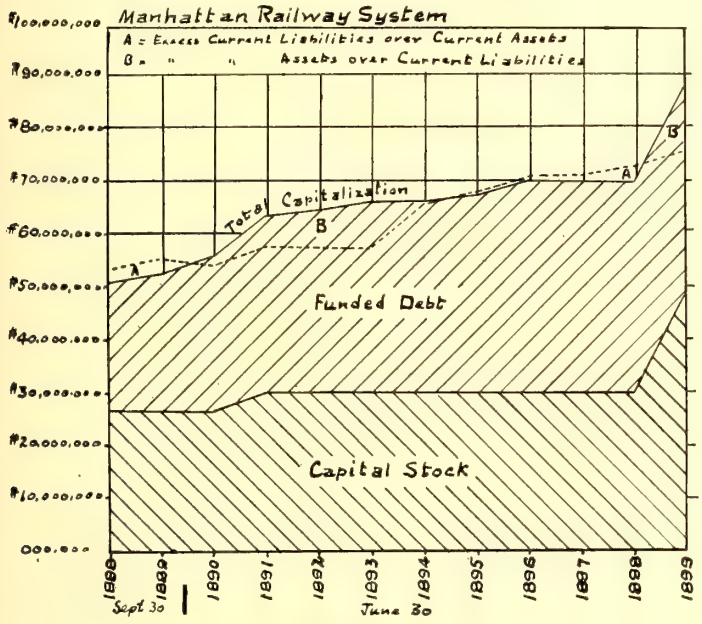


FIG. 4

Percentages of operating expenses to operating income of the Manhattan Railway system, 1888-1899.

	Per cent		Per cent
1888	55.1	1894	54.5
1889	54.5	1895	57.6
1890	52.7	1896	59.7
1891	50.9	1897	57.9
1892	50.7	1898	58.0
1893	50.3	1899	60.3

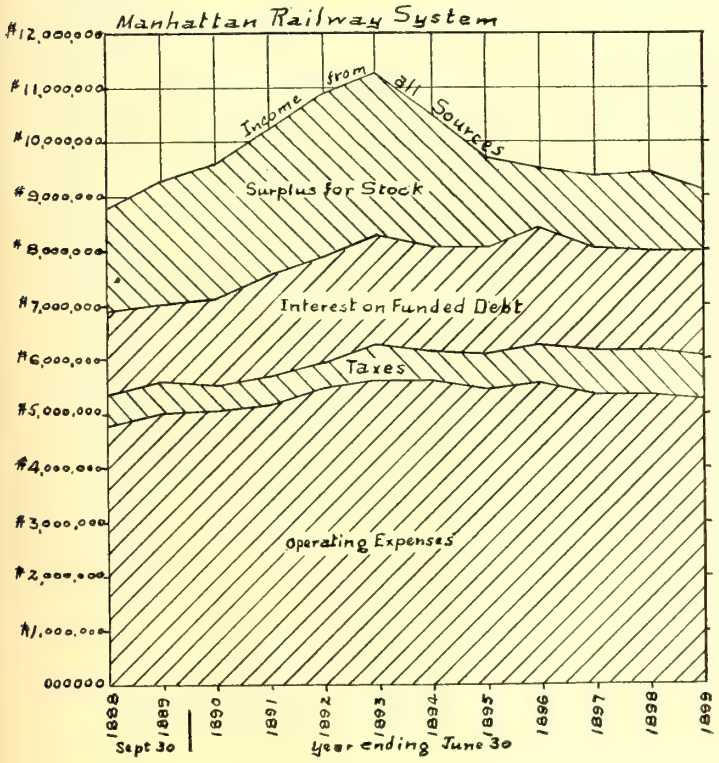


FIG. 5

What does the future hold in store for the Manhattan Company? Can it regain its lost earnings, gross and net? What will be the effect of electrical equipment upon its dividends? These are the questions which are puzzling the managers of this great enterprise.

This may be said broadly, that in the course of time, perhaps ten years hence, perhaps even less, every transportation agency on Manhattan Island will be taxed to its ut-

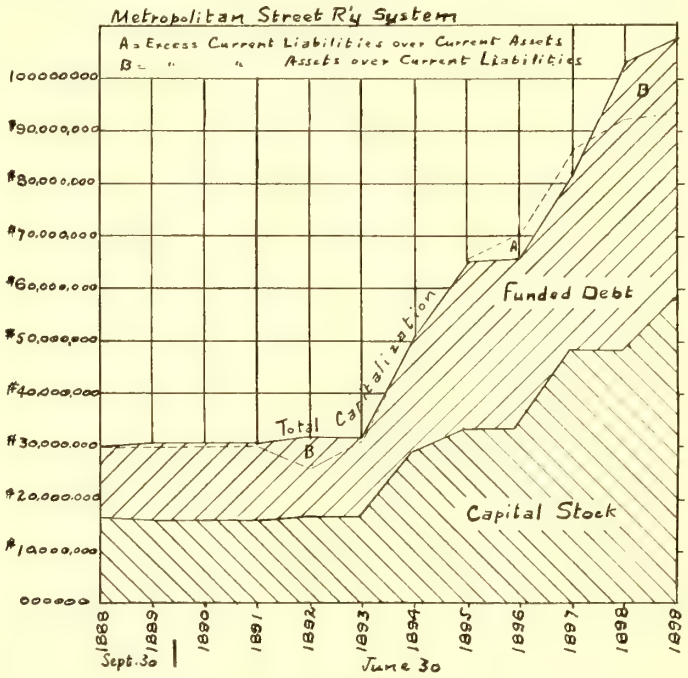


FIG. 6

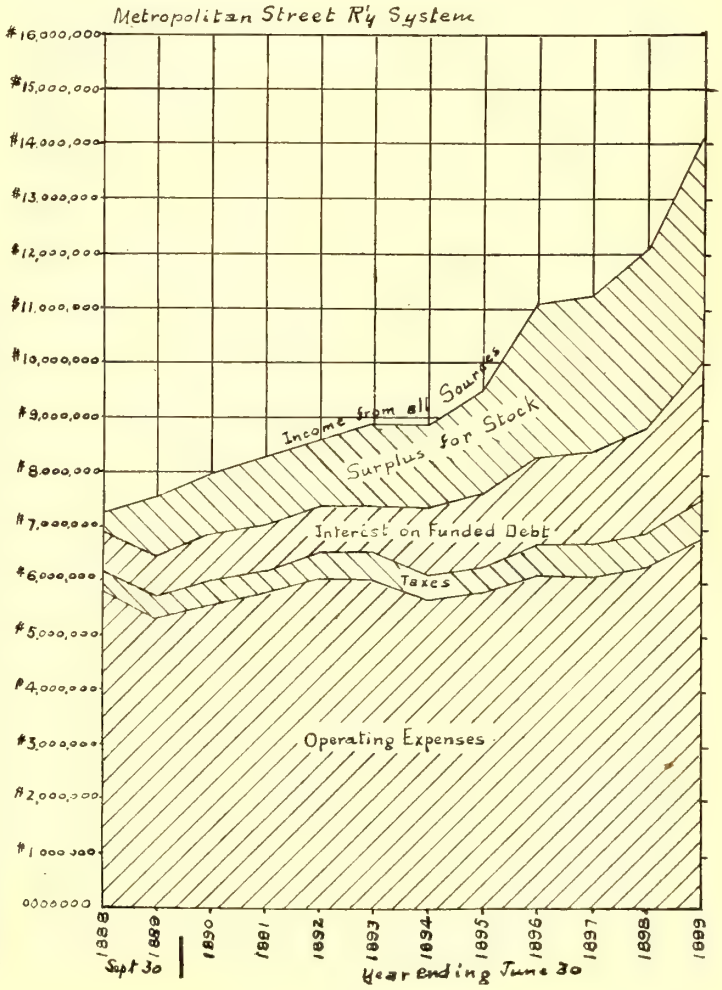


FIG. 7

most to provide accommodation for a traveling public greater by far in numbers and in freedom of patronage than exists to-day. Even should the Manhattan Company

fail to make any great improvements upon its system, its cars would probably, in time, get back much of their lost business, from the simple inability of the people to crowd upon the surface cars. The next few years of such a policy would, however, be disastrous to the company, and, in fact, for the next three or four years at least, if not for more, during the period of electrical equipment, the Manhattan Company must look forward, with what grace it may, to the prospect of diminishing gross and net earnings, since in addition to the still increasing facilities offered by the surface lines, there will be the interruptions to traffic coming with the physical work of electrical equipment.

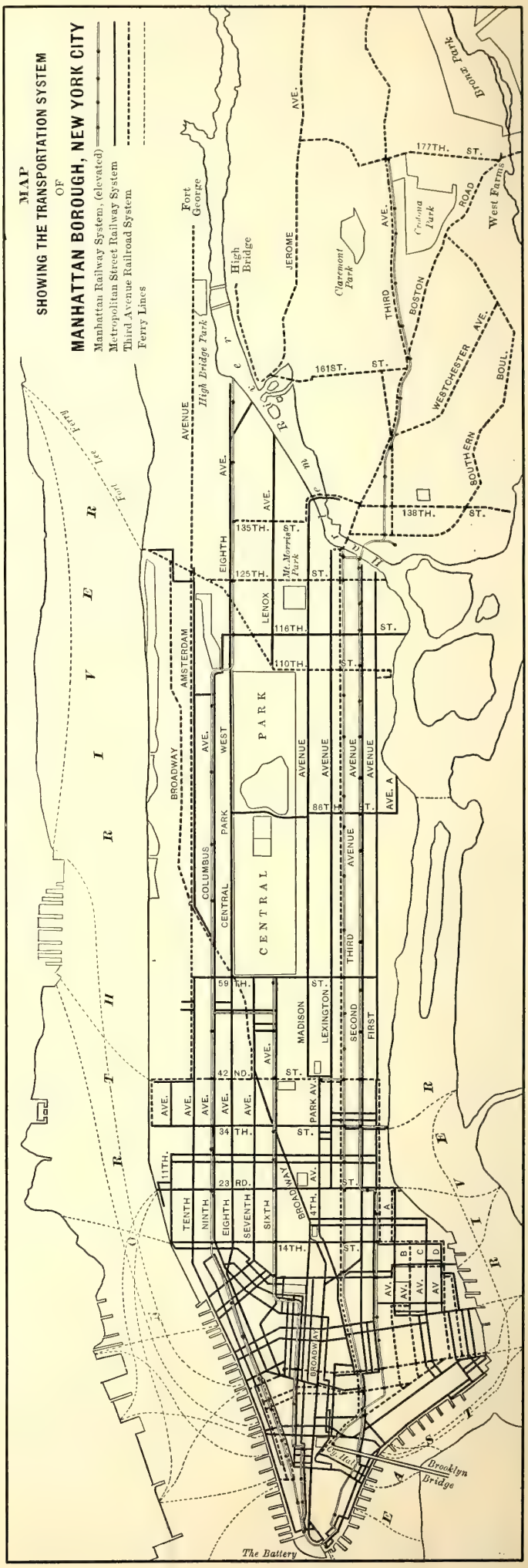
What electricity should do for the Manhattan system is to advance by a few years the period of returning traffic. How many years this will be advanced depends upon the wisdom of the decisions made by the present management. If they go into electrical equipment with the idea of saving money in operating expenses rather than of working up an increased traffic, they will miss their real opportunity, and will suffer in consequence. The cheapest thing which any electric railroad or street railway can buy or make is *power*—the most expensive thing is *labor*. If the Manhattan Company is "penny wise and pound foolish" it will buy motors and equip its power station with the idea of running its cars at the present schedule speeds, or but very little faster. If it deals with the subject in a broad and comprehensive way, determining to give the people what the people need—genuine rapid transit—it will buy large motors and large generators, and spend power freely in sending its trains over the road at much higher speeds than could ever be obtained by steam; it will put electric elevators at all its stations throughout the city; it will adopt types of cars attractive to the public, both in summer and winter; and, in short, it will be generous to the people, of New York City, who are, perhaps, of all city peoples, most quick to appreciate and use the best things of all kinds offered to it.

The immediate future of the Manhattan Company is measurably in its own hands. It is only a pity that in an age of progress and rapidly changing conditions it should have delayed so long in taking advantage of its immense potentialities. It might have controlled the transportation industry of New York City—it has let the opportunity slip from its grasp, and it can never be regained.

The Metropolitan Street Railway System

The remarkable growth in gross earnings from $7,071,940 in 1888 to $13,423,020 in 1899 has already been referred to. A more remarkable thing is that with this 90 per cent increase in gross, the operating expenses show an increase of but 17 per cent, namely, from $5,797,912 in 1888 to $6,783,913 in 1899. This is an exact reversal of the Manhattan history. For return on capital investment there was left in 1888 but $853,970, of which only $118,510 was appliable to dividends on stock, equivalent to less than three-quarters of one per cent upon the $16,221,800 of combined capital stocks of the fourteen, then existing, Metropolitan properties. For the year just ended, the net earnings for interest and dividends amounted to $6,639,816, nearly eight times as much as in 1888, and the surplus left for stock was equivalent to $4,154,506*, or 7 per cent on $58,498,500. Truly a remarkable showing is this, and one which reflects the greatest credit upon the ability of a management which, it is probably safe to say, has few equals and no superiors among the street railway properties of the United States.

What is the future of the Metropolitan system? The



* This figure includes the operating surplus for stock of the Metropolitan Street Railway Company, the Central Crosstown Railroad Company, the Thirty-fourth Street Crosstown Railroad Company, the Twenty-eighth & Twenty-ninth Streets Crosstown Railroad Company (def.), and the Fulton Street Railroad Company (def.), together with the guaranteed dividends on all other properties controlled by the Metropolitan Street Railway Company and the Central Crosstown Railroad Company, through lease.

answer is simple. With continued good management it can hardly fail to become one of the great investment properties of New York City. At present, on a 7 per cent dividend paying basis, it has still over 100 miles of track, representing nearly half its entire mileage, operating by horses —the most antiquated motive power of all. When the complicated network of crosstown lines in the lower end of the city is equipped with some of the cheaper forms of improved motive power, such as compressed air or storage battery, with which enormous investment for conduit construction is not required, the amount of short distance business riding will be vastly increased; when the new power station at Ninety-sixth Street, now nearly finished (from two to three years ahead of the Manhattan and Third Avenue power stations, work on whose foundations has but recently commenced), begins to furnish power for the entire system; and when the new cars constantly building for the Metropolitan Company to supply its urgent demands have arrived in sufficient quantities to take care of the traffic offered; service on the north and south and crosstown lines can be brought to a point more nearly meeting the requirements and largely increased gross and net earnings will inevitably result.

The Proposed Rapid Transit Tunnel Railway

A tunnel railway is projected by the Board of Rapid Transit Commissioners of New York City, and bids for its construction and operation have just been invited. The question as to how such a railway as this would, if built, influence the earning power of the present companies is an interesting one. The answer probably is that irrespective of what the effect might or might not be were the new road at present in operation, the city will, during the five-year period allowed by the Commission for construction, quite certainly grow to the additional facilities which it will offer, and the deliverance from the daily woes of travel which it will offer will be but temporary. The underlying fact which impresses itself upon all who study New York transportation conditions is that in this long, narrow island, upon which a mass of travel surges down in the morning and up at night—this metropolis of America, which is daily attracting more and more permanent residents and temporary visitors—the demand for transportation facilities will always and inevitably be far ahead of the possible supply and every means of relieving the congestion should be welcomed. The proposed rapid transit tunnel will serve to populate, and immensely increase the value of, the upper portion of Manhattan Island and the Annexed District, and it will carry express traffic, not local. Eventually the 6-mile to 10-mile travelers will use the tunnel railway, and 3-mile to 6-mile travelers the elevated system, and the half-mile to 3-mile travelers the surface lines. The surface lines will make much money, the elevated some, and the tunnel railway, it is very much to be feared, will make, for some time at least, but little, if a 5-cent fare is insisted upon.

Electric Railways in Japan

BY W. DELANO EASTLAKE

The street railroad question has reached Japan, and is at present disturbing the Oriental equanimity of the Japanese authorities more than anything else has done for many years past. The government has long since been alive to the fact that an adequate system of urban transportation is a necessity in many Japanese cities. The old style "kago" or sedan chair, long ago was superseded by the more rapid "Kuruma," or jin-riki-sha, those quaint little carts which are pulled by coolies at a breakneck speed. But even the kuruma has proved its inadequacy, and the authorities have started out to find a satisfactory substitute.

Some years ago a trolley line was equipped in Kyoto, and still remains as a monumental evidence of Japanese confidence in American integrity, and the marvelous intrepidity of whatever firm sent out the plant. To say that it is the worst sort of a failure would be to put it very mildly indeed. To be sure it is still in operation, but its uses are now similar to those of a merry-go-round at an American pleasure resort. People from the country, when visiting Kyoto, ride on the electric monster with a dare-devil spirit that is truly enviable. It is a single track system, with a switch at every few blocks, in which the uptown car must wait until passed by the downtown car. These waits are never less than ten or fifteen minutes, and I have frequently known them to last half an hour or more. To be sure, walking is a much quicker way of getting to one's destination, but then think of the excitement of the thing!

It were almost needless to say that the line does not pay were it not for the fact that it declared a 10 per cent dividend last year, and there is another short trolley line in Nagoya, equally as curiously equipped, which is paying 7 per cent dividends. Tokyo, the capital of the empire, a city of over a million and a quarter inhabitants, rejoices in a horse car line, some 8 miles in length, double track, with a capital of one million yen, or $500,000, which is now paying annual dividends of 35 per cent. Even this line, which is the best in the country, would shame the most backward village in the States, but it is enormously profitable for all that. Besides this stupendous dividend, the Tokyo Tramway Company, as it is called, also declared a reserve dividend of 10 per cent last year, which was added to the capital. The present Tokyo systems include, besides the above mentioned tramway company, the Shinagawa Tramway Company and the Senju Tramway Company. The prospective lines include a complete system in Osaka, the next largest city to Tokyo, which is already in the course of construction, or, at least, was to have been started this month; a line between Tokyo and Yokohama, which will be 18 miles long; a line between Kobe and Osaka, and lastly and most important, a complete system for Tokyo, including a belt line. There is one other existing electric road in Japan, which runs—no, moves—between Kodzu and Imoto-Hakone, called the Odawara Electric Company, and which is paying 7 per cent dividends.

Again, there is talk of converting the present Tokyo Tramway into an electric line at an early date. The specifications, among other things, call for rails weighing 50 lbs. per ft., wheels 30 ins. in diameter, and a distance of 7 ft. between the front and rear wheels, or not less than 6 ft. 6 ins. The length of each car is to be 24 ft., their weight, with fifty-two passengers, not to exceed 10 tons; the cars to run at three and five minutes headway, and to make from eight to thirteen round trips daily. Total length of track, 16 miles.

But all this is still on paper, for the authorities have not yet decided upon the system which, if adopted, will become universal in Japan. Not long ago an official (Mr. Fujita) came to this country for the special purpose of looking into the various systems now in vogue, both in this country and in Europe, and while his report was most careful and valuable, it did not bring the authorities to any conclusion. The opinion seems very strong in Japan that the overhead trolley system will soon be superseded by a more modern and perfect one, and so long as they have waited thus long they consider it wise to wait until whatever system is adopted has at least passed beyond the experimental point in foreign lands. There is, however, no doubt but what some system is soon to be adopted, and it largely depends upon the zeal of our manufacturers as to whether that system shall be an American one or not.

LEGAL NOTES AND COMMENTS*

Edited by J. Aspinwall Hodge, Jr., of the New York Bar

A Book on Patent Law for Laymen as Well as Lawyers†

It is seldom that a law book is useful in the hands of the layman; but Mr. Greeley's work on foreign patents and trade mark laws is an exception to this rule, especially in the latter half of the volume which treats of trade mark laws.

We venture to assert that the legal status of trade marks, even in our own country, and especially the legal effect of the registration thereof, is not understood by nine-tenths of the owners of trade marks in the country, and if we are mistaken in this statement, we still believe that it is true, concerning the nature of foreign trade marks.

Mr. Greeley's work, therefore, written in terse English, concisely and to the point, bringing down the laws which, of course, are subject to frequent changes, to date, is almost invaluable. It would be so were the laws which he digests, easily obtainable in the English language by those who are in the vicinity of Washington and New York.

A compendium of such laws, published in foreign languages, and some of them to be found only in the annual volumes of foreign laws, adds much not only to the usefulness, but to the virtual necessity of the volume to anyone who would treat with foreign countries understandingly.

There are other works upon foreign patent laws, and standard ones, but they are ten years old or more, and so, in many cases are not reliable when consulted for the existing law. They do not give, as does the volume under discussion, a satisfactory compendium of the trade-mark laws. We quite agree with the author's comment in his preface, that to the business man the trade mark and a knowledge of the trade-mark law is more likely to be useful, and when it is useful, is more advantageously so than a like knowledge of the patent law.

A perusal of the work has suggested that some of our readers may be interested in a few of the essential characteristics of trade-mark laws.

The original trade-mark rights recognized by the courts were recognized not so much to protect the user of the trade mark, as the public, and it is interesting to read the original decisions which look at the matter from that standpoint. It was thought that the public was injured when an article was passed off upon them which was not what they supposed they were obtaining. Afterward, trade marks were recognized as property which should be protected, because people would suppose that A. B. using a certain trade mark was producing inferior goods, since they had bought goods with that trade mark which were not up to the standard; so that A. B. upon showing these facts was able to succeed in the legal contention that arose out of the fact that the inferior goods were being manufactured by some rival.

The registration acts of the various nations, requiring or allowing the user of a trade mark to register the same, vary much; but they can be easily divided into two classes, and there is not much difficulty in classifying the laws of any nation under one or the other of the two classes.

They are either declarative or attributive. Where they are declarative, the property in the trade mark exists quite apart from registration, and the registration of the trade mark is merely declarative of the existence of the property right, and is merely *prima facie* evidence that he who thus registers is the owner and first user;—evidence which can be rebutted by evidence that some one else has used the trade mark prior to the use of it by the person who thus registers it.

Where the attributive law prevails, as it does in many countries, he who first registers, and sometimes irrespective of whether he has used the trade mark or not, has the right to protect himself against all those who attempt to use it, even if prior to his registration thereof they have used it.

A mere statement of these facts shows how important it is that exporters to foreign countries, before the introduction of their goods bearing a trade mark, should protect themselves, especially where an attributive trade mark law prevails.

* Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

† Foreign Patent and Trade-Mark Laws; a comparative study, with tabulated statements of essential features of such laws. By Arthur P. Greeley, Assistant Commissioner of Patents. John Byrne & Company, Washington, D. C.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

CALIFORNIA.—Bonds—Issuance—Stockholders' Liability.

Under Civ. Code, Secs. 456, 510, which provide that street railroad companies may issue bonds in payment of contracts for constructing and completing their roads, and section 359, which provides that the bonded indebtedness of a corporation may be created or increased by a vote of the stockholders representing at least two-thirds of the entire capital stock, a stockholder is not liable, in an action to enforce his stockholders' liability, for bonds issued in part payment for the construction of the road, for the issuance of which the stockholders never voted.—(Boyd et al., vs. Heron et al., 58 Pac. Rep., 64.)

LOUISIANA.—Appeal—Jurisdiction—Assessment for Public Improvements—Forced Contributions—Paving Streets—Apportionment of Cost—Space Between Tracks.

On motion to dismiss. 1. The matter at issue, being a question of local assessment or charge upon the property of abutting proprietors in a municipality, levied upon compulsion of law alone, to pay the cost of street improvement, and without their knowledge or consent, is a tax, in the sense of the constitutional provision conferring appellate jurisdiction on this court.

2. There can be no difference or distinction in principle between a forced contribution for levee purposes and a forced contribution for street improvement.

3. While it has ever been held with practical unanimity in numerous decisions of this court that the portion of the cost of the paving and improvement of streets and banquettes in cities and towns, which is, under the law, chargeable to abutting property-owners, is not a tax, in the sense of the jurisdictional article of the constitution, yet the reason for so holding evidently is that, under the provisions of the different city charters, such assessments were based primarily upon petitions signed by the abutting property-owners, and consequently not predicated upon the fiat of the Legislature, notwithstanding same are levied upon the theory of local benefits conferred upon the property of said abutting proprietors.

4. The feature which distinguishes local assessments for public State purposes from those for city street improvement is, in all laws except the one under consideration, the assent of the property-owner.

5. This court affirms the proposition announced in State vs. Judges of Court of Appeals, 16 South. 219, 46 La. Ann. 1292, to the effect that "the use of the words 'all cases,' and of the words 'any tax, impost or toll whatever,' clearly indicates on the part of the framers of the constitution an emphasized intention to give to the terms 'tax,' 'toll,' and 'impost' the widest meaning to which they are susceptible, and to allow every citizen to have submitted to the test of legality and constitutionality, by the highest court of the State, any charge upon his property imposed by the State or its subordinate political agencies, when claimed to be legally and constitutionally imposed by them in aid of governmental purposes, whether extending over the whole State, or over particular localities;" and, further, that "it is manifest that the word 'tax,' in this part of the constitution, is used in its largest sense. After the words describing the jurisdiction of this court as extending to all cases involving the legality or constitutionality of any tax, toll, or impost, there is added the word 'whatever;' i. e., whatever the character of that tax, toll, or impost."

6. The present controversy comes clearly within the reason and spirit of that decision, because the cost of the local assessment therein involved is a tax, within the intendment of the jurisdictional article of the constitution.

On the Merits. 1. This suit involves an interpretation of an ordinance of the city of Shreveport which requires that abutting property-holders throughout the length of a street that has been paved shall pay two-thirds of the cost of same, each one paying in proportion to frontage; that the street railroads shall pay in proportion to the space occupied by their roadbed, compared to the width of the street; and that the city shall pay the remainder, this assessment having been made in pursuance of Act No. 10 of 1896, and wholly without the assent of the abutting property-holders. The ordinance is founded upon the supposed authority that is conferred by the second section of said act, which provides that abutting owners shall pay two-thirds of the entire cost, and the corporation shall pay one-third from its general resources, and provided that, where a railway bed or track occupies a part of the street, it shall pay in proportion to the space occupied by its roadbed, compared with the width of the street. Finding, upon comparison of the city ordinance with the statute, that the former has transposed the terms of the latter by stating (1) the share of the abutter to be two-thirds, (2) that of railroad companies in proportion to the space occupied by them, (3) the city should pay the remainder, whereas the latter states (1) the share of the abutter shall be two-thirds, (2) the city one-third, and, (3) provided

that a street railway occupies a portion of the street, it shall pay in proportion to said space, same are irreconcilable.

2. Entertaining the view that the ordinance is not in keeping with the terms of the statute, the true import of which is to require the portion of the cost due for street improvement by railroad companies to be first deducted from the total amount, and the remainder distributed between the abutters and the municipality, two-thirds to the former and one-third to the latter, same is declared null and void.

3. The uniform current of judicial opinion affirms the principle that the right of occupancy of a portion of the streets of a municipality by a street railway corporation is property which is benefited by a street improvement, to the extent of the space occupied by its roadbed and tracks, which renders same liable for its proportionate share of its cost, just as the property of abutting property-owners is liable; that the railway company using the streets for the operation of its cars is in duty bound to pay for the work on the streets which its track alone makes necessary—that is to say, all expense for that portion of the work lying between the exterior rails of the track of the road, and for a distance of 2 ft. from the exterior to the track on each side thereof.

4. That in no case can any portion of the cost of such improvement be attributed to, or assessed against, the abutting property-owners.

5. That, when a statute or municipal ordinance makes provision for the assessment of a street railway corporation for the pavement of such space as its tracks and roadbed occupy, such provision is mandatory, and any portion thereof which is put upon the abutting property-owners is illegal and void.

6. The very object and aim of such a statute as the act in question is to relieve the municipality and abutting owners, proportionately, from defraying any portion of the cost incident to the part of the street improvement covered by the tracks of a street railway.

7. The space occupied by a street railroad company is matter of proof, to be administered and determined in some proceeding contradictorily between all parties in interest—the municipality, the abutting property-owners, and the street railway companies; and the ordinance which arbitrarily fixes said space, without a contradictory hearing, cannot be sustained as valid.—(City of Shreveport vs. Prescott et al., 26 So. Rep., 664.)

UNITED STATES COURTS

NEW YORK.—Appealable Decrees—Violation of Injunction.

An order imposing a fine for violation of a preliminary injunction cannot be reviewed except upon an appeal from the final decree in the cause.—(Nassau Electric R. Co. vs Sprague Electric Railway & Motor Co., 95 Fed. Rep., 415.)

PATENT DECISIONS.—Suit for Infringement—Preliminary Injunction.

Where the question of infringement is a doubtful one, and to sustain the claim requires a broader construction of the claims of the patent than has been given in prior adjudications, such question should not be determined on a motion for preliminary injunction.—(Sprague Electric Railway & Motor Co. vs. Nassau Electric R. Co., 95 Fed. Rep., 821.)

Anticipation—Buffer Spring for Trolley Arm.

1. A patent for a buffer spring so constructed as to come into operation when the upwardly pressed trolley arm of an electric railway car has assumed a vertical position, and, by engaging therewith, prevent damage being done to the trolley, or by it to the car on which it is placed, was anticipated by the prior use of similar springs as recoil buffers to receive the shock of the projector arm in devices for throwing glass balls as targets.

Same.

2. The Baker patent, No. 437,961, for an improvement in trolley devices for electric railways, was anticipated by the Holden patent, No. 244,897, and the Bloom patent, No. 313,804, covering analogous devices in traps for throwing glass balls, and also by the Van Depoele patent, No. 405,750, for an improvement in trolley devices.—(Thomson-Houston Electric Co. vs. Rahway Electric Light & Power Co., 95 Fed. Rep., 660.)

LIABILITY FOR NEGLIGENCE

CONNECTICUT.—Action for Injuries Causing Death—Evidence—Photographs—Argument and Conduct of Counsel—Reading Reports.

1. In an action against a street railroad company, where it was charged with negligence in allowing the rails of its track to project above the roadway, testimony as to the condition of the street at places other than place of accident was inadmissible.

2. In an action against a street railroad company for negligence in maintaining its roadway, testimony showing the condition of the track at and near the place of the accident within a year prior thereto is admissible.

3. In an action against a street railroad company for negligence in allowing the rails of its track to project above the roadway, a photograph of the street, including the place of the accident, is not admissible to show the height of the rails and the condition of the roadway, without any evidence as to its accuracy.

4. Where counsel, in his closing argument to the jury, attempts to influence them by reading findings of fact in a similar reported case, the court may properly dismiss the panel.—(Cunningham vs. Fair Haven & W. R. Co., 43 Atl. Rep., 1047.)

MINNESOTA.—Injury to Passenger—Excessive Damages—Evidence.

1. Evidence considered, and held sufficient to justify the jury in finding that defendant's servants were negligent.

2. Damages held not to be excessive.

3. Certain questions of practice and admissions of evidence considered and disposed of.—(Fonda vs. St. Paul City Ry. Co., 79 N. W. Rep., 1043.)

MASSACHUSETTS.—Obstructing Streets—Contractors—Injury to Pedestrians—Negligence.

1. A woman walking along a street in the evening, not noticing rails temporarily left in the highway to be placed in defendant's street car track, fell and was injured, though her daughter, who preceded her, passed without accident. There were many lights in the vicinty, but the jury might have found that one of the two lights placed there as a warning had gone out. *Held*, that the question of her due care was properly left to the jury.

2. Defendant's railway was then in operation, and a contractor was taking out the old rails and putting in new ones. There was no evidence whether the contractor was acting independently or as employee of the railway company, but defendant, within whose peculiar knowledge it was, offered no evidence to prove the relation between it and the contractor. *Held*, that the evidence justified a finding that defendant was responsible for the rails being there. (Slayton vs. West End St. Ry. Co., 54 N. E. Rep., 351.)

MINNESOTA.—Negligence—Evidence.

1. In an action for damages for the death of plaintiff's intestate, caused by the alleged negligence of the motoneer of one of defendant's cars, *held*, that the evidence was conclusive that the deceased was guilty of contributory negligence.

2. Also, that there was no evidence that the motoneer was guilty of any wanton or willful negligence in failing to make proper efforts to avoid injury after he discovered the deceased in a place of danger. (Gagne vs. Minneapolis St. Ry. Co. et al., 79 N. W. Rep., 671.)

MINNESOTA.—Injury to Passenger.

Plaintiff, a street car passenger, signaled for the car to stop so that she might alight, and as it commenced slowing up she went upon the lowest step of the car, and stood there for a moment, while the car was slowly moving, holding on to the car rail to steady and protect her from falling, when the car, before stopping, started forward with a jerk, and threw her to the ground, whereby she sustained personal injuries. *Held*, that the defendant's negligence and the plaintiff's contributory negligence were questions for the jury. Saiko vs. Railway Co., 69 N. W. 473, 67 Minn. 8, distinguished. (Currie vs. Mendenhall, 79 N. W. Rep., 677.)

MINNESOTA.—Collision with Fire Department—Contributory Negligence.

1. *Held*, the duties of a member of the city fire department, when driving fire apparatus on a call to fire, may require him to take risks which it would be negligence for a private person to take in pursuit of his private business.

2. In an action by such a member against a street railway company for damages for an injury to him resulting from a collision, at a street crossing, between a street car and a hook and ladder truck driven by him, *held*, that the question of defendant's negligence and of his contributory negligence were both for the jury. (Warren vs. Mendenhall, 79 N. W. Rep., 661.)

NEW JERSEY.—Punitive Damages—Torts of Servant.

1. A principal, whether an individual or a corporation, cannot be charged with punitive damages for the illegal, wanton, or oppressive conduct of a servant, unless the principal participated in the wrongful act of the servant, either expressly or impliedly, by his conduct authorizing or approving it either before or after it was committed.

2. Punitive damages are in the nature of a penalty, especially designed as a punishment for the wanton conduct or malicious motives of a tort feasor, and can lawfully be imposed only when the reprehensible act is brought home to the defendant. (Forhman vs. Consolidated Traction Co., 43 Atl. Rep., 892.)

NEW JERSEY.—Injury to Passenger—Negligence—Riding on Platforms—Contributory Negligence.

1. The occurrence of a sudden lurch or jerk of a street railway car, of sufficient violence to throw a passenger off the platform, who was there preparing to alight, and awaiting the stoppage of the car for that purpose, justifies an inference of a breach of duty

upon the part of those operating the car, within the maxim "Res ipsa loquitur." Traction Co. vs. Thalheimer, 37 Atl. 132, 59 N. J. Law, 474. That the car was following another closely, which was stopping and starting suddenly, is a fact for the consideration of the jury, in determining the cause of the sudden lurch or jerk, and as bearing upon the questions of negligence arising in the cause.

2. It is not negligence per se for the passenger to ride upon the platform of an electric street railway car, nor to get up and go there from inside the car before the car has stopped, to await an opportunity to alight.

3. The railway company operating such a car is bound to exercise a high degree of care to carry its passengers safely in or upon whatever part of the car they are permitted to ride.

4. Whether a passenger riding upon a platform, or standing there awaiting an opportunity to alight, while the car is moving, should, in the exercise of ordinary care for his own safety, take hold of the hand rail there, is a question which, under all the circumstances, must be determined by the jury.—(Scott et al. vs. Bergen County Traction Co., 43 Atl. Rep., 1060.)

NEW YORK.—Collision Between Street Cars—Contributory Negligence of Motorman.

1. Under a rule of defendant, a street railway company, if a car going east after starting from the station was found to be defective it was to be brought back to the station over the west-bound track. About 5 o'clock on a morning that was so foggy that a car could not be seen more than 15 ft. or 20 ft. distant, a car going east was started on the east-bound track, and after it had gone about a half of a mile the motorman found it had no fender; and, instead of returning on the east-bound track, he proceeded 2 miles to a switch, and returned over the west-bound track. About twenty minutes after five, another car, with a conductor and a motorman, was started from the station, going east, over the west-bound track. As to whether this was by order of the train dispatcher, the evidence was conflicting. Both the conductor and the motorman knew of the rule stated. The car was proceeding at the rate of 4 miles an hour, the motorman ringing the bell continually; and when it had gone about 2 miles he saw the headlight of the returning car about 15 ft. in front of him, and when too late to prevent a collision by which he was injured. Held, that the proximate cause of the accident was the negligence of the conductor and motorman in taking out the car on the wrong track on a densely foggy morning, and that the company was not liable.

Conductor and Motormen Fellow Servants.

2. The conductor and motorman on an electric car are fellow servants, and the negligence of the former is imputable to the latter.—(Savage vs. Nassau Electric R. Co., 59 N. Y. Suppl., 225.)

NEW YORK.—Injury to Children—Negligence.—A boy of six, of average intelligence, was permitted by his mother to play after dark on the street in front of the house, under her control. The father was on the opposite side of the street, and the boy, while his mother was temporarily in the house, and the father was not watching, started from the curb to cross to the father. The place was 50 ft. to 60 ft. from the crossing, and a street car, 37 ft. to 75 ft. away, was approaching at about six miles an hour, its usual rate in that locality. The curb was 18 ft. from the track, and the view of the car was unobstructed. The boy struck the car at the edge of the fender or the dashboard, and was injured. The motorman was prudently operating the car, and stopped it in 20 ft. *Held*, that the company was not liable. (Adams vs. Nassau Electric Ry. Co., 58 N. Y. Suppl., 543.)

NEW YORK.—1. Injury to Employee—Contributory Negligence.—An employee of an electric railway company, who while accompanying a flat car a short distance in the discharge of his duty, rides thereon instead of on the motor car, which is designed for the accommodation of passengers, cannot, as a matter of law, be said to be guilty of contributory negligence, if injured while so doing.

2. Same.—Nor can he be said to have been guilty of contributory negligence, as a matter of law, for sitting on a corner of the car, so that one of his legs was between the flat car and the motor.

3. Same—Obligation of Master.—It is the duty of the master to exercise reasonable care in furnishing safe and suitable appliances for the servant to work with, and the servant has a right to rely on the discharge of this duty.

4. Same—Notice of Defect—Character Thereof.—In an action to recover for personal injuries, evidence that an accident was due to the sudden falling off of the brake shoes of a car shows such a defect as would authorize the jury in finding that the defendant, in the exercise of reasonable care, should have had notice thereof.

5. Same.—In an action by an employee to recover for personal injuries, evidence that an accident was due to the sudden falling off of the brake shoes of a car shows a defect of which he, being temporarily engaged with the car, could not reasonably be supposed to have notice. (Butler vs. New York & Q. C. Ry. Co., 58 N. Y. Suppl., 1061.)

NEW YORK.—1. Damages—Injury to Vehicle—Cost of Repairs.—Evidence of the cost of repairing a vehicle injured by the alleged negligence of defendant is insufficient, as a basis of damages, without further evidence that such cost was the reasonable worth of the necessary repair.

2. Same—Usable Value of Vehicle.—While the usable value of a coach, for the period during which it was being repaired, is a proper element of the damages accruing from the injury to the coach, yet the evidence of such value must not be so uncertain as to require the jury to guess and speculate. (Volkmar vs. Third Ave. Ry. Co., 58 N. Y. Suppl., 1021.)

NEW YORK.—Driving Across Track—Contributory Negligence.—Where a driver of an express wagon attempted to cross car tracks on a street where the company's cars had the right of way, and when a car was only 100 ft. away, and, finding his mistake, attempted to get over by whipping his horse, but too late, he was guilty of contributory negligence. (Reiss vs. Metrop. St. Ry. Co., 58 N. Y. Suppl., 1024.)

NEW YORK.—Appeal—Review.—Where, in an action for collision on a highway, plaintiff's servant testified to circumstances from which his freedom from contributory negligence and defendant's servant's negligence might be found, despite the latter's contradictory statements, a judgment for plaintiff should not be disturbed. (Seaman vs. Metropolitan St. Ry. Co., 58 N. Y. Suppl., 1053.)

NEW YORK.—Carriers—Injuries to Passengers—Sufficiency of Evidence.—Plaintiff testified that the street car started suddenly while she was alighting, throwing her to the ground. The conductor, the motorman, and three passengers testified that the car came to a full stop before plaintiff attempted to alight, and that it made no movement until after she had fallen. *Held*, that a judgment for plaintiff would be reversed. (Hart vs. Metropolitan St. Ry. Co., 58 N. Y. Suppl., 1088.)

NEW YORK.—Appeal—Review—Excessive Damages.—Unless it is manifest that the verdict in an action for personal injuries was the result of passion, prejudice, or corruption, it will not be disturbed as excessive.

2. Same—Error Cured.—In an action for personal injuries, the defendant moved to strike out the value of the doctor's services. The court denied the motion, saying, "I will deny the motion, but she [plaintiff] cannot recover for it here," but charges that there was no evidence of payment to physicians sufficient to warrant recovery for medical services, and that the doctor's bill was eliminated from the case, were given at the close of the case. *Held* that, if there was error in denying the motion, it was cured by the subsequent charges. (Polak vs. Metropolitan St. Ry. Co., 58 N. Y. Suppl., 1133.)

NEW YORK.—Elevated Station in Street—Right to Erect.

1. A street railway company cannot erect an elevated structure in a street for the storage of its cars or accommodation of its trainmen, to the injury of an abutter.

Same—Cleaning Cars in Street—Injunction.

2. Where a street railway company's charter prohibits it from washing its cars in a street, an abutter may have it restrained from so doing.—(Waldmuller et al. vs. Seaside & B. B. El. R. Co. et al., 58 N. Y. Suppl., 7.)

NEW YORK.—Negligence—Question for Jury.—Plaintiff was knocked down by a cable car, and, after being dragged some distance, was run over. The gripman, who was an inexperienced man, testified that the car was stopped almost as soon as plaintiff was struck. A number of the witnesses who saw the accident contradicted the gripman's statement that the gong was rung, and also testified that the car went about 75 ft. after plaintiff was struck. An expert witness testified that the car could have been stopped within 25 ft. *Held*, that the question whether there was negligence in not stopping the car sooner should have been left to the jury.

2. Same—Effect of Contributory Negligence.—Although plaintiff was negligent in being struck by defendant's car, he may recover, if his injury was caused by defendant's subsequent negligence in failing to stop the car in time after he was struck. (Green vs. Metropolitan St. Ry. Co., 58 N. Y. Suppl., 1039.)

NEW YORK.—1. Carriers—Defective Appliance—Curtain Rods—Liability.—An open electric car was provided with curtains, at the bottom of which was an iron rod, with brass shoes on each end, which worked in a groove. On the day of a high wind, when the curtains were pulled down on the windward side, a shoe broke where it was inserted into the rod, and the end of the rod struck and injured plaintiff, a passenger. The break was clean, and showed no flaw. The car was built and the curtains put in by a firm of high standing in 1895, and the car had been used only dur-

ing the summers of 1895 and 1896. Similar curtains were in general use on a great many other roads. No similar accident was shown, and there was evidence that none such had occurred on defendant's road. It was not shown that the rod had ever been examined. *Held*, that defendant is not liable.

2. Same—Degree of Care.—An electric railway company is not bound to use the highest degree of care in respect to the curtain rods of its cars. (Leyh vs. Newburgh Elec. Ry. Co., 58 N. Y. Suppl., 479.)

NEW YORK.—Injuries to Passengers—Contributory Negligence.

1. Plaintiff signaled a street car approaching the crossing on which he was standing to stop, and it slowed down, but did not stop completely, whereupon he attempted to board it while in motion, and after it had passed the crossing, and in doing so was injured. It did not appear that the slowing down of the car was in response to plaintiff's signal. *Held*, that plaintiff was guilty of contributory negligence.

Same—Failure to Stop for Passenger—Negligence.

2. A street car, on being signaled to stop, merely slackened its speed, without stopping, whereupon plaintiff attempted to get on it while in motion, and was injured. There was no evidence that the car had slowed down in response to the signal, or that the conductor or motorman knew of the attempt to board it. *Held*, that a finding in an action to recover for such injuries, that the persons in charge of the car were negligent, was not warranted. —(Reidy vs. Metropolitan St. Ry. Co., 58 N. Y. Suppl., 326.)

NEW YORK.—Injuries to Passengers—Defective Appliances.

A finding by a jury that a construction by a railroad company of overlapping swinging doors leading to a platform that was used daily by several thousand persons, and was long enough to enable the company to build doors, so that they could not overlap, was negligence, so as to justify a recovery by a passenger injured thereby, will be sustained; it being the company's duty to furnish its patrons with reasonably safe means of ingress and egress to and from the platform.—(Kiernan vs. Manhattan R. Co., 58 N. Y. Suppl., 394.)

TEXAS.—Damages—Personal Examination.

Where plaintiff in an action for personal injuries has exhibited them to the jury, and physicians have testified in relation to them, defendant is entitled to have an examination by experts of its own selection.—(Chicago, R. I. & T. Ry. Co. vs. Langston, 51 S. W. Rep., 331.)

NEW YORK.—Collision Between Electric Cars—Injury to Passenger.—An electric car, running at a high rate of speed, came into collision with a car on a parallel track, which had collided with a beer wagon a few seconds before. There was no evidence as to the manner of operating the car which collided with the beer wagon, nor as to who was answerable for such car being thrown on the track of the car on which plaintiff was a passenger. The distance between the cars at the time of the first collision was about 150 ft., and the interval of time about five seconds. *Held* to justify a finding that defendant was not guilty of negligence. (Snediker vs. Nassau Electric Ry. Co., 58 N. Y. Suppl., 457.)

NEW YORK.—Evidence—Expert Testimony.—In an action against a street railway for injuries to a child three years old, it appeared that the motorman was justified in believing that the child would cross the track safely, until the car was within 20 ft. of the child. At this distance the motorman applied the brake, and stopped the car within 20 ft. to 25 ft., but not in time to prevent the accident. An expert witness called by plaintiff testified that, by proper application of the brake, the car could be stopped within a distance of from 20 ft. to 25 ft. *Held* that, as the evidence was competent and material to issue, it was error to strike it out at the request of plaintiff. (Frohle vs. Brooklyn Heights Ry. Co., 58 N. Y. Suppl., 561.)

NEW YORK.—Damages—Personal Injuries. In an action for personal injuries, an instruction that, if the jury found for plaintiff, he was entitled to recover what would be his reasonable expense incident to his condition in the future, is erroneous, where there is no evidence as to what he would be required to pay because of his injuries in the future. (McKenna vs. Brooklyn Heights Ry. Co., 58 N. Y. Suppl., 462.)

PENNSYLVANIA.—Accident to Passengers—Instructions.

1. There being conflicting evidence as to whether a passenger got off a street car before it stopped, or did not leave it till it stopped, and it started with a sudden jerk while she was getting off, causing her to fall, and nothing to take the case out of the rule that it is negligence for a passenger to alight from a moving train, it is error to charge that, if the jury take the version that the car had not stopped when she undertook to get out, they might find her guilty of contributory negligence, and in that case she would not be entitled to recover, and that, if she undertook to get off the car before it stopped, they might ascertain that she ought to have waited.

2. There being no evidence that the car was going so slowly as to be substantially stopped when the accident occurred, it is error to introduce that element into the answer to a requested instruction.—(Neff et al. vs. Harrisburg Traction Co., 43 Atl. Rep., 1020.)

PENNSYLVANIA.—Carriers—Injury to Passengers—Evidence.

An electric car on an up grade stopped, and could not be moved. An employee of defendant (though in what capacity it did not appear) gave instructions to the motorman, sanded the track, and, when all attempts to move the car proved futile, told the motorman that he would procure another car, which he did. In bringing up the relieving car, from some cause it ran into the disabled car, and injured a passenger. Held, that the burden was on defendant to rebut the presumption that the injury was by its negligence, by showing that such employee on the relieving car was a mere intruder, acting without authority.—(Madara et ux. vs. Shamokin & Mt. C. Electric Ry. Co., 43 Atl. Rep., 995.)

PENNSYLVANIA.—Contributory Negligence — Non-suit.—A woman stopped at the curb of a street, and looked before attempting to cross. The trolley car that subsequently struck her was then approaching at a distance of 185 ft. She stood there "some time" after looking, and while crossing the track she was struck. The evidence was conflicting as to the speed of the car and its distance from the woman immediately before she stepped on the track. *Held*, that the question of contributory negligence was for the jury. (McGovern vs. Union Traction Co., 43 Atl. Rep., 949.)

TENNESSEE.—Appeal—Objections—Harmless Error—Trial —Instructions—Negligence of Motorman.

1. An objection to the admission of evidence cannot be first raised on appeal.

2. A charge that it is the duty of a motorman to keep a vigilant lookout for children on the street, and upon the first appearance of danger, or probable collision with a child, to stop the car in the shortest time and space possible, does not impose too great a degree of care on the motorman, where it is charged, in the same connection, that he is bound to act only as a man of ordinary prudence.

3. In an action for death by negligence, the court said that it was natural for the jury to have their sympathies aroused, and that "this [was] entirely proper," but that, as jurors, they must not forget their duty to render a verdict according to the law and the evidence, and also cautioned them not to allow their sympathy to affect their verdict. *Held*, that there was no reversible error.

4. Special requests need not be given, when they are embodied in the main charge. (Citizens' St. Ry. Co. vs. Dan, 52 S. W. Rep., 177.)

TENNESSEE.—Negligence—Street Crossing Accidents—Contributory Negligence—Burden of Proof.

1. In an action for negligence, the burden of proof is not on plaintiff to show affirmatively that he was exercising ordinary care.

2. In action for personal injuries, brought by one who was run down at a crossing by a vehicle, a charge that defendant might presume that any one crossing the street would see the way in which he was using it, and not attempt to use it right in front of him, so as to make it impossible for him to avoid a collision, is erroneous, as ignoring the circumstances of the collision, and the rate of speed at which defendant was driving. (Burke vs. Citizens' St. Ry. Co. et al., 52 S. W. Rep., 170.)

TEXAS.—Speed—Instructions—Evidence.

1. In an action to recover for damages occasioned by a collision with one of defendant's street cars, it is not error to charge that it is negligence to run its cars at a greater rate of speed than is allowed by ordinance.

2. Error cannot be predicated on a part of a charge where, when considered as a whole, the charge fully protects appellant's rights.

3. In an action for damages resulting from a collision with a street car, it is not error to permit a witness to state that "the car was going faster than any horse and buggy would travel over a good road at any kind of a trot," as the latter fact is a matter of common knowledge and observation.

4. In an action to recover for personal injuries sustained by reason of a collision with a street car, testimony that witness saw plaintiff a few days after the accident, and that he was limping, is competent, as showing present pain.

5. In an action to recover for personal injuries, the admission of testimony "that witness saw plaintiff a few days after the accident, at a place other than plaintiff's home, and that plaintiff said he was hurt, and wished that he had not come," is harmless error where the fact that he was hurt is not controverted, and the verdict is not complained of as excessive.

6. Where the evidence shows that there were two people in the wagon at the time of the accident, testimony by the motorman that "they said they did not blame" him is incompetent where

offered as a part of the res gestæ, and it is not shown that it was plaintiff who spoke the words.

7. Where it is shown that the mules drawing the wagon in which plaintiff was riding were frightened, and ran in front of the car, testimony that there was nothing indicating that they were going on the track was properly excluded, as calling for the conclusion of the witness.—(City Railway Co. vs. Wiggins, 52 S. W. Rep., 577.)

Patent Decision

A decision was rendered Nov. 10 in the United States Circuit Court of the Eastern District of New York in the case of the Thomson-Houston Electric Company, against the Nassau Electric Railway Company. The suit was brought on claim of infringement of the Elihu Thomson patent on magnetic blow-out issued to the plaintiffs in 1883, and is of particular interest from the fact that the defendants were using the apparatus of the Lorain Steel Company. The decision which was rendered by Judge Thomas was in favor of the defendants on the ground of wanting of novelty in the invention.

Judge Thomas also rendered a decision the same day in the case of the Sprague Electric Railway & Motor Company vs. the Nassau Electric Company, for alleged infringement of patent 324,892, issued to F. J. Sprague on Aug. 25, 1885, relating to the suspension of electric motors under cars. The judge considered that the defendant in its equipment infringed claims 2 and 6 of this patent, and stated that the complainant should have a decree enjoining the defendant from infringing these claims.

The Distribution of a Fare

At a meeting of the Metropolitan Street Railway Association, composed of employees of the Metropolitan Street Railway Company, held Nov. 4, President Vreeland, of the company, delivered an address to his men concerning management and operation. "To the minds of people like us," said he, "engaged in a business the financial foundation of which is a five-cent piece, the mention of millions of dollars really conveys only a dim idea. There is a certain point at which the mind loses grasp of the significance of figures; it is like talking of the vast interstellar spaces. We know they are very great and we let it go at that. When it comes to five cents, though, that is right in our line, and in order to bring within the understanding of every one just how each five-cent piece you men collect is divided, I have made the following analysis from the company's records to show where we stand with the capitalists who own the property we operate. You will observe they do not get much the best of us on the divide, for this is how the nickel is distributed:

Labor	.0195
Material	.0048½
Taxes	.0026½
Interest	.0144
Total	.0414
Leaving for stockholders	.0086
Total	.0500

"The fact that less than seven-eights of one cent out of every fare goes to the owners—in other words, the stockholders of the property—will, I doubt not, be interesting to a great many public instructors, who continually discuss the railroad business as one where there is nothing but income to embarrass the management. Another interesting fact was developed in this investigation of mine, and that was that out of every dollar spent in operating the Metropolitan system, 80 cents went for wages, and only 20 cents for material."

Street Railways for Removal of Refuse

H. S. Beattie, treasurer of the Metropolitan Street Railway Company, of New York, contributes in the last issue of the "Municipal and Railway Record" an article on this most interesting subject. Mr. Beattie states that he does not care to say how practicable such an undertaking as the transportation of express over the the lines of his company, after they are all operated by mechanical power, would be, but strongly advocates the employment of street railway cars to carry off ashes, garbage, snow, ice, etc. Mr. Beattie's plan is to have a sufficient number of vans operated over the railway lines to one dumping place. Taking New York as an example, he says in part: "All the details of this plan, from the loading of the vans, at the point of collection, to the automatic dumping of their contents into sea-going, self-dumping scows, at the chosen central, single dumping station, received the unqualified indorsement of practical men, every one of them an authority in transportation matters, prior to the introduction of cable or electric power. How much easier of accomplishment should it now be, when the Metropolitan Street Railway and Third Avenue Railroad companies are operating over 120 miles of their lines by mechanical power! How much easier still will any such undertaking be, when the horse shall no longer be used by any railroad in the city, when the conditions that must obtain under an ideal system of underground electric traction shall have been realized, and each car of a line may be operated as independently of another as if they ran on separate tracks.

"The withdrawal of over 300 horses and carts from the most congested strips of the streets of New York during the busiest hours of the day is in itself a benefit, the commercial value of which would require many figures to express.

"The water front of the city is more valuable than that of any known maritime municipality. The annual rentals paid by most of our shipping interests run up into the tens of thousands of dollars. Yet thirteen of the most desirable locations on the East and North Rivers are abandoned to the uses of the Department of Street Cleaning as dumping stations, when one would be sufficient. Considering the rental value of these dumping stations were they released to the commerce of the port, and the depreciation in value which their existence occasions to the property adjacent to them, it is safe to state that the city treasury would be the beneficiary by their abolishment to the extent of not less than $1,000,000 per annum. And this amount would not be diminished by any increase of expenditure as a consequence of the proposed change in method. On the contrary, there should be a saving of one-third in the cost of carting, or not less than $250,000 per annum, if the appropriation for that item of the work of the department for the year 1895 is to be as large for 1896 and succeeding years.

"Furthermore, the cost of final disposition for the current year, considerably over $400,000, should be reduced at least one-half, through the concentration of the scows and steam tugs of the department at one point; the rentals paid for hired scows would be rendered unnecessary by the almost instantaneous loading of those vessels, to fill some of which now requires more than two days by the ordinary cart dumping method."

New Construction at Staunton, Va.

R. D. Apperson, general manager of the City Street Car Company, of Staunton, Va., advises us that his company is figuring on building a new car house and power station with steel-trussed roofs, one 50 ft. x 100 ft., the other 30 ft. x 115 ft., arranged for slate covering. The company also wants prices and all information at once for shafting, clutch pulleys, clutch couplings, bells and mechanical draft.

New Traffic Arrangements in Brooklyn

The Brooklyn Rapid Transit Company, which controls all the street railway and elevated lines in Brooklyn, with one exception, has just placed in operation a system for the interchange of traffic between the elevated and surface lines, the like of which is to be found in no other portion of the United States. The congested state of traffic on the surface lines had been bothering the officials of the company for some time prior to the acquisition of the elevated railroads in January, and since that time they have been strenuously wrestling with this weighty problem. On Nov. 1, a system of transfers was finally put in operation which gives promise of accomplishing this task. The system provides that all long distance riders, particularly those to the suburbs, use the elevated trains for transportation to their termini, after which a transfer is given to the surface lines if the passenger desires to continue further. It is also practically obligatory for the passenger to patronize the elevated roads as a second fare is charged on the surface cars which parallel these lines and heretofore carried passengers direct to the suburbs for a single fare. In returning from the suburbs the same methods are in vogue, thus when a passenger reaches the termini of the elevated lines he is given a free transfer to the elevated, but if he desires to continue the entire distance by the surface cars, he is required to pay an additional fare. The system will be of advantage to the long-ride passenger, as the elevated railways make better time than the surface cars within the congested district. It will also be of advantage to the short-haul passengers, for by the time a car had reached the city proper, under the old method, there was little chance of the short distance rider securing a seat.

Test of 300-kw. Units at Richmond

In a paper presented at a meeting of the American Institute of Electrical Engineers, in New York, Nov. 22, E. J. Willis, superintendent and engineer of the Richmond (Va.) Traction Company, gave some figures of a test made by him March 30, 1897, of two 300-kw. direct-connected railway units at different loads The equipment tested is described below:

Card Numbers.	Time.	Boiler Pressure.	Receiver Pressure.	Vacuum.	Feed Temperature.	Throttle Temperature.	Injector Temperature.	Overflow Temperature.	Draught Flue Temperature	R. P. M.	Mean Pressure H. P. Cylinder.	Mean Pressure L. P. Cylinder.	Volts.	Amperes.	Water Feed.	Coal Feed.
1 & 2	12.10 P. M.	108	4 lbs.	25½	190½	343	65	90	360	101	25.76	6.55	550	205		
3 & 4	12.30 "	110	5 "	26½	190	343	65	90	360	101	29.75	6.25	550	210		
5 & 6	12.45 "	118	6 "	26½	190	343	65	91	350	101	24 37	6 60	550	200		
7 & 8	1.00 "	125	7 "	26½	186	350	65	91	320	101	24.50	6.42	550	195		
9 & 10	1.15 "	115	5 "	26½	186	343	65	91	320	101	28 12	6.40	550	192		
Totals.....		576	27	131½	942	1722	325	453	1710	506	137.50	32.22	2750	1002	3469	345
Averages.....		115	5 2-5	26½	188	344	65	91	342	101	27.50	6.44	550	200		
11 & 12	1 19 P.M.	112	7 lbs.	26	186	346	65	97	360	101	39 50	8.60	550	298		
13 & 14	1.36 "	115	8 "	26½	185	346	65	100	380	100	39 60	8.90	550	300		
15 & 16	1.50 "	114	7 "	26½	183	340	65	97	400	101	40.00	8.17	550	297		
17 & 18	2 05 "	115	8 "	26½	183	343	65	98	400	101	37.75	8.70	550	300		
19 & 20	2.23 "	115	7 "	26½	183	343	65	98	400	101	41.50	8.25	550	300		
Totals.....		571	37	132½	920	1718	325	490	1940	504	197.75	42.82	2750	1497	4912	455
Averages.....		114	7 2-5	26½	184	344	65	98	388	101	39.55	8.56	550	299		
21 & 22	2.25 P.M.	113	10 lbs.	26½	185	341	65	111	400	102	48.75	11.45	550	400		
23 & 24	2.42 "	100	6 "	26½	185	329	65	111	460	100	48.87	11 87	550	400		
25 & 26	2.51 "	115	9 "	26½	185	343	65	111	500	101	46.50	11 15	550	400		
27 & 28	3.10 "	113	8 "	26½	185	342	61	111	500	100	50.37	11.00	550	395		
29 & 30	3.25 "	118	5 "	26½	185	344	61	100	500	100	49.50	10.60	550	393		
Totals.....		559	38	132½	925	1699	317	544	2360	503	243.99	56 07	2750	1988	5141	575
Averages.....		112	7 3-5	26½	185	340	63	109	472	101	48.80	11.21	550	397		
31 & 32	3 25 P.M.	110	10 lbs.	26	185	340	61	108	520	101	58.87	15.05	550	500		
33 & 34	3 50 "	110	10 "	26	185	340	61	100	540	101	57.00	14.20	550	500		
35 & 36	4.05 "	110	10 "	26	180	339	61	100	560	101	55.75	14.55	550	500		
37 & 38	4.20 "	108	10 "	26	180	339	61	100	580	101	58.87	14.07	550	500		
39 & 40	4.35 "	110	10 "	26	180	340	61	103	580	101	58.25	14.07	550	500		
41 & 42	4.50 "	110	10 "	26	180	340	61	103	580	101	58.25	14.50	550	500		
43 & 44	5.05 "	110	10 "	26	180	340	61	102	580	101	58.50	14.57	550	500		
45 & 46	5.20 "	110	10 "	26	180	340	61	102	580	100	60.25	14.70	550	500		
47 & 48	5.35 "	110	10 "	26	180	340	61	102	580	101	57.00	14.80	550	500		
Totals.....		988	90	234	1630	3058	549	912	5100	908	520.74	130.51	4950	4500	14486	1690
Averages.....		110	10	26	180	340	61	101	567	101	57.86	13.39	550	500		

CALCULATED RESULTS.

LOAD.	POWER. Indicated H.P.	Electrical H.P.	Kilowatts.	Evaporation Water per lb. of coal (actual).	Water per lb. of co l from and at 212° F.	Coal Consumed. Per indicated H.P. hour.	Per electric H.P. hour.	Per K.W. hour.	STEAM. Per indicated H P hour.	Per electric H.P. hour.	Per K.W. hour.	EFFICIENCIES. Indicated H P. per electric H.P.	Electric H.P per indicated H P.	Indicated H.P. per K W
200 Amperes.	216	146	110	10.05	10.71	1.45	2.18	2.90	14.8	21.9	29.1	1 48	.68	1.96
300 "	299	220	164	10.8	10.75	1.43	1.94	2.60	15.3	21 9	28.1	1.36	.74	1.82
400 "	373	293	219	8.94	9.53	1.54	1.96	2.63	13.8	17.53	23.46	1.27	.79	1.70
500 "	469	369	275	8.57	9.18	1.66	2.11	2.83	14.25	18.1	24.3	1.27	.79	1.70

Boilers.—One 300-h.p. Campbell & Zell water-tube boiler with 3000 sq. ft. submerged heating surface.

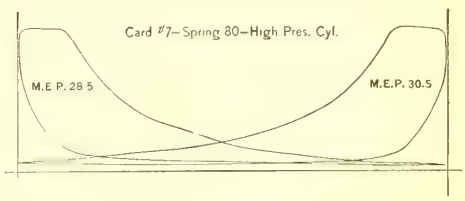
Engine.—16-in. and 30-in. x 42-in. Hoover, Owens & Rentschler horizontal tandem compound condensing engine, double eccentric, 100 r.p.m.

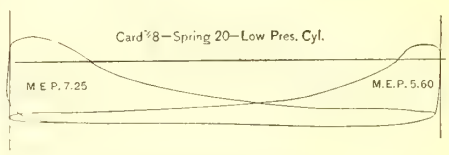
Generator.—300-kw., six-pole, steel-frame General Electric railway generator.

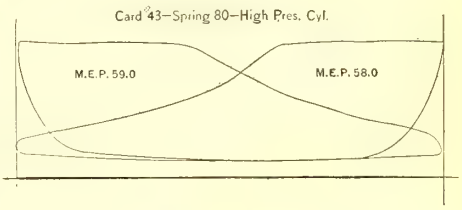
Piping.—The piping is practically what is known as standard, being an 8-in. spring from boiler to 14-in. steam-header and 6-in. spring from steam-header to throttle. A short 14-in. exhaust pipe exhausts through a Hartford heater into a Deane jet condenser.

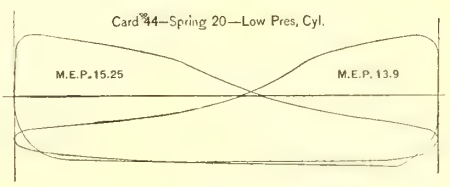
A large water rheostat was provided, capable of handling the full output of the generator, and a Weston ammeter and voltmeter were placed upon the circuit of the generator. By this means the output of the generator could be fixed, maintained and measured at any desired point. The system of piping permitted the feed-pump and condenser to be operated by a separate boiler, so that all the steam generated by the boiler passed through the engine. All valves were tested and made tight. A Worthington hot-water meter was thoroughly overhauled before the test and was accurately tested before and after the run. The water and steam consumptions are those given by this meter. The coal fired during the test was Pocohontas run of mine, giving probably 13,000 B. T. U. The draught at the grate during the run was 5/8 in. Indicator cards were taken as nearly every fifteen minutes as possible off both ends of each cylinder, and also simultaneous readings of coal, water, electrical output and the other items mentioned in the table. Sample cards are shown herewith. The object was to determine the steam, water, coal consumption and indicated horse-power of this unit at different loads. The load was as follows: For one hour at 200 amps., the next hour at 300 amps., and so to 500 amps. It was intended to place the load the next hour at 600 amps., but the machine became too warm, and instead the load was continued for two hours at 500 amps.

It is regretted that the point of load could not be carried higher, but it is to be remembered that railway generators are usually designed for fluctuating loads, and that such a steady loading as given in this test is likely to cause considerable heating. It is further unfortunate for the sake of accuracy that on account of the need of the generator for the operation of the load, the duration of each test could not have been made greater, since the determination of coal and water consumption for such short periods of time is almost always attended with unavoidable inaccuracies. The water rheostat was composed of two sheets of boiler plate 5 ft. x 6 ft. each. By means of soda the conductivity of the liquid was brought to the desired point. With light loads and before the water commenced boiling completely there was some fluctuating in amperage, but after the water got to boiling thoroughly the load could be maintained perfectly steady. At 500 amps. there was









about 15 sq. ft. of each plate submerged. The water evaporated by the boiling was replaced by a hose connection and the water level in the rheostat tank thereby maintained constant. The writer would state that in his experience with rheostats of any size, if a steady load is required, it is better to let the water come to a boil and the plates remain steady, replacing the evaporated water with a running connection, than to attempt the continual raising and lowering of the plates.

This test was made to confirm the writer's opinion that it is advisable with railway units carrying fluctuating loads to install a double eccentric undersized engine, and that better running economy can thereby be obtained than by the installation of the usual larger and more expensive engine. It will be noticed that the engine gave its best steam economy at about 400 amps., and as the average load on this engine is lower than this, the wisdom of the installation for this plant of so small an engine for the 300-kw. units is plainly shown.

The Design of Fusible Cut-outs *

BY B. H. GLOVER

The simplest, and therefore most common, method of protecting electrical circuits is by means of the fusible cut-out. While much might be said about circuit breakers, switches and special combinations for opening and controlling circuits, the object of this paper is not to enter into a discussion of the relative merits or proper adaptation of these fittings, but simply to put before you some facts demonstrated by exhaustive tests and extended practice, and from this information and experience derive a few conclusions regarding the proper design of fusible cut-outs.

That the present cut-outs are not entirely satisfactory goes without saying. If they were the subject of this paper would not have been suggested.

It is a strange characteristic of this age of progress that sometimes the most common and necessary articles are accepted in the crude, and often unfinished, form in which they have originated, and are apparently forgotten and neglected in the mad rush for something new or strange. The return swing of the pendulum is, however, inevitable, and we now hear of new forms of arc lamps and renewed interest in the perfection of various forms of lamps depending on the incandescence of heated conductors or metallic oxides. The thermal cut-out is still one of the most unreliable of the many devices employed on electrical circuits. Its use is universal, but beyond a few practical details the device is but little understood. Such improvement as has been made has largely been due to the vigilance of the various insurance boards. As a source of vexation and uncertainty the fusible cut-out is probably unrivaled.

Speaking from the standpoint of the fire underwriter, the proper design of cut-outs is an important subject, inasmuch as a very considerable fire waste has been, and continues to be, occasioned through the faulty construction and design of these fittings. All tests and treatments have shown the common cut-out to be subject to such variations and modifying influences that but little of practical value can be deduced from analytical investigations.

A cut-out may be said to consist of three principal parts—(a) the base and its cover, (b) the terminals, and (c) the fuse. These will be taken up in the order given so far as is possible.

(a) In the earlier days of electric lighting wooden bases were used, but were soon abandoned, due to continual trouble with "grounds" and "shorts," resulting from absorption of moisture and the loosening of contacts and charring due to the combustibility of the wood. Porcelain is now almost universally used. The base and cover being much the larger portion of a cut-out, the porcelain manufacturer has taken it upon himself to design and sell these goods. Important electrical details are often sacrificed for convenience in getting out the porcelain, and "any old thing will go" seems to be the motto followed in some cases, no regard being paid to the various and excessive demands made upon the product. It is poor practice to use short fuses in order to economize in porcelain.

The quality of porcelain used and its glazing is seldom given any consideration by contractors or engineers except, perhaps, for use with very high potentials. The subject of glazed and unglazed porcelain in itself opens up a large field for discussion. A glaze with an excessive coefficient of expansion will in time become full of cracks or become "crazed," as the porcelain manufacturers express it. These cracks retain moisture and offer paths of comparatively low resistance between terminals of opposite polarity or to ground.

The use of lead in the glaze usually results in a metallic film upon the blowing of a fuse. The parts of a cut-out about the fuse itself should preferably be left unglazed. The fuse should not be in contact with any surface of the base. If supports between the terminals are necessary they should be in the form of traverse ribs with smooth rounded tops.

While an air space is desirable about the fuse the ends of the block should not be left entirely open. As a fuse usually ruptures at or near the center, the aim should be to provide a proper vent at this point and still retain sufficient pressure to cause a blow-out of the metallic vapors and suppression of the arc formed. For these reasons a rather restricted air space at the ends and an enlarged air chamber with vents, near the center of the fuse gives more reliable action. A cover for the base should always be used. The fire risk is made less and the sensitiveness of the fuse is thereby increased, especially for small fuses.

(b) Terminals are universally made of brass in the form of stampings, castings or sections of square or round bar. The following modes of connection to the wires have been noted: a screw and washer, a screw with one upturned lug on terminal, with and without washers; a set screw, two set screws, an angular bottom piece with a clip above, held by one or two screws; double clips with a center V groove, and several others.

In the construction of switches it is considered quite proper and necessary to provide lugs, firmly bolted to the switch, into which the conducting wires shall be soldered. This applies to switches of over 25 amps. capacity. If for switches and bus-bars and in making connections to dynamos and motors, why not for cut-outs?

Connections for currents up to 25 amps. should be made to terminals provided with screws and washers with a turned-up lug on both sides to prevent this wire from slipping out. When the capacity of the cut-out exceeds 25 amps. connections should be made with lugs firmly screwed to the terminals on a flat surface, and into which the conducting wires can be soldered. This may seem like excessive care, but when it is considered that very appreciable losses are due to the many poor contacts and connections made in a circuit, too much attention cannot be given to this matter of contacts. The terminals should be set in from the ends of the blocks so that live portions of the circuit will not be exposed. The proper distance between terminals has long been a disputed question.

A catalogue of a well-known manufacturer of these goods shows, for 110-volt circuits, break distances of from ¼ in. to 2½ ins. He no doubt strikes an average somewhere.

An engineer of a prominent company stated two years ago: "We are redesigning our link cut-outs so that the fuse metal tips shall be fully 1 in. apart. Some of our cut-outs are much less than this, and we believe it is safer to have a longer break distance than what we are now using." A Chicago engineer, whom you all know, said a few years ago: "I have always felt that the emphasis of experimental evidence should be directed to convincing the people of the advisability of using long fuse blocks, thereby contributing to the reliability of such protecting devices."

This is all reliable testimony, and should be given careful consideration, not only by manufacturers, but by contractors and engineers as well. There are many goods on the market with a ½-in. break distance between terminals.

A current of 20 amps. will invariably establish a vicious arc between terminals at this distance, and the terminals will frequently melt with explosive violence. The terminals are not only fused, but often the entire base and cover are shattered into fragments. Such results are aggravated by the enormous capacity of our modern stations in populated districts. For a given fuse, blown in a given time there is a critical length. Careful experiments have shown these lengths to be as follows:

	Inches
For 3-5 amps	2½
For 10-15 amps	3½
For 20 amps	4

Or for each 5 amps. an increase in length of ½ in. These lengths seem excessive when judged by common practice, but the data clearly indicate where practice might be improved.

Realizing that extended reforms cannot be instituted at once, the rules of the National Electrical Code specify 1¼-in. break distance between terminals for 110 volts, and 2½ ins. for 220 volts, the fuses to be held free from contact with the base and be provided with tips of hard metal. In the open type of cut-out the terminals usually have a greater distance between them than in the covered style, but a serious fault in their design is that the terminals are set in flush with the surface of the porcelain. Terminals should be secured to the base by at least two screws, so as to prevent turning and loosening. Screw-heads on the back should be countersunk and the heads covered with a moisture-proof and insulating wax or compound. These points should go without saying, but an inspection of stock being sold shows that there is neglect along these lines.

* Paper read before the Chicago Electrical Association, Nov. 17, 1899.

(c) The ordinary fuse is made from an alloy, the greater part of which is lead. This alloy is used in the form of wire, wire links or strips. The opening of the circuit is caused by the melting of the fuse. The necessary heat is obtained from the energy developed in the fuse by the current. But the blowing of a fuse is not immediately an electrical act. The current fuses the metal, the cross section is reduced at some point due to gravity, unequal expansion or "sweating," the heat intensifies at this point and a globule falls, breaking the circuit and establishing an arc, which soon burns out a length of the fuse. The time required for this action may vary between considerable limits under different conditions. In some cases this fact is an advantage, while in others it might be fatal.

A combination intended to increase the accuracy of operation and to reduce to a minimum the radiation and conduction of heat is found in the enclosed fuse.

A fibre tube is filled with a porous powder and the fuse is soldered to the brass ends of the tube, being imbedded in a powder except in the center of the tube, where a small capsule forms an air chamber. These fuses will operate at a predetermined point for any overload, and can be relied upon within very close limits. An objection has been made to their use, as there is no exterior indication to show when a fuse has opened. A new design is about to be put on the market with the object of overcoming this objection. It consists of an inclosed fuse with a shunt of fine high-resistance wire between the terminals on the outside of the fibre tube. The blowing of the fuse diverts the current through the shunt wire, which immediately blows and serves as an outside indicator. Enclosed fuses without the air chamber are not as sensitive or reliable as those with the air chamber.

An ideal fuse would be one that would act at nearly a constant time interval for all currents in excess of its normal. In this respect it would resemble a magnetic cut-out. Its curves would be a straight line from the point of its rated capacity and slightly approaching the vertical axis for all excess currents. In practice the curves of all thermal cut-outs must be more or less modified hyperbolas. The ideal curve could only be obtained were it possible to eliminate conduction and radiation losses. This line of attack should be followed in designing a sensitive fusible cut-out. Small fuses approach this condition to a greater extent than large ones.

For sudden heavy overloads a multiple fuse of several small wires is much more sensitive than one large one of the same capacity. For the same reason a thin, flat ribbon may be considered more reliable than a round fuse.

Invitation to Contractors for the New York Tunnel Railway

The following invitation for bids for the construction and operation of a tunnel railway has been issued by the Board of Rapid Transit Railroad Commissioners of New York City.

OFFICE OF THE BOARD OF RAPID TRANSIT RAILROAD COMMISSIONERS OF THE CITY OF NEW YORK.

The city of New York (hereinafter called the city), acting by its Board of Rapid Transit Railroad Commissioners, proposes to build a rapid transit railroad in the city of New York. By this advertisement the Board invites proposals to construct the railroad, to equip the same, to put the same into operation and thereafter to use and operate the same upon a lease thereof from the city for the term of fifty (50) years with a right to a renewal of the lease for a further term of twenty-five (25) years, all upon the term and conditions set forth in the draft of contract hereinafter referred to.

Payments to the contractor will be made for construction as the work proceeds as provided in the form of contract.

The annual rental to be paid by the contractor under such lease, after completion, will, except as provided in the contract, amount to the interest paid by the city on its bonds for the cost of construction (including interest during construction, but excluding bonds issued to pay for easements and the like), and in addition 1 per cent on such cost of construction with provision for contingent abatement or reduction of such 1 per cent during the first ten years of the lease, and, in addition, if the proposal of the contractors shall so state, in years when the gross receipts from the operation of the road exceed five million dollars ($5,000,000), a sum equal to the percentage of such excess stated in such proposal.

The points within the city of New York between which the said road is to run and the route or routes to be followed are as follows, namely: From the corner of Broadway and Park Row under Park Row to Centre Street, under Centre Street to new Elm Street, under new Elm Street to Lafayette place, to and under Fourth Avenue and Park Avenue to 42d Street, under 42d Street to Broadway, under Broadway to 59th Street, under Broadway (formerly the Boulevard) to 124th Street, then by viaduct to 134th Street, under Broadway and Eleventh Avenue to a point about 1350 ft. north of 190th Street, to the southeast end of Ellwood Street, over Ellwood Street, Kingsbridge Road and Riverdale Avenue to Kingsbridge Station of the New York & Putnam Railroad, together with a loop under City Hall Park and Broadway connecting Centre Street and Park Row, and a branch as follows: Running from 103d Street to and under 104th Street, crossing Central Park, to Lenox Avenue and 110th Street, under Lenox Avenue to 142d Street, easterly to and under the Harlem River, to and under 149th Street to Third Avenue, to and under and by viaduct along Westchester Avenue to Southern Boulevard, to Boston Road and Bronx Park.

The general method of construction shall be such as to provide for the portion of the route on the loop south of the City Hall and for the portions of the route on both the east and the west side lines north of 103d Street, two tracks, and for the portion of the route between the City Hall loop and 103d Street, four tracks. These tracks shall be of the standard gage, that is to say of a width of 4 ft. 8½ ins. between the rails. The roof of the tunnel shall be as near the surface of the street as street conditions will permit, and is to have a height of not less than 13 ft. in the clear and with a maximum width in the clear, except as influenced by local conditions, of 50 ft. where there are four tracks and 25 ft. where there are two tracks. There shall also be suitable stations, turnouts, switches and cross-overs. The portion of the route underground shall be constructed with steel girders, with brick or concrete arches or masonry walls and arched roof. The viaduct portions shall be of steel and masonry. The manner of construction of the portions underground shall be by tunneling or open excavation.

The railroad is, for the purposes of the contract, divided into four sections: Section I, including the part from the southern terminus at the City Hall to 59th Street; section II, including (a) the part on the west side from 59th Street to 137th Street, and (b) the part on the east side beginning with the branch at 103d Street and the Boulevard, and extending to 135th Street and Lenox Avenue; section III, including (a) the part on the west side from 137th Street to Fort George, and (b) the part on the east side from 135th Street to Melrose Avenue; and section IV, including (a) the part on the west side north of Fort George, and (b) the part on the east side north of Melrose Avenue. The city expects that the entire railroad, that is to say, all of such four sections, will be constructed and operated. But the city desires to restrict its entire pecuniary liability for rapid transit at any one time within the limits deemed consistent with its other obligations and interests. The railroad is, therefore, to be constructed and equipped in sections. The contractor shall begin with section I. If and when, within one year after the commencement of work on section I the city shall so elect, the contractor shall construct section II. If and when, after the commencement of section II, and within two years from the commencement of section I, the city shall so elect, the contractor shall construct section III. If and when, after the commencement of section III and within three years after the commencement of section I the city shall so elect, the contractor shall construct section IV. The railroad shall, so far as concerns the rights and obligations of the parties under the contract, be deemed to include only section I, and in addition the other sections II, III and IV, which the city shall determine to construct within the limits of time aforesaid.

The term of years for which the contract is proposed to be made extends for fifty years after the completion of the road and its readiness for operation as declared by the Board, with an option to the contractor to extend the lease for twenty-five years at a rental to be fixed as in the contract provided, but not less than the average rental for the last ten calendar years before the contractor's demand for renewal.

Other requirements, provisions, details and specifications are stated in the printed form of contract now on file at the office of the chief engineer of the Rapid Transit Board, 22 William Street, New York City, where copies of the same and of the forms of bonds and contractor's proposal may be had. Such printed form of contract is to be deemed part of this invitation.

Sealed bids or proposals for the construction and leasing of such rapid transit road indorsed: "Proposals for constructing and leasing Rapid Transit Railroad," with the name of the person or persons, corporation or corporations making the same will be received at the said office of the Board at 320 Broadway, Borough of Manhattan, New York City, until Jan. 15, 1900, at 12 o'clock noon, at which time or at a later date to be fixed by the Board, the proposals will be publicly opened at the said office and the award of the contract, if awarded, will thereafter and within thirty days after the opening of the bids be made by the

Board to the person or persons, corporation or corporations, if any, whose proposal shall, in its opinion, be for the best interest of the city. The bidder or bidders whose proposal shall be accepted shall in person or by duly authorized representative attend at the said office of the Board within ten days after the notice of a delivery by the Board and deliver a contract in the form referred to duly executed.

At the time of the delivery of the contract the contractor shall give security as follows:

(1). By deposit of one million dollars ($1,000,000) in cash or in securities of the character of securities in which savings banks of this State may invest their funds and which securities shall be approved by the Board. Such one million dollars ($1,000,000) shall be security for construction.

(2). By a continuing bond in the penalty of one million dollars ($1,000,000) to secure construction, operation, payment of rental and all other obligations of the contractor.

(3). By a bond in the penalty of five million dollars ($5,000,000) to secure construction and equipment.

[The forms of the bonds are prescribed in the contract, and further provisions follow in the invitation to bid, covering various details connected with the presentation of bids, certification of deposits, etc.]

Notes on Railway Motor Rating

John Lundie, the well-known transportation engineer, has recently contributed the following paper to the "Electrical World and Engineer," which we reproduce herewith, with the kind permission of its editors:

MR. LUNDIE'S ORIGINAL PAPER

The following notes on motor rating comprise a summary of results which the writer had intended to reserve for publication in an extended paper, justifying the somewhat radical statements made, but which are published now, believing they may be of value to others working along similar lines.

The power rating of an electric motor under actual conditions of operation, on either constant or frequent intermittent load, should be directly proportional to the average electrical power input, independently of variations in current, except as maximum current may be governed by commutation.

The sum of the percentages of I^2R losses and core losses at all inputs throughout the range of practical operation can be made practically a constant. In order, however, that a proper balance of heating in different parts of the motors may be maintained, whether the heating be due to I^2R or core losses, the range and method of regular operation of the motor should be taken into account in its design.

Thus a motor may be specified of a certain kilowatt capacity to be operated within given limits—the kilowatt capacity being the rate of input which the motor could take constantly with a given maximum temperature difference above the surrounding atmosphere with the motor designed for constant uniform work. The following relation would practically govern the operation on frequent intermittent work:

K = Kilowatt capacity.

t = Percentage of time motor is worked on any current I.

E = Voltage (practically constant).

$K \times 100{,}000 = \Sigma\, EIt$.

For example, a motor for heavy traction service might be designated a 30-kw. motor, to be operated in service on a line voltage of 500 within the limits of 100 amps. and 250 amps. The commutation limit of the motor would be about five times the standard rating, or

$$5 \times 30 \times \frac{1000}{500} = 300 \text{ amps.}$$

which, in the case assumed, would not be reached in operation, the limits indicating that the capacity of the motor is governed by heating.

This motor on intermittent service ought to operate anywhere within the following conditions:

$$\text{On 100 amps.,} \frac{6000}{100} = 60\% \text{ of the time;}$$

$$\text{On 250 amps.,} \frac{6000}{250} = 24\% \text{ of the time;}$$

or on any products of amperes and percentage of time within these limits integrating 6000, it being, of course, assumed that running on resistance is at all times reduced to a minimum

With such a standardization of motor rating, many advantages would become apparent to those seeking motors for specific service, amongst which may be noted:

(1). The rating of the motor is directly proportional to the average input.

(2). The sum of the operating motor capacities on cars would equal the load on the station, due allowance for outside losses being made

(3). The relation between this method of rating and that at present in use is simple. Calling kilowatt input equal to horse power at the rim of the wheel, to allow for efficiency, then approximately horse power (present rating) $= \frac{10}{3}$ kilowatts (proposed rating).

DR. HUTCHINSON'S COMMUNICATION

The "Electrical World and Engineer," having editorially criticised Mr. Lundie's paper on several grounds, Dr. Cary T. Hutchinson addressed the following letter to the editors, further explaining and indorsing Mr. Lundie's plan:

Mr. Lundie's suggestion is to rate motors intended for intermittent service, such as railway service, on a basis of the average electrical input regardless of the method in which the load varies, assuming always that the variation of load is so made that the temperature attains a constant value; that is to say, assuming that the motor is not allowed to cool down between applications of the load.

This suggestion has for its justification the fact, which seems to be borne out by an examination of a number of test records of railway motors of different sizes and makes, that the I^2R and core losses of a given motor are a constant percentage of the input at constant potential over a large range of input. If this is the case, it is obvious that there will be the same total energy spent in heating the motor whether a certain current is applied all the time or double the current for half the time. Your editorial assumes that the energy losses are constant in amount and not in percentage.

This suggestion to rate a motor on its average input obviously coincides with the present method of rating for continuous duty, since the rated load and the average load then coincide. Equally clearly it does not take into consideration the limitation fixed by commutation. This is a matter which must be considered separately. The present practice in rating railway motors is to specify a temperature elevation of 75 degs. C. for a continuous run of one hour. The rules of the American Institute of Electrical Engineers specify a temperature rise of 50 degs. C. for an intermediate period, the wording of the rule being as follows: "In apparatus intended for intermittent service, as railway motors, starting rheostats, etc., the rise of temperature should be measured after a shorter time, depending upon the nature of the service, and should be specified." That is to say, this rule does not give any definite rating for motors for intermittent service. The question of the time was purposely left open since the conditions of service were so different that it was impossible to specify times in the different cases. You will see that as far as the suggestion to rate on an average load is applicable, the question of time is entirely eliminated, and the rating very much simplified.

Whether the sum of I^2R and core losses in motors other than railway motors is a sufficiently close approximation to a constant percentage of the input, is a matter that can only be determined after a careful examination of data of tests in each particular case. Probably a better way to put the matter would be that the range within which the sum of these losses is a practically constant percentage, would have to be determined separately for each class of motors. For railway motors it seems to be a fact that the sum is a constant percentage throughout the range of practical operation of the motors. It is not constant at very low loads or at very high loads, but this is a matter of no special consequence, since the motors are not expected to operate at either extreme.

This suggestion does not take into account the temperature of the field coils and armature of the motor separately. The temperature elevation is supposed to be measured by resistance, and is the average of the two. To guard the matter carefully, a clause should be added limiting the maximum temperature elevation in either part. The field and armature should be so designed that the temperature elevations of the two parts shall be the same for the load rated in accordance with this method, and the two elements should be separately designed so that neither will attain a dangerous temperature within the range of load permitted to the motor. It is clear that when the temperature of the two parts is not equal, one must be higher than the average, and the other lower.

Motors rated in this manner are rated on a basis of continuous duty with a given temperature elevation. Railway motors, and all motors intended for intermittent service, work on loads which are heavy overloads as compared with their load for continuous duty. Hence, the figure giving the rating of a railway motor in accord-

ance with this suggestion, expressed in kilowatts, would be very low; a 100-h.p. motor would become approximately 30-kw. This would probably not be acceptable to the maker. To avoid this difficulty the motor might be given an arbitrary designation expressing the product of the current and the percentage of time for which the current could be applied. In the case cited by Mr. Lundie, the motor might be called A-B 6000, meaning that it would take 100 amps. for 60 per cent of the time, 250 amps. for 24 per cent of the time, or any intermediate values of which the product is 6000; the limits between which the sum of the two losses is a constant, in this case being 100 and 250 amps.

This matter, I think, is deserving of consideration, as it seems to offer a more satisfactory method of rating motors for intermittent work than any I know of.

MR. LUNDIE'S SECOND COMMUNICATION

Mr. Lundie has also addressed the following letter to the editors of the "Electrical World and Engineer," still further explaining his position:

Your editorially expressed objections to the proposed method of motor rating are essentially that the following two assumptions cannot be true: First, that the electrical efficiency of the motor should be constant at all loads within the commutation limit; second, that the temperature should be the same whether an excessive load were applied at the beginning or at the end of a cycle of test. You sum up by stating that while the advantages of the proposal are not to be gainsaid, yet the uncertainty of the fundamental assumption is too great to warrant its adoption.

No precise criticism can be made of your objections, as they are based on your statement (which is correct) that the assumption is not strictly true. As, however, the proposition is to secure a method of rating which within service limits will represent the capacity of the motor, your objections may be met as follows:

As to your first objection, you support it by stating that the combined copper and iron losses cannot be constant because the copper losses are approximately proportional to the square of the input, while the iron losses, although very complex, are roughly constant, and the sum of a constant and a square function cannot be a first-power function.

Replying to this objection, the *percentage* copper losses are proportional to the square of the input divided by the input, or are directly proportional to the input—a first-power function. If the iron losses were considered constant, the percentage losses would be inversely proportional to the input—a hyperbolic function, but approximately a first-power function on the branch of the hyperbola. The iron losses, however, are not constant in a series motor, and are such as to make the approximation of the percentage losses still closer to a straight line function than if they were constant. In the characteristics of a motor before the writer, the iron losses are approximately proportional to the square root of the input, and the percentage losses, consequently, inversely proportional to the square root of the input. The sum of the percentage copper and iron losses in this motor throughout a range of from 40 to 200 amps., does not vary 2 per cent. Surely this is close enough to a first-power function to satisfy almost the laboratory, not to mention the demands of railway service.

The ideal to be worked towards in motors intended for intermittent, fluctuating work should be that of practically constant electrical efficiency throughout the whole range of service operation.

Your second objection as to the final temperature depending on whether overload were impressed in the beginning or end of a test cycle, will not hold in frequent intermittent service, as we are not dealing with one cycle, but with a continued repetition of cycles in rapid succession, and the maintaining of a given maximum temperature is simply a question of the rate of radiation of heat. With a given average rate of generation of heat, and the same rate of radiation, the temperature remains a constant. The short time between applications of load in railway work does not permit of an appreciable drop in temperature, and the rate of radiation is a function of this temperature.

As to your suggestion that the testing of a motor would be a lengthy and elaborate process, this again is a result of your considering only a single cycle of test. As a matter of fact, the motor in service is under continuous test, the average rate of input as the load fluctuates anywhere within the range of operation, being a measure of the capacity under which it is being operated. This fact is one of the strongest arguments in favor of the proposed method of rating.

The writer is well aware that there are many points which will have an important bearing on the method of rating proposed, such as restrictions to free radiation, unequal heating of field and armature, etc., but believes that they may all properly be made subservient to the general proposition.

Recent Shipments to Havana

The Morris Electric Company, which received recently, orders for a large amount of railway apparatus for the new electric street railway system of Havana, has already made a number of shipments. On Nov. 27, fifty car loads of Mason terra cotta ducts were shipped from Philadelphia on the Earn Line steamer "Hindoostan." Other shipments which will follow soon are 2200 iron poles, made by the Electric Railway Equipment Company, of Cincinnati, Ohio, 54 miles of overhead line material made by A. & J. M. Anderson; 54 miles of trolley wire from the Waclark Wire Works, a lot of galvanized iron span wire from Washburn & Moen, two trolley wagons made by J. A. McCardell & Company, and thirty car loads of 1,000,000 c.m. feeder cable, made by W. R. Brixey, making altogether 182 car loads, besides the terra cotta shipment.

The Morris Electric Company is also doing a large business with other companies, both in this country and abroad. Among its shipments outside of this country during the past month have been 30 miles of trolley wire, two Trenton trolley wagons, hydraulic rail benders and track tools to Lisbon, a large shipment of miscellaneous equipment to Cape Town, and 280,000 lbs. of copper wire with all necessary brackets and fittings for the new extension for the Mexico Street Railway.

Among his domestic orders, Mr. Morris includes orders for bonds for Elmira, N. Y.; Akron, Ohio; Anderson, Ind.; New York, New Haven & Hartford Railway, Euclaire, Wis.; Detroit, Mich.; Union Railroad, New York, and elsewhere. To facilitate his city work, Mr. Morris has fitted up a shop at Twenty-seventh Street and Ninth Avenue, which contains a brass foundry and full line of machine tools, and will be designed for the manufacture of bonds and general railroad supplies.

Soap for Car Cleaning

A pamphlet containing the papers and discussion at the thirteenth annual convention of the Master Car and Locomotive Painters' Association of the United States and Canada, held at Philadelphia, Sept. 12, 1889, on the subject of the cleaning of passenger cars and locomotives, has recently been published by the Modoc Soap Company, of Cincinnati, Ohio. The discussion on this subject is quite remarkable in showing the universal indorsement by the delegates present of Modoc soap and Modoc car cleaner and the methods employed by them in its use will be of interest to street railway superintendents. The first paper was by T. J. Rodabaugh, master car painter of the Pittsburgh, Ft. Wayne & Chicago Railroad. He stated that he had found that washing cars every day with a window-brush and cold water killed the luster of the varnish and produced in a few weeks a dull, flat looking car. He now employs Modoc liquid for the inside and outside of the cars every thirty days; between these times the cars are wiped off every trip with cotton waste. Every five months Modoc powdered soap is used. Thos. Byrne, master car painter of the Chesapeake & Ohio Railroad, and H. M. Butts, of the New York Central & Hudson River Railroad, gave similar testimony to the value of this soap and cleaner in papers on the same subject. In the discussion which followed various delegates described their methods of cleaning cars, and the discussion elicited the fact that practically all present were users of these products, and that the method of their employment was practically the general directions issued by the Modoc Soap Company. On some roads where there were many tunnels or other conditions which required more frequent cleaning of the cars the latter were cleaned with the liquid more often than on other roads, but the general method of cleaning was practically the same in all.

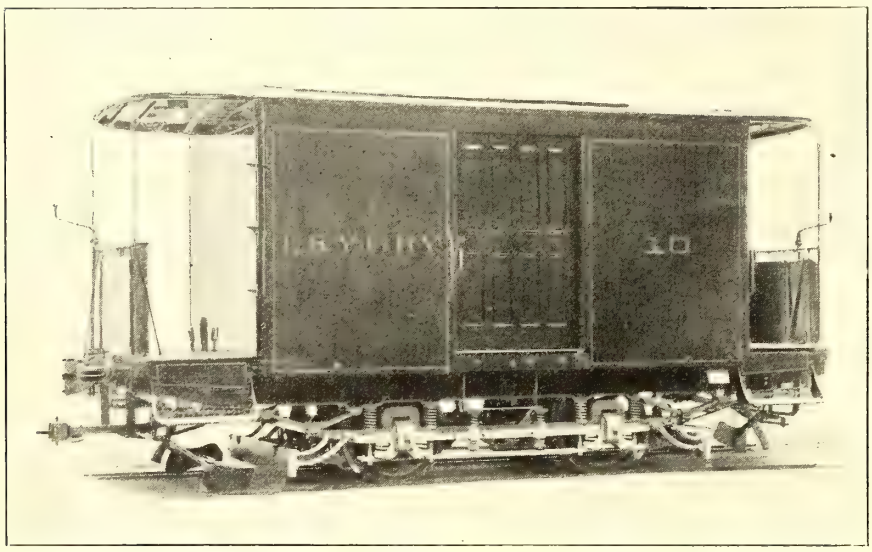
The Modoc car cleaner is used for ordinary cleaning, and is usually sufficient. In cases, however, where it has not been used regularly and the car has been neglected, a preliminary cleansing with Modoc soap is recommended. This is a mild soap, designed to do the least possible harm to the car. The manufacturers claim that for steam railroad service the cars should be cleaned not less frequently than once every thirty days, and that the cost of treatment is not more than $1.25. It is not economical to allow cars to run five or six months without cleaning.

The Federal Steel Company has just closed a contract with the Corporation Tramways of Glasgow for $500,000 worth of steel rails, special work, etc., for the new electrical equipment. The girder rails will be manufactured at the Lorain Steel Company's shops and the special work at the Johnstown plant.

Heavy Freight Car

The Lewiston & Youngstown Frontier Railway Company, of Lewiston, N. Y., has purchased from the J. G. Brill Company a freight car which is also an electric locomotive and is of rather unusual design. It is represented in the accompanying illustration. The body is 14 ft. long and has the usual sliding side doors, but is otherwise completely enclosed. The width at the sills is 7 ft. 8 ins., and the height inside is 6 ft. 8 ins. There are two platforms, one at each end, fitted up with controllers, brake handles, bells, etc. The construction is unusually heavy for the reason that the locomotive not only has to carry a load of 6 tons, but is also intended to haul standard freight cars. For this reason it is fitted with Master Car Builders standard couplers in addition to the radial draw bar for street railway cars. There are two G. E. 1200 motors. The car is mounted on No. 21-E trucks with a 6-ft. wheel base and 33-in. wheels.

Each platform is fitted with a sand box and Littell track scrapers. In the engraving these track scrapers are shown dropped in position on the left hand end and raised at the opposite end. The car weighed with two motors 18,250 lbs., all of which was, of course, available for adhesion. While the spring arrangement of the No. 21-E truck will make it light and easy riding, the great weight gives it sufficient tractive power to enable it to handle very considerable loads in ordinary steam freight cars.



FREIGHT CAR AND LOCOMOTIVE, LEWISTON

Porcelain Insulators for High-Tension Work

The accompanying engraving shows four new types of porcelain and glass insulators for high-tension work, manufactured by Fred. M. Locke, of Victor, N. Y. Mr. Locke has devoted a great deal of attention to this subject, and his insulators are used extensively on high-tension lines in this country. Fig. 1 shows a porcelain outer shell and glass center insulator manufactured for 50,000-volt lines and tested up to 100,000 volts at the works at Victor. Fig. 2 shows a glass triple petticoated insulator for 20,000-volt lines. Fig. 3 shows a glass insulator for use in transposing telephone lines, and Fig. 4, a similar insulator made of porcelain.

The demands for high-tension insulators have grown so rapidly as to compel the erection of new works at Victor by Mr. Locke. They contain the latest appliances used in the manufacture of insulators, and are two stories in height. The first floor contains the separating and mixing vats and molding process, where the water is squeezed out of the clay; also a great kiln for firing the insulators. The second floor is used for molding, shaping and drying. The insulators are burned at a very high temperature, and are vitrified throughout, increasing both their electrical and mechanical strength. The factory has a capacity of 60,000 insulators a week.



FIG. 2



FIG. 1



FIG. 3



FIG. 4

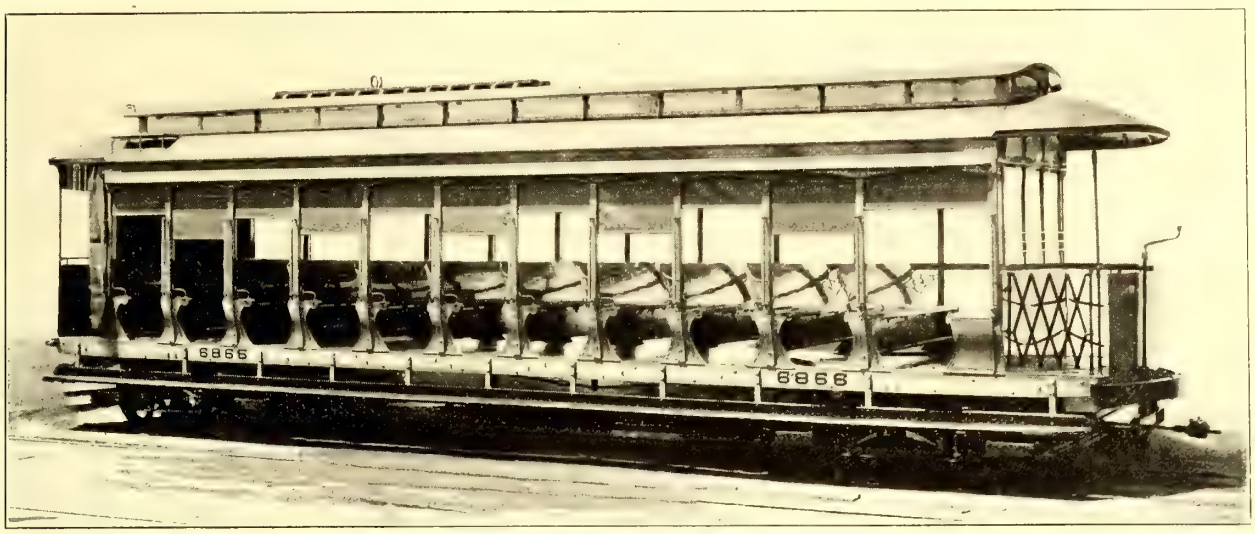
Consolidation of Pennsylvania Roads

All the street railway companies operating in and around Allentown have been merged into one company known as the Lehigh Valley Traction Company. As heretofore constituted, the system in and about Allentown consisted of nine companies, namely: Allentown Passenger Railway Company, Catasauqua & Northern Street Railway Company, Bethlehem & Allentown Street Railway Company, Bethlehem & South Bethlehem Street Railway Company, South Bethlehem & Hellertown Street Railway Company, Allentown & Emaus Street Railway Company, Lehigh Valley Traction Company, Allentown & Lehigh Valley Traction Company, and the Allentown & Bethlehem Rapid Transit Company. The lines of all these companies were operated on lease by the Allentown & Bethlehem Rapid Transit Company, and later by the Allentown & Lehigh Valley Traction Company as lessee. The consolidation has been brought about by each of the seven street railway companies ratifying the agreement of their directors by which the six street railway companies first mentioned are consolidated with and merged into the Lehigh Valley Traction Company, and by a transfer by the Allentown & Bethlehem Rapid Transit Company and the Allentown & Lehigh Valley Traction Company of all their power plants, cars, equipments and assets to the new company, the Lehigh Valley Traction Company. The officers of the new company will be Albert L. Johnson, president; Tom L. Johnson, vice-president, and J. E. Kenney, secretary. The directors are Albert L. Johnson, Tom L. Johnson, Samuel Harris, R. E. Wright and W. J. Hartzell.

Long Open Car for Atlantic City

The West Jersey & Seashore Railway Company, of Atlantic City, has just put in service a number of open cars, whose construction has been modified to suit the requirements of its service.

These cars form a very good example of what is now becoming very popular for street railway men, that is, the specializing of standard types to meet purely local conditions, thus obtaining all the advantages of standard cars, while adopting such features as make them peculiarly well fitted for the work which they are to perform. These cars have four 1-in. truss-rods, secured to the



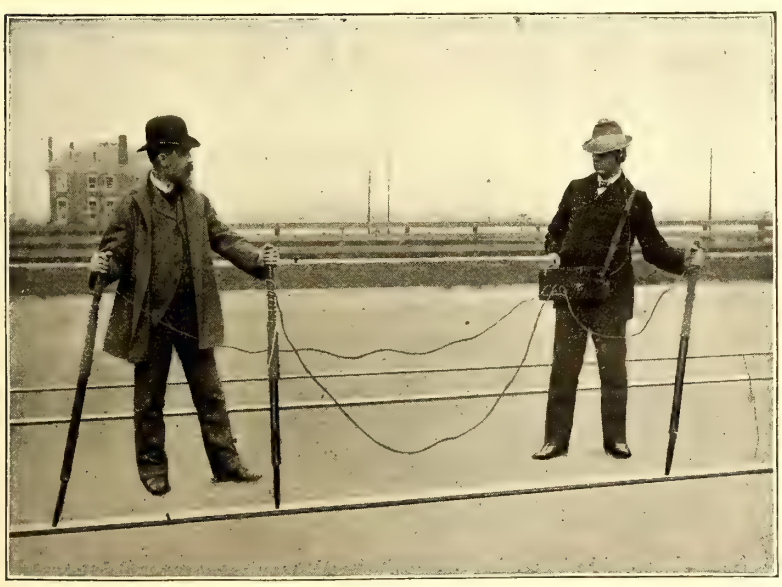
NEW OPEN CAR FOR ATLANTIC CITY

The cars are intended to run in one direction only around a loop, and have therefore been designed with strict regard to this service by the J. G. Brill Company, which built them. The body is within a fraction of an inch of 38 ft. in length, and is 43 ft. 9 ins. over the dashers. It is 7 ft. wide at the sills and 7ft. 8 ½ ins. wide over the posts. The platforms are short, that in the rear being 3 ft. 3 ins. and that forward 3 ft. 6 ins. These platforms are not intended for passengers. They have no seats, and that in front is closed on one side by the guard-rail, which runs from dasher to dasher, and is screwed fast, and on the other side by a Brill folding gate. The trolley board is placed at the rear end of the car, its center being 10 ft. 6 ins. from the rear end. As the car is to be operated in one direction, only one bulkhead is used, which is at the forward end. There is but one step, 11 ins. wide, having a 16½-in. riser. It is 20 ins. from the head of the rail.

The car is mounted on a pair of No. 27-G. trucks. There are two Westinghouse No. 38-B motors on the inside of the rear axles, with nose suspension. The forward axle is arranged for a Westinghouse compressor.

The inside of the car is finished in cherry and ash. The seats are reversible except the one against the bulkhead. The panels are of the round-corner, seat-end type. A rather unusual feature is the covering of the roof with tin instead of canvas. There is one gong, one sand-box and a pilot on the front end of the forward truck.

insides of sills below the bolster. This is necessary, as the weight of the car without motors is 20,700 lbs. The trucks weigh 5000 lbs. each.



TESTING RAIL BONDS IN BOSTON

A New Method of Testing Rail-Joints

A new method of testing the resistances of rail-bond has been invented by R. W. Conant, electrical engineer of the Boston Elevated Railway Company, and is in use on the lines of that corporation. A great advantage of the device is its quickness, as well as its accuracy, and its ability to make measurements rapidly enables the company to make frequent tests of its rail-bonds, an advantage which is self-evident.

The accompanying engraving shows the method of its practical application. The joint being tested is between the left-hand and center poles, and the inspectors are determining the resistance introduced into the rail circuit by reason of this joint. The method employed is the simple one of balancing the resistance of two circuits against each other and of determining when they and the other resistances are equal by telephonic means. The two circuits used are that between the center pole and the left-hand pole and that between the center pole and the right-hand pole. If there was no joint it would be necessary, of course, in order to make the circuits of equal resistance, to have the center pole midway between the two outside poles. If, however, the joint adds a resistance to a 30-ft. rail equal to, say 3 ft. of track, the center pole will have to be 3 ft. nearer the left-hand pole when these two span a joint. This joint represents a fairly good condition of track. With poor joints, however, the right-hand, or indicating pole, would have to be shifted anywhere from 6 to 30 ft. away from the center pole, depending on the condition of the joint, while with bad joints it would be over 30 ft.

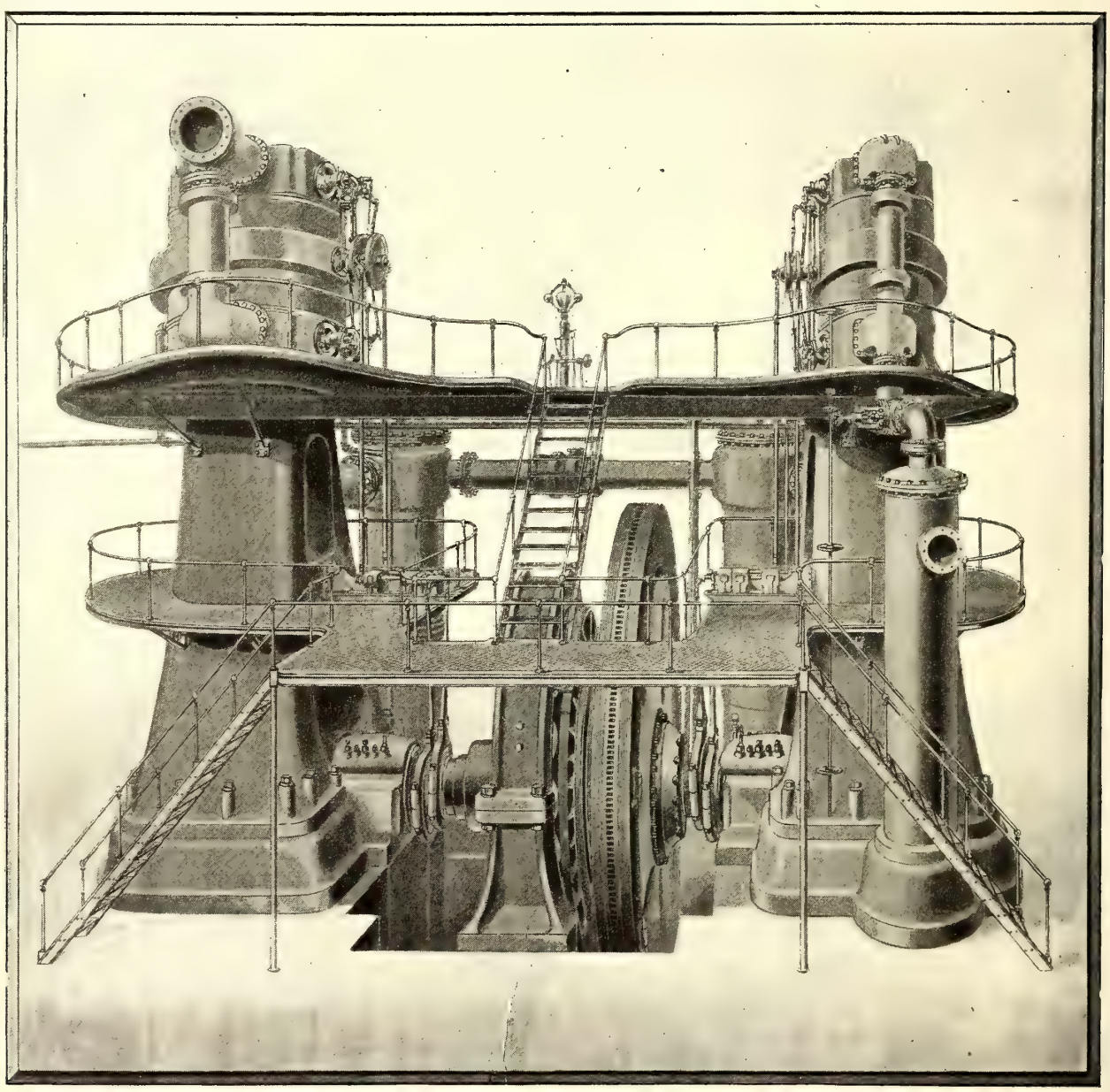
As will be seen, the Conant rail-joint testing instrument utilizes the current already on the track by reason of the car service, and no matter how variable this current may be, since the variation through the joint and adjacent rail is precisely the same, it introduces no error. The operator, having the case slung over his shoulder, directs his assistant to strike his two connecting poles into the rails, spanning the joint, with about 3 ft. between the poles. He then strikes his indicating pole into the rail, say 4 ft. from the center pole, and listening at the telephone attached to the box, which has a continuous interrupter in circuit, he throws a switch alternately to right and left and compares the two sounds heard from joint and 4 ft. of rail. Finding in the above case that the sound from the joint is the louder, he shifts his pole so as to span a greater length of rail. When the sounds are found to be approximately equal, a final test of balance is made by leaving the switch on the box in the middle position, when no sound should

be heard. In case a slight sound is noticeable he shifts his pole until it is entirely killed. This then gives the length of rail equivalent to the joint, from which, if it is desired, knowing the weight of the rail, the resistance may be calculated.

An intensifying attachment on the instrument allows of its use with very weak track currents, and the complete instrument is a simple and durable piece of apparatus. The instrument is being placed on the market by the Chase-Shawmut Company, of Boston, Mass.

Large Corliss Engine

The largest direct-current generating unit in the world is now approaching completion at the works of the International Power Company, at Providence, R. I., and will be installed in the power station of the Boston Elevated Railway Company. The indicated horse power of the engine at maximum efficiency is 4000 h.p., but this load can be varied 12 per cent to 15 per cent either way without materially effecting the efficiency. The engine, which is illustrated herewith, is of the vertical type, compound condensing, with cylinder dimensions 42 ins. and 90 ins. by 60 ins. stroke, and will run at 75 r.p.m. under a steam pressure of 180 lbs. The valves are of the Corliss type, but are located in the heads, instead of on the sides, of the cylinder, the usual practice. In this way, the clearance is reduced to a minimum, that in the low-pressure cylinder being less than 2 per cent. The cylinders are jacketed, barrel and head.



4000-H.P. CORLISS ENGINE FOR BOSTON ELEVATED RAILWAY

The pistons are of the box type. The rods are 9 ins. in diameter, have a 3-in. hole throughout their length, and are of nickel steel of 50,000 lbs. elastic limit. They are hydraulic forged and oil tempered, and are packed with Tripp metallic packing; below the metallic packing box is another of soft packing to prevent the passage of oil. The cross-heads are of air furnace charcoal gun iron. The connecting rods are all hydraulic forged nickel steel. They are circular in section, 9½ ins. in diameter near the cross-head and 13 ins. near the crank-pin. A 3½-in. hole extends through the rods from end to end. The distance between pin centers is 13 ft. 9 ins. The cross-head pin and crank-pin are all open-hearth forged nickel steel, bored out and oil tempered.

The engine shaft, which is furnished by the Bethlehem Steel Company, and illustrated in the Street Railway Journal for August, is of hollow forged nickel steel 27 ft. 10 ins. in length, 32 ins. in diameter in the bearings, and 37 ins. in the body, with a 17½-in. hole through its length. The weight of the engine shaft is 65,410 lbs., of the crank disc 58,004 lbs., of the armature 125,000 lbs., and of the fly-wheel 265,515 lbs., making a load on the bearings aside from the connecting rod, pistons, etc., 513,929 lbs.; 143 lbs. per square inch of projected area.

The fly-wheel is 28 ft. in diameter; the main bearings are 32 ft. in diameter, 56 ins. long and 19 ft. 9 ins. center to center. Both top and bottom shells are water jacketed, and oil is fed to the bearings at both top and bottom.

The cylinders are set 29-ft. 2-in. centers, with crank at 90 degs. Steam is brought to the engine by a 16-in. main, which enters first a receiver 3 ft. in diameter; from the receiver it passes through a 12-in. globe throttle valve to a 12-in. pipe, which conducts it to the steam valve chambers of the high-pressure cylinder. The valve gear is so arranged that the governor may control the cut-off in both cylinders, or the low-pressure cylinder may be run

on the fixed cut-off. The change can be made while the engine is in motion. The engine is guaranteed to regulate as to speed within 1 per cent under practically constant load, and to vary not more than 3 per cent with sudden changes of 25 per cent in load.

New Long Car for Cleveland

A type of car which is proving very satisfactory for long distance riding on the Cleveland City Railway is illustrated in this



LONG DOUBLE-TRUCK CAR FOR CLEVELAND

connection. It is used on the St. Clair, Detroit & Rocky River Line, which is controlled by the Cleveland City Railway Company.

The car, which was built by the G. C. Kuhlman Company, has a length over all of 47 ft., and contains fifteen benches, each capable of seating six passengers, or a total of ninety passengers in all. The width over the posts is 8 ft. 4 ins., and that over the steel sill plates 7 ft. 9 ins.

The car is finished in white oak, with cherry trimmings, and bird's-eye maple ceilings. The metal trimmings are of polished bronze. The car is vestibuled in front, and is equipped with four 35-h.p. Westinghouse motors on Brill No. 27 trucks.

This car has been adopted as the standard for this class of service on the Cleveland City Railway, and the Kuhlman Company is now engaged in building twenty similar in general character to that illustrated.

Track Scrapers

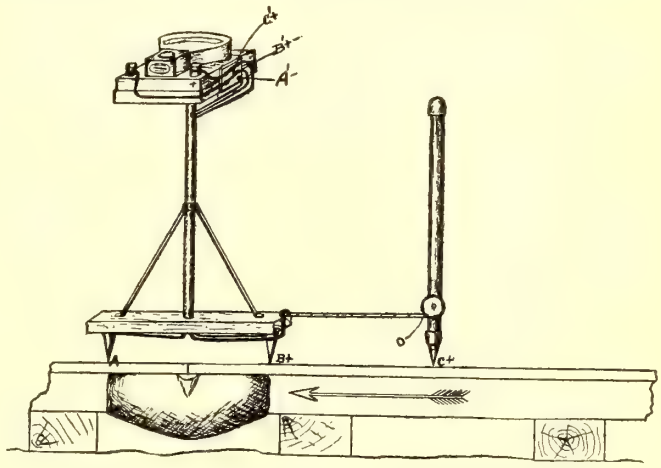
There is one piece of apparatus of the greatest value to street railway companies which receives little attention—this is the track scraper. In summer and winter, and on almost all lines except those running on the cleanest city streets the track scraper can be applied to advantage. In the winter time it performs invaluable service, and cars during early hours of snow storms can keep up to the schedule until the snow plow or sweeper is put at work. In the summer time mud and dirt on the rails can be removed and not only a better contact, but much easier riding, can thereby be obtained.

One of the best known devices of this kind is the Littell track scraper, as built by the J. G. Brill Company. Its action is automatic and its construction is of the simplest character. A heavy bar is bent into a rectangular U-shape. This is fastened to a board by a pair of bearings. At the outer ends of the bar the two scrapers are attached and at the bottom of the U, a lever leading to the platform is attached. The normal position of the scraper is up or raised from the track and the treadle hooked to the platform in a position where a touch of the foot will drop the scrapers upon the track. It is always ready for service at a moment's notice, a touch of the toe being all that is necessary to drop the blades upon the rails. The application is practically instantaneous, the blades may be dropped, the obstruction removed and the scraper lifted by a downward motion of the foot. This form of scraper has repeatedly been used as a life saving device, the blades being dropped the instant a person was discovered on the track. When lifted the blades are entirely out of the way and not liable to be interfered with. The whole arrangement is very light and strong and can be readily applied to any car by simply bolting the plank upon which it is mounted to the platform timbers. A view of the device is shown in the engraving of the Lewiston &

Device for Testing Rail Bond Resistances

The accompanying sketch shows an instrument for determining the resistances of rail-joints, invented by Chas. J. Schnaus, of the Missouri Railroad Company, of St. Louis, Mo. As shown, it is applied to a cast-welded joint, but readings can be made of any type of bonded joint.

The apparatus consists of a voltmeter, reading tenths of volts, mounted on a stand made of pipe, and with a wooden base. The latter is fitted with two hardened steel points, *A* and *B*, which serve as contacts, and are connected by wires passing through the rod to two points, *A'* and *B'*, on the two-circuit switch, attached to the voltmeter. The apparatus is also furnished with a third rod, *C*, which has a hardened steel point at its base, and is connected to the base of the stand by a steel tape line. The tape reel, which



DEVICE FOR TESTING RAIL BOND RESISTANCES

winds up automatically, is attached to the rod *C*, and the outer end, which is attached to the stand, is connected electrically to the voltmeter at the joint *C'*. The points *A* and *B* on the stand are spaced so that they just bridge the joint, if the track is cast welded, or if a fixed distance, say 30 ins. apart for an angle-plate joint. Readings are taken during the day while the regular schedule is in force.

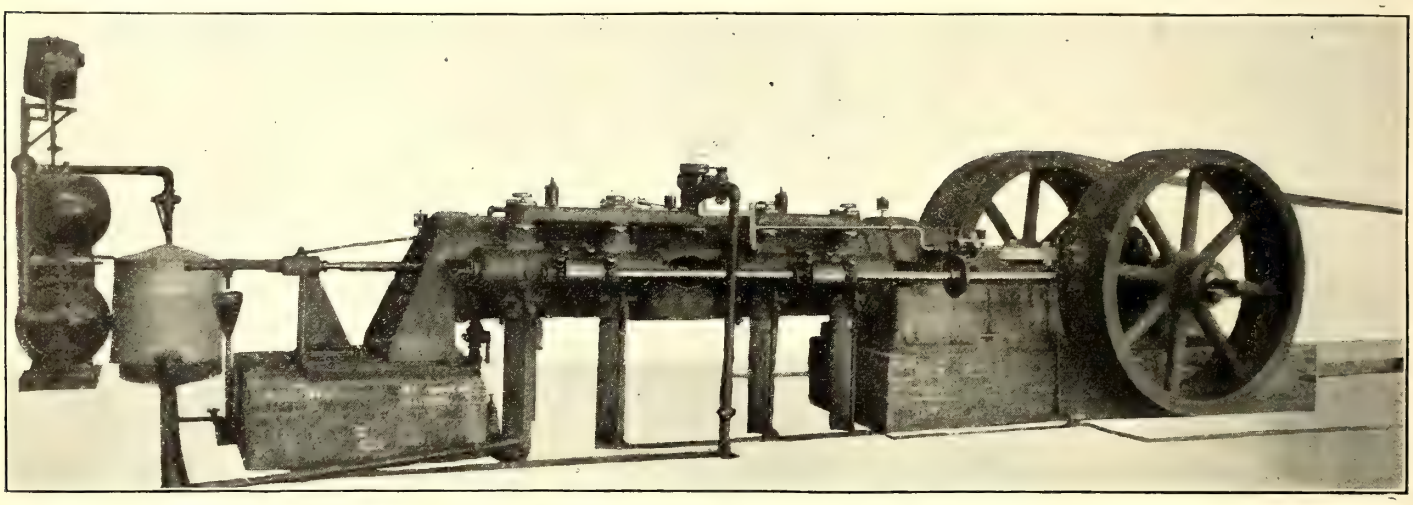
The instrument is first placed over a joint and the drop in voltage between *A* and *B* is taken on the voltmeter. The rod *C* is then drawn away from the stand until the resistance between *B* and *C*, as determined by the voltmeter reading, is the same as that between *A* and *B*. This distance is then read from the tape, and the difference between the length *A B* and *B C* represents the resistance of the joint in terms of inches of rail length. For convenience in reading this distance the zero point of the tape can be set at 30 ins. from *B*, or the distance between *A* and *B*. The re-

sistance in fractions of an ohm can easily be obtained from this measurement if desired.

The advantages claimed for this instrument are, that it is portable, does not interfere with the running of the cars, requires only the ordinary contact with a rail, is easily manipulated and fairly rapid. Experience with this instrument in St. Louis shows that two men can measure 2 miles of double track laid with 30-ft. rails in a day.

The Standard Automatic Gas Engine

The use of gas engines for power station service presents many advantages, and it is claimed that in some cases they are more economical than steam power, especially in space, first cost, attendance and fuel. A new engine of this type is that built by the Standard Automatic Gas Engine Company, of Oil City, Pa. While the company is comparatively unknown as yet to the majority of present or prospective gas engine users, and while many of the details of the engine as described below are radically novel, the fact that neither the company nor the engine is in inexperienced hands is proven by mentioning the name of the president of the one and the designer of the other, J. W. Raymond, designer of the improved Raymond engine, built for many years by the J. I. Case Threshing Machine Company.



THE STANDARD AUTOMATIC GAS ENGINE

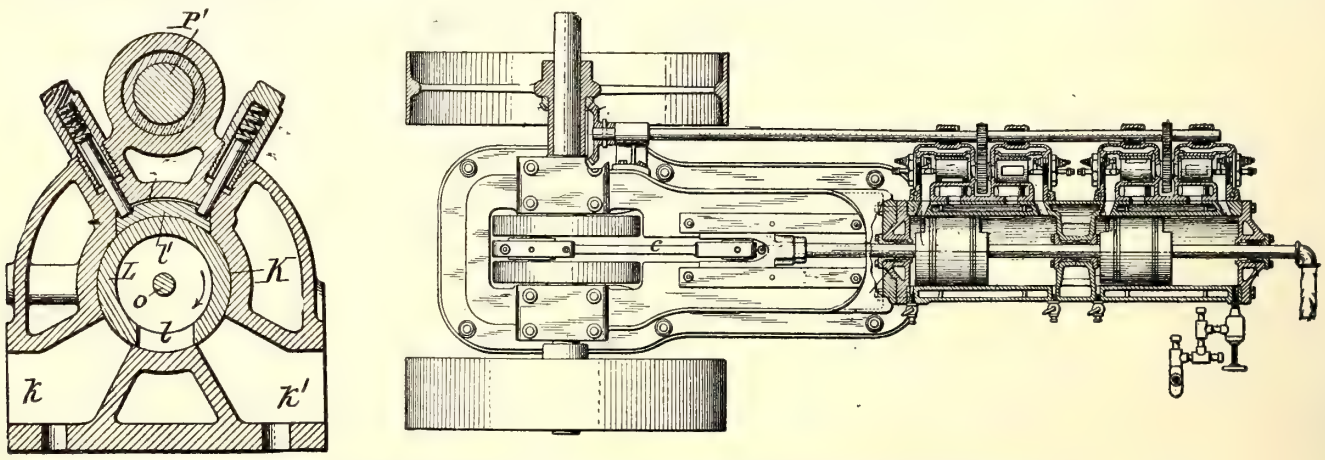
The engine operates upon the familiar Beau de Rochas, or four-stroke cycle, commonly known as the Otto, giving per single-ended cylinder one impulse during two revolutions. The special features deserving, perhaps, first mention, are the valve and valve gear. There is only one valve for both admission and exhaust, and this valve is a hollow cylinder of cast-iron, chilled and ground. The interior of the valve is open to the engine cylinder and as the valve turns in the valve chest, an opening in the valve alternately connects the cylinder with an admission and an exhaust port. A cross section through this valve is shown in Fig. 1. *L* is the cylindrical valve rotating in the valve chest, *K*, and held up against the valve seat by the springs and piece, *l'*. As it rotates, the port, *l*, connects the interior of the valve—which is open to the cylinder—alternately with the admission chamber, *k*, and the exhaust chamber, *k'*. The valve does not oscillate or have a reciprocating motion of any kind, but simply rolls continuously around in one direction, being turned by a horizontal shaft, driven by mitre gears from the main shaft, and turning the valve stem by 2 to 1 spur gears. The absence of poppet valves, cams, springs, and so forth, makes the engine remarkably noiseless.

The ignition is electrical in character, accomplished by a wiping spark between side tool-steel electrodes. The moving contact simply rotates with the valve, and the stationary contact is held by springs outside the valve chest and adjustable while the engine is in operation.

The governing of this engine is not accomplished by missing impulses, but by varying the quantity of the charge by throttling. The mixture is throttled by one plain balanced butterfly valve as simple as the damper in a stove pipe and almost entirely free from friction, since all points of the butterfly, except the stem, are out of contact with the walls of the valve chamber except when the valve is shut tight. For this reason the force which the governor must apply to move the valve is much less than that required for piston or other forms of valves, the leverage and necessary extent of motion of the fly balls is reduced and the regulation is correspondingly perfect. The proportions of the mixture are determined by entirely independent valves in the incoming air and gas pipes, the constituents being pulled through these and the mixture being pulled through the governing valve by the suction of the filling stroke.

The engine is horizontal and, in small sizes, 15 h.p. and upward, is of the ordinary single-acting form, with a trunk piston acting as a cross-head. In sizes of 50 h.p. and up, the engine is made with two single-acting cylinders tandem on the same piston rod. The cycles of the two cylinders are displaced one revolution from each other, so that one impulse per revolution is obtained, the expansion stroke in one cylinder occurring immediately before the compression stroke in the other.

Naturally, some means must be devised for cooling the piston rod, which runs out through the explosion chamber of the cylinder nearer the crank to the piston of the other cylinder. The piston rod is extended out through the head of this cylinder also, in the form of a tail rod, and is made hollow. A long pipe is then in-



FIGS. 1 AND 2.—CROSS SECTION THROUGH VALVE AND HORIZONTAL SECTION AND PLAN OF ENGINE

serted into the hollow rod and is packed at the tail rod end. Cooling water is injected through this long pipe clear into the rod in the second cylinder and flows back inside the rod, but outside the pipe, to a drip at the tail rod end. The piston rod is packed with non-inflammable packing where it comes through the cylinder head.

The company has recently completed a still more interesting engine with two 18-in. x 18-in. double-acting cylinders, tandem on one piston rod, with outside cross-head of standard steam engine construction. The two double-acting cylinders give two forward impulses per revolution simultaneous with the compression strokes in the other end of the cylinders. The heavy compression both ways gives very smooth running, even with considerable slack in the cross-head and crank-pin boxes. The piston rod of this engine, owing to the heavy strains it is called upon to bear, is made of nickel steel, drawn with the hole for the cooling water in it. The water in this case is introduced through the cross-head and discharged through the tail rod. One balanced-pressure sight-feed lubricator on the center of each cylinder lubricates the pistons with a high fire-test engine oil. Fig. 2 shows a plan of this engine.

The pistons are cored out and the water passing through the rod is compelled to circulate also inside the pistons, thus cooling them. One horizontal shaft runs along beside the cylinders and turns the four valves of this engine (one for each end of each cylinder) through two pairs of cut gears. The governor actuates one butterfly valve, which throttles the mixture to all four cylinder ends. The course of the mixture to any one, two or three of the four cylinder ends may be cut off to increase the compression and economy at low loads. Indeed, any valve chest may be opened and the igniter taken out while the engine is running.

This engine is started by turning it over to the proper point and igniting electrically a charge of very slow burning powder in an enclosure connected with one cylinder head. The connection is made through a number of right-angle bends made in capped tees in such a way that the ash from the powder blows past the bends and is caught in the caps, from which it may be removed from time to time. The engine may also be piped to a compressed air tank or steam supply for starting.

This engine is shown on page 896, set up and belted to a 150-kw. Westinghouse generator for the Oil City Street Railway. A duplicate is under way for the same purpose, and two 500 h.p. each are under order. No storage batteries will be used.

The engines are rated on the basis of mean effective pressure, the one shown in the illustration being conservatively rated at 200 h.p. on the basis of a mean effective of 32 lbs. per sq. in., although much higher mean effectives may be obtained. Indeed, this engine is guaranteed to develop 300 brake h.p. with a consumption of not more than 3000 cu. ft. of natural gas per hour, this gas showing about 990 B. T. U. per cu. ft.

An interesting equipment of engines for which the company has closed a contract will consist of four like that shown in the illustration, which are ordered for use in Germany. These will be made into two engines by coupling two of them together with cranks at quarters, each complete engine thus consisting of two pairs of tandem double-acting cylinders giving four impulses per revolution. Each such engine will be direct coupled to a three-phase 60-cycle alternator mounted between the cranks, and these alternators will be run in parallel and with rotary converters. Another order is for two engines of 350 h.p. each, to carry a street railway load in Western Pennsylvania. These engines will get their gas from by-product coke ovens, a gas which is at present thrown away, and will require no elaborate preparation, such as washing or scrubbing to adapt it for use in the engines. All it needs is to be passed through holders in which it can deposit its tar.

The Standard Automatic Gas Engine Company, of which Mr. Raymond is president, as noted above, is capitalized at $36,000, but expects to increase its capitalization to $100,000 to accommodate increasing business. It has recently erected new shops on the banks of the Allegheny River, about 2 miles below Oil City. The building contains also the new street railway gas engine power house and is about 180 ft. long by 67 ft. wide. The contract will soon be let to lengthen it 150 ft.

Safety Third-Rail System at New Britain

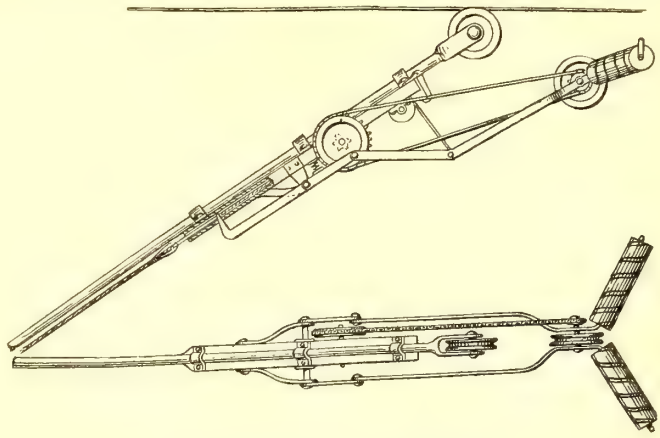
A series of tests were made Nov. 9, of the McElroy-Grunow safety third-rail system at New Britain, Conn., on a section of track belonging to the New York, New Haven & Hartford Railroad Company. The tests were made under the supervision of William Grunow, Jr., the inventor of the system. Owing to the shortness of the section high speed could not be secured, but the switches showed their ability to handle heavy currents. The brakes on the trial car were tightened, enabling the amount of current taken from the rails to reach as high as 1000 amps. at a pressure of 550 volts, but no sticking or arcing of the contact surfaces was discernible after careful inspection had been made.

The system consists of two rails carried between the regular track rails. One of these is a conductor rail, from which the current is taken into the car; the other is used for transmitting the current controlling the switching devices in the section boxes. The main current is not broken until the car begins to take current from the next following section. In this way there can be no arcing in the section box.

Trolley Pole Replacer

A new and ingenious trolley wire finder has recently been invented by Paul Kaufmann, of Lockport, N. Y., and is illustrated herewith. The frame of device is about 14 ins. long, and is constructed of tubing to render it light. When not in use, it lies from 4 ins. to 5 ins. below the trolley wheel, just low enough to clear the roof of the car when the trolley is running on a low wire. The device is actuated by a spring at the foot of the pole, which spring is connected by a wire to the replacer frame. The connection is not made directly, but through a rack bar shown in the engraving.

The operation of the device is then as follows: When the regular trolley wheel leaves the wire, it carries the replacer up with it until this latter strikes the wire. This actuates the double lever



TROLLEY POLE REPLACER

in the frame of the device, disengaging the rack-bar to which the spring is attached. The spring then draws up the replacer, pulling down the trolley. The grooved deflecting rollers then carry the wire to the auxiliary trolley wheel between them. This auxiliary wheel is connected by a sprocket chain with a gear wheel on the trolley pole, and its revolution turns the latter wheel. This gear wheel engages the rack-bar and retensions the spring until the rack-bar touches a hasp, which holds the frame in replacing or operative position. As the hasp releases its hold, the frame drops down and the regular trolley wheel is guided to the wire. At the same time the bar at the end of the frame engages the rack-bar, and the device assumes its original position.

The engraving does not represent the device in its proper proportions, but the auxiliary apparatus has been enlarged to show it more comprehensively.

Organization of R. W. Blackwell & Co., Ltd.

The announcement was made last month that Robert W. Blackwell & Company, Ltd., of 39 Victoria Street, Westminster, London, S. W., has been registered with a capital of £200,000. The company has been formed for the purpose of taking over the business of engineers and contractors heretofore carried on by Messrs. Robert W. Blackwell & Company, at London, Liverpool, Paris and New York. The directors of the company are: Robert W. Blackwell, Philip Dawson, Benjamin Hunting Howell, Sir Charles E. Howard Vincent and Francis Henry Barker. The change in organization mentioned has been made to extend the business of the company.

R. W. Blackwell & Company is one of the oldest and best established firms engaged in the electrical contracting and supply business in England, and has established a high reputation in the tramway and lighting fields. It has been the contractor for or has furnished supplies to a very large number of the electric tramway enterprises in Europe, particularly in England, and has branch offices in a number of the European capitals and in New York.

Annual and Quarterly Reports of New York City Companies

MANHATTAN RAILWAY COMPANY

At the annual meeting of the stockholders of the Manhattan Railway Company, of New York, held Nov. 8, the following directors were re-elected: George J. Gould, Russell Sage, Samuel Sloan, Edwin Gould, R. M. Gallaway, Marcellus Hartley, Thomas T. Eckert, G. P. Morosini, Donald Mackay, Howard Gould, Warren B. Smith, John T. Terry and Alfred Skitt. The officers were re-elected as follows: President, George J. Gould; vice-president, Alfred Skitt; secretary and treasurer, D. W. McWilliams. The company's report of operation is as follows:

Year ending Sept. 30,	1898	1899
Gross earnings	$9,204,466	$9,325,111
Operating expenses and taxes	6,066,682	6,113,790
Net earnings	$3,137,784	$3,211,321
Interest on bonds	1,889,681	1,889,681
Balance	$1,248,103	$1,321,640
Dividends	1,200,000	1,560,000
Deficit	sur.$48,103	$238,360
Previous surplus	4,353,104	4,401,207
Total surplus	$4,401,207	$4,162,847

Operating expenses, per cent, excluding all taxes, 56.69; operating expenses, per cent, including all taxes, 65.56; number of passengers carried, 177,204,558.

This report, compared with that of 1898, shows an increase in dividends of $360,000, due to the payment of dividends of 2 per cent on $30,000,000 and on $48,000,000, the increased capital arising from the $18,000,000 issue of stock to provide for electrical equipment and to extinguish floating debt and for betterments. The report on passengers carried, 177,204,558, shows a falling off and is attributed to the competition of the surface roads. The figures in 1898 were 179,728,356, in 1897, 183,184,641, and in 1896, 182,437,244.

Of the meeting and the affairs of the company Russell Sage is quoted as saying: "No interest connected with William C. Whitney had a voice at the meeting. I have stated time and again that Mr. Whitney had no investment interest, if any, in Manhattan. Before the election I told Mr. Gould that it would be impolitic, in view of the satisfactory condition of the company and the progress making in changing the motive power to make any change in the directorate or the officers. He concurred in my views. The meeting was entirely harmonious. The subject of electric traction was not brought up formally, but it was discussed between individual stockholders, and full satisfaction was expressed at what has been done and in the plans which are being carried out. No matter what the stock market thinks of our report for the year, we have every reason to be satisfied with the system and its finances."

The annual report of the Manhattan Railway Company, published above, was supplemented during the month by a report for the quarter ending Sept. 30. The figures of this quarter, as compared with that of last year and of 1892, follow:

Quarter ending Sept. 30	1892	1898	1899
Gross receipts	$2,468,730	$1,788,613	$1,912,829
Operating expenses	1,294,251	1,249,003	1,274,019
Net earnings	1,174,479	539,610	638,810
Other income	35,000	47,500	188,300
Total	1,209,479	587,110	827,110
Interest, taxes, etc	681,089	607,172	646,045
Surplus for stock	528,390	def.20,062	181,065
Dividends	a450,000	b300,000	c480,000
To surplus account	78,390	def.320,062	def.298,935

a, 1½ per cent on $30,000,000; b, 1 per cent on $30,000,000; c, 1 per cent on $48,000,000.

QUARTERLY REPORT OF THE METROPOLITAN STREET RAILWAY CO.

The Metropolitan quarterly report for the year ending Sept. 30, is as follows, comparison being made with 1898 and 1897:

Quarter ending Sept. 30	1897d	1898	1899
Gross receipts	$2,407,083	$3,120,371	$3,560,827
Operating expenses	1,289,277	1,548,396	1,716,613
Net earnings	1,117,806	1,571,975	1,844,214
Other income	86,829	97,515	77,853
Total	1,204,635	1,669,489	1,922,066
Fixed charges	820,448	1,117,680	1,130,330
Surplus for stock	384,187	551,809	791,736
Dividends	375,000e	375,000e	787,500f
To surplus account	9,187	176,809	4,236

e, 1¼ per cent on $30,000,000; f, 1¾ per cent on $45,000,000; d, excluding Second Avenue Railroad.

ANNUAL REPORT OF THE THIRD AVENUE RAILROAD COMPANY

At the annual meeting of the stockholders of the Third Avenue Railroad Company, of New York, held Nov. 15, the old board was re-elected except that William H. Webb, recently deceased, was replaced by George A. Heyl. The statement of operation for the year ending Oct. 31, 1899, with which is compared the report for the last two years, is as follows:

	1897	1898	1899
Receipts from passengers	$2,570,842	$2,359,799	$2,098,871
Operating expenses	1,444,648	1,180,465	1,392,400
Earnings from operation	1,126,194	1,179,334	706,471
Income from other sources, including dividends on stock of other companies	47,368	42,316	680,933
Total earnings	1,173,562	1,121,650	1,387,404
Fixed charges			
Interest on bonds	250,000	250,000	250,000
Taxes	122,286	119,578	116,020
Net earnings	801,276	752,072	1,021,384
Dividends	850,000	800,000	840,000
Surplus	def.48,724	def.47,928	$181,384

It will be noticed that gross receipts have fallen off about 11 per cent, and earnings from operation about 35 per cent. As against this there appears income from other sources this year of $680,933, as against but $42,916 last year. In order to make the showing a fair one, account should be taken of the interest on the floating debt incurred in purchasing the stock of the underlying companies, now in the treasury of the Third Avenue Company. In the balance sheet of June 30, 1899, this floating debt amounted to nearly $13,500,000, the interest on which at 4 per cent would amount to about $540,000, or at 5 per cent, $675,000.

The company's dividends in 1894 were 8 per cent, in 1895, 9 per cent; in 1896, 9¾ per cent; in 1897, 8¼ per cent; in 1898, 7¾ per cent, while in 1899, three dividends of 1¾ per cent were paid and the fourth, just declared at the annual meeting, was 1¼ per cent, making 6½ per cent for the calendar year.

The falling off in earnings shown in the annual report is, of course, due in large part, if not entirely, to the delays and difficulties of traffic in the reconstruction period. With the new long cars now in operation and which are likely to become the most popular cars in the city, the Third Avenue Railroad will doubtless gain traffic from both the Manhattan Elevated and Metropolitan Companies, and will even, perhaps, return to the standard of earlier days.

New Franchise in Milwaukee

The Milwaukee Electric Railway & Light Company and the special committee of the Common Council have at last agreed on the terms of the new street railway ordinance. It remains now for the Common Council to act on the agreement. The city agrees in the ordinance to grant the extension of all the company's franchises for a term of about ten years, all to end in 1934, and to grant eleven additional franchises to terminate at the same time. In return for these privileges the company agrees to grant workingmen's four-cent fares from 5:30 to 7 A. M., and from 5 to 6:30 P. M., beginning Jan. 1, next, and at the end of five years to give a straight four-cent fare. In return for these concessions the city will abandon all right to regulate or change fares until the new franchises expire in 1934. No provision is made for the readjustment of fares at any time during the next thirty-five years, no matter what the changed conditions may be. The company has accepted this proposition, and on these terms it has made formal application to the Common Council for the additional franchises agreed upon. The ordinance, as it now stands, is somewhat different in terms from that which the committee agreed on a few days ago.

Instead of demanding a sliding scale reduction in fares, reaching a four-cent fare four years hence, the sliding scale is abandoned and the four-cent fare is to be introduced after five years. The workingmen's fares are to go into effect at once and the council committee abandons its demand that the company pay for all original paving between the tracks.

Electrical Banquet in Philadelphia

The Morris Electric Company, of New York, tendered a banquet to the electrical press and a number of persons in the electrical railway industry on Nov. 14, at the Bingham House. Among those present were: Edward S. King, of the Baltimore & Ohio Railroad; C. B. Fairchild, "Street Railway Review;" George Mason, Potomac Terra Cotta Company, of Washington, D. C.; S. H. Harrington, Harrington Rail Bonding System, of New York; Elmer P. Morris, Morris Electric Company, of New York; John Blair MacAfee, president, Railways Company General and American Engineering Company, of Philadelphia; C. C. Bent, superintendent, Baltimore & Ohio Railroad Company; G. E. Pratt, Hubbard Electric Brake Company, of Chester, Pa.; George F. Porter, W. R. Brixey, New York; D. A. Hegarty, Railways Company General; W. E. Harrington, Camden & Suburban Railroad Company; Ambrose B. Umstead, Earn Line Transportation Company; W. H. Antrome, "Philadelphia Record;" J. Franklin Stevens, Keystone Electrical Equipment Company; Stephen Goddard, "Electrical Review," New York; J. L. B. Haehulen, Baltimore & Ohio Railroad Company; F. B. Franklin, Baltimore & Ohio Railroad Company; W. K. Beard, STREET RAILWAY JOURNAL.

Speeches were made by Mr. Bent, of the Baltimore & Ohio Railroad Company; Mr. MacAfee, and, of course, Mr. Morris. Many of those present, including Mr. Morris, were pioneers in the electric railway field, and their reminscences of the early struggles were of great interest to those who had only lately engaged in the work. Credit was given to the genius of Van Depoele, Sprague, Thomson and other inventors, as well as to the ability of such engineers in developing the work as F. S. Pearson, B. J. Arnold, Louis Duncan, G. F. Greenwood, H. F. Parshall and W. E. Baker. Mr. Morris received many congratulations upon the recent large orders which he had received for the equipment of the Havana Electric Railway, reference to which is made elsewhere in this issue. The dinner was given upon the occasion of the first shipment of fifty car loads of terra cotta ducts by steamer to Havana.

Consolidation of Well Known Publications

In the final issue of "Paper," published Nov. 10, it is announced that after that date "Paper" will be amalgamated with the "Paper Trade Journal." The conditions which brought about the establishment of "Paper" have now been removed through its agency, for the recent change of ownership in the "Paper Trade Journal," by which one of the best known newspaper men in this country, Col. C. H. Jones, became principal owner and manager of this old and well known trade publication, was due, in large part at least, to the rivalry of "Paper" during the past year. Col. Jones deserves, and will receive a large measure of success in his new venture, and the effect of his remarkable ability and enterprise has already become apparent in the pages of the "Paper Trade Journal."

Personal

MR. A. K. BAYLOR, of London, has arrived in America.

MR. HARRY W. HEAP, receiver of the Phœnix City Railway Company, was married recently to Miss Helen Wells, of Prescott.

MR. M. ADAMS, of Montoursville, Pa., assumed the duties of assistant superintendent of the Montoursville Passenger Railway Company on Nov. 1.

MR. HENRY N. RANSOM, purchasing agent of the International Traction Company, of Buffalo, was married Nov. 21, to Miss Alice Gillet.

MR. W. C. HELLER has resigned the general managership of the Montgomery & Chester Electric Railway Company, to accept a similar position on the Rapid Transit Railway of Xenia, Ohio.

MR. THOMAS E. MITTEN, general superintendent of the Milwaukee Electric Railway & Light Company, has been traveling in Canada and the East during the past two weeks.

MR. FRANK E. ROWELL has been elected treasurer of the Portsmouth, Kittery & York Street Railway Company, of Portsmouth, N. H., to succeed the late I. C. Libby, of Waterville.

MR. J. C. HUTCHINS, vice-president and general manager of the Detroit Citizens' Street Railway, has been elected president of the Detroit Electric Railway, to succeed the late Albert Pack.

MR. M. M. KOHN, general manager of the Oceanic Gas & Electric Company, Ltd., of Honolulu, H. I., is at the Hoffman House, New York. During his visit here, Mr. Kohn will make purchases in the mechanical and electrical lines

MR. WILLIAM WEAVER, of Ogden, manager of the Ogden Street Railway Company, of Ogden, Utah, has been appointed receiver of the Bear River Irrigation and Ogden Waterworks Company, to succeed William Adamson and S. S. Conklin.

MAJ. L. N. DOWNS, president of the Michigan Traction Company, of Kalamazoo, will remove to Philadelphia shortly to assume the presidency of the Railways Company General. This company recently secured control of the Michigan Traction Company.

MR. H. F. PARSHALL, the widely known consulting engineer of London, arrived in New York on Nov. 25, and will remain here for several weeks. He is accompanied by Mr. A. R. Monks, managing director of the British Thomson-Houston Company.

MR. FRANK M. HAYNES, president, purchasing agent and superintendent of the Lorain Street Railway Company, has tendered his resignation to accept a similar position in London, Eng., on lines recently acquired by A. J. Moxham and Tom L. Johnson.

MR. NELSON C. DRAPER, until recently mechanical engineer with the Central Railway Company, of Peoria, has been appointed constructing and mechanical engineer of the Peoria & Pekin Terminal Railway, with headquarters in Peoria. This company operates both steam and electric railways.

MR. J. BRODIE SMITH has been elected general manager of the Manchester Street Railway, of Manchester, N. H., to succeed Mr. E. P. Shaw, Jr., of Boston, who is forced to resign owing to the pressure of his other business connections. Mr. Smith will assume the general managership of the road Dec. 1.

MR. F. M. ZIMMERMAN, superintendent, purchasing agent and chief electrician of the Atlanta Railway Company, has resigned that position to accept a position with the Lorain Street Railway Company. Mr. Zimmerman will succeed Mr. Frank M. Haynes, who has connected himself with Mr. Johnson in his London project.

MR. E. J. BARNEY, president of the Barney & Smith Car Company, tendered his resignation as president of the company at the quarterly meeting of the directors, held Nov. 14. The resignation will take effect Jan. 1. At the meeting it was announced that the business on hand at the present time amounted to more than $2,000,000, and that the aggregate business which will be done this year will exceed that of last year by at least $600,000.

MR. A. N. CONNETT, engineer-in-chief of the works department of the Compagnie Francaise Thomson-Houston, of Paris, arrived in this country on Oct. 21, and returned to Paris during November. Mr. Connett is accompanied by Mr. J. A. Aubaret, engineer with the same company, who will remain in this country about six months studying street railway management in its different phases. Mr. Aubaret will reside in Washington while in this country.

CAPT. CHARLES E. HALL, master of construction for the Chicago City Railway from 1881 to 1897, and previously from 1857 to 1863 engineer in charge of nearly all the railways in Cuba, died in Chicago recently. Capt. Hall was born in Copenhagen, Denmark, and came to the United States as a child. He served in the war of the rebellion as captain in both the Fourth and Forty-ninth Wisconsin regiments.

MR. ROBERT F. FOX, formerly superintendent of the Scranton Railway Company, of Scranton, Pa., died a short time ago at his home in Meadville. Mr. Fox was well and favorably known in the East, and was at one time connected with the Brooklyn roads as assistant engineer. This position he resigned to accept the position at Scranton. From Scranton Mr. Fox went to Wil-

mington, Del., to assume the general managership of the lines of that city, and of Chester, Pa., which are controlled by the same interests as the Scranton company, but was compelled to resign the latter place owing to the failure of his health.

MR. F. J. O'DONOGHUE, superintendent of the Nashua, (N. H.) Street Railway, died at Nashua, Nov. 10, after a brief illness. Mr. O'Donoghue was well known in New England, and was connected with the Lowell & Suburban Railway before accepting the position at Nashua in 1896. Mr. O'Donoghue was born in Ireland forty-three years ago, but came to this country at an early age. He received his schooling in Boston and removed to Lowell when a young man, continuing to reside here until accepting the position in Nashua. His mother, two sisters and five sons survive him.

MR. R. W. BLACKWELL, of London, is in New York and will remain here for some weeks on business connected with his large European and American interests. Mr. Blackwell's business has reached such large proportions that additional working capital has become necessary, and a limited liability company, under the name of Robert W. Blackwell & Company, Ltd., was recently formed, with strong personal and banking alliances. New offices are being opened in the principal cities of Great Britain, and others will shortly be located on the Continent. Among the new parties interested in Robert W. Blackwell & Company, Ltd., are Col. Sir Charles Edward Howard Vincent, K. C. M. G., C. B., M. P., and Mr. Francis Henry Barker, chairman of the Associated Share Investment Company.

MR. GRANVILLE C. CUNNINGHAM, M. I. C. E., who has been for some years past managing director of the City of Birmingham Tramways Company, has been appointed general manager of the Central London Railway, one of the most important city transportation undertakings in the world (full description in the STREET RAILWAY JOURNAL for March, 1898, page 141). The cost of construction of this railway has been enormous, particularly in its city terminus at the bank, and as it bisects the great area of traveling London, passing under Bayswater Road and Oxford Street, it can hardly fail to secure an enormous revenue. Whether or not this revenue, gross and net, will be sufficient to earn a fair rate upon the investment, is the real question, but the company is to be congratulated on securing the services of Mr. Cunningham, whose experience in electric railroading during the past ten years has been second to that of few managers on either side of the Atlantic. Mr. Cunningham was for some years general manager and chief engineer of the Montreal Street Railway Company, one of the most successful and conservatively managed properties in North America.

COLONEL GEORGE B. M. HARVEY, president of the Atlantic Coast Electric Railroad Company and head of the Harvey syndicate, which recently purchased the street railway system of Havana, has been elected president of the publishing house of Harper & Brothers. Colonel Harvey is thirty-five years of age and a native of Vermont. After a newspaper experience commencing with the "Springfield Republican" and including the "Chicago Daily News," the "New York World" and the "Newark Journal," Colonel Harvey severed his connection with newspaper work in 1893 to engage in electric railroading, notably in Staten Island and in Eastern New Jersey. Previous to that time he had served on the staff of Governors Green and Abbett, of New Jersey, and had acted as Commissioner of Banking and Insurance of New Jersey. In a number of his railway enterprises he has been associated with Mr. William C. Whitney. In addition to his railway work and his connection with Harper & Brothers, he is vice-president of the Monmouth Trust & Safe Deposit Company, a director of the Lakewood Trust Company, a director of the Audit Company, a director of the Mechanics & Traders' Bank, of New York, vice-president of the National Salt Company and owner and editor of the "North American Review."

MAJOR RUSSELL B. HARRISON, formerly of Terre Haute, who has been a prominent and gallant officer during the recent Spanish war, returned to the United States on sick leave about Nov. 1, and will remain in this country from thirty to sixty days before returning to his post. Major Harrision has made a fine record during the war. He was originally appointed to the staff of General Fitzhugh Lee, in command of the 7th Army Corps, and was first detailed to act as Assistant Inspector General of the corps. A little later he became Chief Ordnance Officer, and had in charge the equipment of the corps with all ordnance necessary for their campaign. Still later he became Provost Marshal, with widely varied and important duties, having in charge the sanitary policing and sanitation of the camps, the regulation of the signal service system, etc. On the occupation of Havana he was placed in command of Morro Castle, being thus the first American officer to enter the castle and assume command. In April and May, 1899, the 7th Army Corps was mustered out of service, but Major Harrison was one of two or three officers retained in the service, and he became Inspector General of the Department of Santiago and Puerto Principe, under General Leonard Wood. In July there came an epidemic of yellow fever in his department, and while inspecting hospitals in the vicinity of Cuba about the middle of August, he succumbed to the fever, and had perhaps the most severe case ending in recovery known in the annals of medicine. On October 18 he was able to leave the hospital, and was put on sick leave and sent to New York. He left on November 5 for Omaha, where his wife has resided during his absence, and will remain there for some time to come.

MR. GARRETT A. HOBART, Vice-President of the United States, who died last month, was for a long time president of the Paterson (N. J.) Railway Company, and took an active interest in its management. It was largely through the personal attention which he gave the property, together with the efficient management of Mr. McAdoo, the company's general manager, that the property was brought to its present efficient state. Mr. Hobart was born June 3, 1844, at Long Branch, and was graduated from Rutger's College in 1863. He entered the legal profession, in which he soon secured success, as well as in business and politics. For eleven years he was chairman of the Republican State Committee of New Jersey, and beginning with 1884, was a member of the Republican National Committee. As presiding officer of the Senate he acted with great efficiency, and was also prominent in party councils, a fact which has not been true of most Vice-Presidents. In addition to his connection with the Paterson Railway Company, he was interested in many other corporations, engaged in transportation, banking and manufacturing.



GARRETT A. HOBART

AMONG THE MANUFACTURERS

A COMPANY has been incorporated in London, with a capital of $15,000, for the purpose of printing and publishing a European edition of the "American Machinist."

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, has recently received a letter from the Seoul Electric Company, of Seoul, Korea, ordering a Cross Special No. 3 filter with a capacity of 30 gals. to 40 gals. per day.

THE GREEN ENGINEERING COMPANY, of Chicago, who are the manufacturers of the Green traveling grate described recently in the STREET RAILWAY JOURNAL, and are also contractors for complete steam plants, having opened an office in St. Louis, in room 642, Century Building.

THE BROWNELL CAR COMPANY, of St. Louis, is very busy on a number of orders, among them one for fifty-five new cars to be used by the Metropolitan Street Railway Company, of Kansas City. The shops are full of work from other orders as well, and the company reports an excellent outlook for the coming year.

THE SEGUINE-AXFORD VENEER COMPANY, of Newark, N. J., is rapidly extending its lines into every field where veneers are used. The company is giving particular attention to street car work, and is supplying, when specified, ceilings and other veneer work made with a guaranteed moisture-proof glue of their own make.

THE WALWORTH MANUFACTURING COMPANY, of Boston, has recently moved its main office from 16 Oliver Street to its new store, 128-136 Federal Street. The company has secured at this latter address fine offices, which have been fitted up in the best manner possible for conducting its large and constantly increasing business.

THE INTERNATIONAL BRAKE SHOE COMPANY, of Chicago, has recently received numerous inquiries regarding the diamond "S" brake shoe from foreign lands, with a view toward adapting it as standard. To care for this growing export trade the company has recently published pamphlets in the various languages for circulation abroad.

GEO. KISSAM & COMPANY, of New York, the well known advertising agents, have recently published a tasteful folder giving particulars of the International Traction Company, of Buffalo and Niagara Falls, the advertising on whose lines is controlled by this firm. The folder also presents a bird's-eye view of the entire system, with the Niagara Falls in the foreground.

THE UNION BOILER TUBE CLEANER COMPANY, of Pittsburgh, Pa., has just completed a contract for cleaning two Hazleton or porcupine-boilers having over 2000 tubes, one end of which is welded tight. These tubes were badly scaled, and the closed end required a special tool of unique design, as well as the use of the Union Boiler Tube Cleaner Company's special design of flexible shaft.

THE CLING-SURFACE MANUFACTURING COMPANY, of Buffalo, N. Y., reports a rapidly increasing demand for Cling-Surface, with recently large shipments to England and Mexico. Of the many testimonial letters sent in by users of this preparation for belts the Union Traction Company, of Philadelphia, says: "We have ordered a second can of Cling-Surface, which is evidence that we consider it satisfactory."

THE STERLING VARNISH COMPANY has just issued a small but interesting pamphlet on the subject of insulating varnish, which contains besides a good deal of valuable information, a number of fac simile letters of recommendation, orders, etc. An edition has been printed in French and German for distribution on the Continent, and all in this or foreign countries who desire to obtain a copy, will do well to address the company.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY, of 831 Arch street, Philadelphia, Pa., has recently purchased the good will, stock and fixtures of the Franklin Electric Supply Company, of 506 Cuthbert Street. Mr. Roberts has had long experience and close connection with electric industry, and his company is in an excellent position to advise purchasers as to apparatus, as well as to supply them with various kinds of electrical goods.

THE CLEVELAND CRANE & CAR COMPANY, of Cleveland, Ohio, has recently published a tasteful catalogue descriptive of the electric cranes built by it for railway power stations and factories. These cranes have had a most successful record where they have been installed, especially in power stations where electric power is so easily available and most convenient. The cranes are built in all types, including traveling cranes, jib cranes, locomotive cranes, etc.

THE DE WITT SAND BOX COMPANY, of Lansingburg, N. Y., has recently closed a contract with the Third Avenue Railroad Company, of New York, for 840 sand boxes. The De Witt Sand Box Company is a recent organization which will manufacture the De Witt sand box, formerly made by E. F. De Witt & Company. The change has been made to increase the manufacturing facilities of the firm, which has recently been taxed, owing to the large number of orders received.

THE BERLIN IRON BRIDGE COMPANY shipped from its plant at East Berlin, Nov. 15, a train load, comprising about twenty-seven cars of structural material consigned to the United States Commission at Paris, France. This material will constitute a very important element in the American exhibit at the Paris Exposition, and is for the steel framework of a machine shop to be used exclusively by the American exhibitors of iron and wood-working machinery at the exposition.

THE EIGHTEENTH EDITION of the Electrician Electrical Trades' Directory and Hand Book for 1900 is now in preparation, and is to be ready in January, 1900. This well-known British publication is a carefully compiled list of British, colonial and foreign engineers, manufacturers, lighting and tramways companies, and, in fact, all engaged in electrical pursuits throughout the world. Correspondence should be addressed to the "Electician" office, Salisbury Court, Fleet Street, London, E. C.

THE SOUTHERN PACIFIC COMPANY has issued a trio of pamphlets entitled "Shasta Route," "California South of Tehachapi" and "Wayside Notes Along the Sunset Route." The pamphlets are well gotten up and contain an industrial, geographical and scenic description of the interesting features along the company's route. The illustrations are especially clear and attractive. A map of California, with a brief description of its resources, attractions, topography, climate, etc., is also published by this company.

THE GOLD CAR HEATING COMPANY, of New York, has recently published a large circular descriptive on one side of its system of electric heaters, and on the other side giving the salient points of the recent suit between the Consolidated Car Heating Company and the Palmer & Monson Street Railway Company, in which it was decided that the Gold system was not an infringement of the patents of the former company. Mention of this decision was given in the last issue of the STREET RAILWAY JOURNAL, and a reproduction of this circular is published elsewhere in this issue.

J. G. BRILL COMPANY, of Philadelphia, has just secured an order from the Union Traction Company for 150 cars. One hundred and ten of these cars are to be of the twelve-bench open type, with an aisle through the center; the other forty are fourteen-bench open cars, also with center aisle. Both are to have the Union Traction Company's standard finish, and to be of the same style and finish as furnished the Union Traction Company by the Brill Company during the past summer. Westinghouse No. 38 motors will be used on the twelve-bench cars and four Westinghouse No. 3 motors on the fourteen-bench cars.

GEORGE W. LORD, of Philadelphia, manufacturer of Lord's Boiler Compound, after twenty-three years at his former location, moved on Dec. 1, to his new plant, 2238 to 2250 North Ninth Street, Philadelphia. The new plant covers a ground space of 150 ft. x 175 ft., and consists of a three-story and basement brick building, with foundation and walls sufficiently strong to allow the addition of three more stories, should that space be required any time in the future. The equipment will include the latest apparatus for manufacturing the chemicals used in the preparation of the many formulas of Lord's Boiler Compounds.

THE FRANK M. PIERCE ENGINEERING COMPANY, of New York, reports a very active business, largely as a result of Mr. Pierce's extensive foreign travel within the last few years. During the last month the company reports contracts closed as follows: Four 500-kw. direct-connected, cross-compound, heavy duty, St. Louis Corliss railway engines; one 500-kw. direct-connected, simple, heavy duty, St. Louis Corliss railway engine; twenty-two engines on order to supply the company's English trade, and one electric lighting power plant for equipping a central station in one of Uncle Sam's new island possessions.

THE HAM SAND BOX COMPANY, of Troy, N. Y., reports a large number of recent orders. These boxes are used extensively abroad, as well as in this country, as shown by the following list of foreign railways on which the boxes have recently been applied: Bolton Corporation, Lancashire; Blackpool & Fleetwood Tramroad Company, Potteries Electric Traction Company, Corporation of Liverpool, Dublin United Tramways Company, Waterloo & City Railway, London; Corporation of Sheffield, Liverpool Overhead Railway Company, Carlisle Tramways Company, Corporation of Sunderland, Corporation of Dundee, Corporation of Southport, and Great Grimsby Street Tramways Company.

THE CLONBROCK STEAM BOILER COMPANY, of Brooklyn, manufacturers of the Morrin "Climax" steam boiler, reports that the Climax boilers, which the company had on exhibition at the Trans-Mississippi and International Exposition, Omaha, Neb., 1898, and the Greater American Exposition, Omaha, Neb., 1899, have all been sold to the following parties: The Council Bluffs Street Railroad Company, Council Bluffs, Ia., one 500-h.p. and one 250-h.p. boiler; the Madison Street Railroad & Electric Light Company, Madison, Ia., one 250-h.p. boiler, and the International Packing Company, Omaha, Neb., for its new plant at Sioux City, Ia., three 500-h.p. and one 200-h.p. boilers.

EXPERIENCED HELP, at a time when required, is an important matter with railway companies. Good men are required, and an emergency creates a demand that must be promptly filled. E. G. Johnson, who has been for several years Superintendent and General Manager of the Philadelphia & Bryantine Railroad and the Bryantine Transportation Company, has opened an office in the St. James' Building, Broadway, New York, and is in touch with the railways and with the best class of labor, which can be vouched for and recommended. Application to Mr. Johnson will be regarded as confidential and immediate response given. No

charges are made for the service rendered and personal attention is given by Mr. Johnson to all business intrusted to his office.

ANNOUNCEMENT is made of the organization of the New York Air Compressor Company under the laws of the State of New Jersey. The capital stock of the company is $100,000, and a complete foundry and machine shop plant has been purchased on the line of the New York & Greenwood Lake Railroad at Arlington, N. J. Contracts have already been let for a full modern equipment of tools. It is intended to manufacture a complete line of air compressing machinery at the new plant. The officers of the company are: J. W. Duntley, president; Alexander MacKay, vice-president; W. P. Pressinger, secretary and treasurer. The directors are: J. W. Duntley, Alexander MacKay, W. P. Pressinger, William B. Albright, W. O. Duntley, Thomas Aldcorn and Austin E. Pressinger. The New York offices of the company are at 120 Liberty Street.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, reports fifty-five orders for the month of October, the machine ranging in size from the smallest to 300 kw. capacity. A repeat order was received from the Maryland Steel Company, of Sparrows Point, Md., this making the fifth order, and being for a 300-kw. generator and several motors. Orders were received from the London, England. "Star," and the St. Petersburg, Russia, "Novia Wremia," two of the most important papers of the respective cities, for the Bullock "teaser" equipment for operating newspaper presses. Two 300-kw. alternating current generators were shipped to the Wilson Aluminum Company, of Holcombs Rock, W. Va., to be used in the manufacture of ferro-chrome, an electro-chemical product used in the manufacture of chrome steel.

THE NEW CAR HOUSE at Port Chester, N. Y., for the Port Chester Street Railway Company, will be furnished by the Berlin Iron Bridge Company, of East Berlin, Conn. This building will be one of the largest of its kind in the country. The Berlin Iron Bridge Company also reports a large number of other orders. Among them are a new pier shed and dock, 40 ft. x 600 ft., at Providence, R. I., for the Clyde Steamship Company, and some new work for William Cramp & Sons, Ship & Engine Building Company. The work for this company will include a new machine shop 142 ft. wide and 350 ft. long, three stories in height. All the floors, including the gallery floors, to be controlled by electric traveling cranes. The building will be of steel frame-work, the outside walls of brick, and will be one of the largest and most complete machine shops in the world.

THE AMERICAN STEEL & WIRE COMPANY, of Chicago, has issued a circular to its customers explaining that the partial destruction on Nov. 4 of one of its plants at Waukegan by fire will not seriously delay the filling of orders. The circular says: " The fire affected particularly the finishing end of the plant, the rolling mill not being damaged in any respect. Our warehouse, with a fair stock of goods, was also saved. We have already made arrangements for the execution by our other plants of unfilled orders at Waukegan, and desire to assure you that all orders now placed with us which have been lodged at Waukegan for shipment, will be taken care of by shipment from other plants with very little, if any, delay; and all future orders will receive our prompt and careful attention as heretofore. We therefore solicit a continuance of your future favors, and are in position to respond promptly."

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY and the Westinghouse Air Brake Company, of Pittsburgh, have published during the last month two very tasteful catalogues, one relating to the new electric railway motors of the former company, the other to the electro-pneumatic system for controlling trains, of the Air Brake Company. The new motors described include the 68, 69, 56, 70 and 50-C., all of which were described in the October issue of the STREET RAILWAY JOURNAL. The catalogue includes as well a number of attractive views of some typical Westinghouse power stations, and is very handsomely printed and illustrated. A description of the Westinghouse electro-pneumatic system of control, which is the subject of the second pamphlet, was also published in the October issue. The catalogue, however, gives a large number of new engravings, and will be found of interest to all electric railway engineers.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently taken the exclusive territorial agency for the Multiplex Reflector Company. These corrugated reflectors and head-lights are claimed to be an entirely new departure and the latest and best thing in the reflector line yet produced. They are said to produce 300 per cent more light, both in intensity and volume, than any other plain or parabolic reflector on the market, and the company invites comparison to substantiate this claim. They are especially adapted for street railway work and certainly deserve the consideration of anyone on the market for a first-class and strictly up-to-date head-light. The Multiplex Reflector Company makes an electric arc head-light with automatic regulation, and claimit to be the only self-regulating arc head-light made. These head-lights are so constructed that no amount of jarring or vibration will disturb their adjustment or affect the light in the least. The manufacturers are always glad to send these head-lights out on trial, or for competitive tests.

THE JACKSON & SHARP COMPANY, of Wilmington, Del., has recently shipped to the Perth Tramways Company, Ltd., Perth, Western Australia, five 18 ft. closed car bodies, and to the Buenos-Aires & Belgrano Tramway Company, Buenos-Aires, Argentina, twenty convertible car bodies, and five ten-bench open cars of the standard type used in this country. Its domestic orders have also been considerable. Among other work the company has just completed six 30 ft. cross seat cars for the Bridgeport Traction Company, Bridgeport, Conn. These cars are very fine in every respect. The interior finish is of mahogany. The seats are upholstered in crimson plush, and have bronze handles on the corners in place of the overhead hand straps. They have upper and lower sash, the top sash being permanent, and glazed with embossed glass. The lower sash when down gives a very large opening, which makes the car very desirable for summer as well as winter service. These cars have a seating capacity of forty persons each. They are equipped with twelve heaters. The platforms are vestibuled, and have double side folding doors. The cars are mounted on short wheel base trucks, and have four motors. They are equipped with Sterling safety brakes. The Brunswick Traction Company, New Brunswick, N. J., has also recently received six 28-ft. closed cars from the Jackson & Sharp Company.

New Publications

Verbatim Report of the Third Regular Annual Meeting of the Street Railway Accountants' Association of America. Published by the Street Railway Accountants' Association of America.

The verbatim report of the Chicago convention of the Street Railway Accountants' Association of America is just at hand, and Secretary Brockway certainly deserves great credit for the promptness with which this report has appeared so soon after the annual convention. The report contains 160 pages, and has as a frontispiece an excellent likeness of President Calderwood.

Report of the Eighteenth Annual Convention of the American Street Railway Association. Published by the Association. 219 pages.

The official report of the Chicago Convention has been published with the usual promptitude, and members of the association can have the satisfaction of having the printed report before them within less than a month from the close of the convention. It is needless to say that this adds very much to the value of the report and the secretary should have due credit therefor. Some of the diagrams and the banquet menu are reproduced in different colors, and the frontispiece, a portrait of ex-President Sergeant, is an excellent one.

Trade Catalogues

Insulating Varnish. Published by the Sterling Varnish Company, of Pittsburgh, Pa. Illustrated.

Interior Conduit Catalogue No. 75. 148 pages. Illustrated. Published by the Sprague Electric Company, of New York.

Cranes and Electric Hoists. 20 pages. Illustrated. Published by the Cleveland Crane & Car Company, Cleveland, Ohio.

Westinghouse Railway Motors. 34 pages. Illustrated. Published by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

Catalogue No. 64. Lundell Generators, Direct Connected and Belted Types. 36 pages. Illustrated. Published by the Sprague Electric Company.

Westinghouse Electro-Pneumatic System for Controlling Railway and Other Motors. 38 pages. Illustrated. Published by the Westinghouse Air Brake Company, Pittsburgh, Pa.

Application of Storage Batteries in Railway and Power Plants. Circular No. 55. 12 pages. Illustrated. Published by the Electric Storage Battery Company, of Philadelphia.

Digest of the Contents of this Issue

IN

GERMAN, FRENCH AND SPANISH

Inhalts-Verkürzung—October, 1899.

Elektrisches Bahnwesen in Amerika, wozu Chicago einen Beleg liefert. . . . . . [Seite 613.]

Die Obergrund-Bahnnetze in Chicago werden von zehn und die Hochbahnlinien von fünf unabhängigen Gesellschaften betrieben. Mehrere der hauptsächlichsten Linien weisen noch Seilbetrieb auf, doch ist die grössere Meilenanzahl bereits mit Elektrizität ausgestattet, und beabsichtigt man, die Umwandlung des Seilbetriebs in elektrischen sobald als möglich vorzunehmen. Pferdebahnen sind fast ganz aus Chicago verschwunden, indem da nur noch einige Nebenlinien der mit Seil betriebenen Linien existiren. Die Hochbahnlinien werden sämtlich mit Elektrizität betrieben und bilden bei weitem das ausgedehnteste Hochbahnnetz der Welt. Natürlich giebt es in Chicago eine grosse Anzahl Kraftstationen, um alle unabhängigen Bahnnetze in Betrieb setzen zu können; von den meisten ist eine Abbildung beigegeben, woraus die Anordnung der Maschinerie u. s. w. erhellt; auch sind sie diagrammartig veranschaulicht, um auf solche Weise die relativen Grössen der Stationen sofort hervortreten zu lassen. Fast sämtliche grosse Kraftstationen werden ohne Kondensation betrieben, und giebt es in Chicago nur drei oder vier Stationen mit Kondensation. Die Unmöglichkeit, eine genügende Wasserzufuhr zu einem mässigen Preise zu erhalten, hat zu der Verwendung von Kühlanlagen und Tischen geführt, mittelst deren das Wasser für Kondensation mehrere Male benutzt wird. Wiewohl der Oberbau in Chicago, gerade nichts Wunderbares aufweist, verdient er dennoch einige Autmerksamkeit und zwar besonders hinsichtlich des Umgiessens von Schienenstössen, ein Verfahren, worin man es hier zu einem hohen Grade von Vollkommenheit gebracht hat. Das Oberleitungssystem ist, wenn auch einfach, sehr gut, und war man weniger darauf bedacht, ihm ein schönes als vielmehr ein anspruchsloses Aussehen in den Strassen zu verleihen. Den Schluss dieses Artikels bildet die Beschreibung nebst beigefügten Abbildungen der Konstruktionsarten, wie sie bei der neuen Nordwest-Hochbahn zur Anwendung kamen.

Elektrisches Bahnwesen in Deutschland. Von Louis J. Magee. [Seite 647.]

Dieser Artikel enthält eine sehr werthvolle Beschreibung deutschen Bahnwesens aus der Feder des Betriebsleiters der Union Elektricitäts-Gesellschaft, einer der grössten Fabrikgesellschaften in Deutschland. Das Besitzrecht von deutschen Trambahnen wird ausführlich erörtert, und werden die Beziehungen der bedeutenden Finanz-Syndikate oder Gruppen zu der Strassenbahn-Industrie dargelegt, und kann man den Einfluss, den diese Gruppen auf die rasche Entwicklung Deutschlands ausgeübt haben, wohl kaum über schätzen. Die Haupteigenthümlichkeit des deutschen Bahnwesens, worin es sich vom amerikanischen unterscheidet, liegt in der Benutzung des gemischten Systems bei elektrischem Betrieb, wobei die Wagen im Mittelpunkte der Stadt durch Akkumulatorenbatterien und in den Umgebungen durch das System mit oberirdischer Stromzuführung fortbewegt werden. Noch Etwas, was Deutschland thut, und was weder in Amerika noch sonstwo in der ganzen Welt in demselben Grade geschieht, ist das Errichten von dekorativen Masten, von kombinirten Fahrdraht- und Beleuchtungspfosten u. s w. Herr Magee giebt weiterhin sehr interessante detaillirte Schilderungen, was Kraftstationen, Gleis, oberirdische Leitung, rollendes Material etc. anbetrifft: und aus Allem geht hervor, dass Deutschland die Wissenschaft der Elektrotechnik auf eine hohe Entwicklungsstufe gebracht hat.

Elektrisches Bahnwesen in Grossbritannien. Von Sidney H. Short. [Seite 663.]

Prof. Short hat in diesem Artikel viele der hauptsächlichsten Eigenthümlichkeiten des britischen Bahnwesens zusammengestellt und setzt die Schwierigkeiten auseinander, die der Entwicklung der Industrie in jenem Lande bis auf den heutigen Tag hindernd im Wege standen; es war dies eine Folge der durch die Parlamentsakte auferlegten Beschränkung und des wachsenden Verlangens nach Eigenthumsrecht, wie es die Stadtbehörden den Privatunternehmungen gegenüber kundgaben. Die technischen Einzelheiten über Oberbau, oberirdisches Leitungssystem, rollendes Material u. s. w. sind sorgfältig in Wort und Bild wiedergegeben.

Finanzielle Charakteristiken der bedeutenden Stadt-Bahnnetze der Welt. Von Edward E. Higgins. . . . . [Seite 680.]

Eine Sammlung der Statistiken betreffs Meilenanzahl, Kapitalanlage, Einnahmen und Ausgaben des Bahnnetze in Städten von mehr als 500000 Einwohnern in allen Ländern der Welt, in solcher Weise angeordnet, dass daraus der verhältnismässige Gewinn sowie auch die günstigen Gelegenheiten für Kapitalanlagen erhellen.

Elektrisches Bahnwesen in Oesterreich-Ungarn. Von E. A. Ziffer. . . . . [Seite 685.]

Die erste elektrische Bahn in Oesterreich für Personendienst wurde i. J. 1883 eröffnet und war 4 km lang; die in Ungarn i. J. 1889. Letztere Linie wurde nach dem Systeme mit unterirdischer Stromzuführung gebaut. Diese Leitung wird auf Seite 687 veranschaulicht. Das System kommt in Budapest in ausgedehntem Maasse zur Verwendung und soll auch in Wien installirt werden. Im Allgemeinen jedoch benutzt man das Fahrdraht-System. Konzessionen werden Privatgesellschaften von der Regierung bewilligt, doch ist die Dauer derselben auf sechzig Jahre beschränkt. Stadtgemeinden besitzen ebenfalls das Recht zum Bauen und Betreiben von Strassenbahnen. Auch sind alle Bahnen von untergeordneter Wichtigkeit für einen Zeitraum von zwanzig Jahren von Staatssteuern und in einigen Fällen von städtischen Abgaben befreit. Sodann giebt der Verfasser ein Verzeichnis der elektrischen Bahnen, nebst deren durchschnittlichen Länge, Spurweite, Personenbeförderung und Einnahmen. In den Städten sind die Schienen entweder auf Beton oder Schotter bis zu einer Tiefe von 30 cm gelegt, und beträgt deren Gewicht 34 bis 43 kg pro m. Ausserhalb der Stadtgrenzen benutzt man Vignoleschienen im Gewichte von 21 bis 23 kg pro m auf Holz- oder Metallschwellen. Der Verfasser beschreibt weiterhin das Verfahren bei Schienenverbindungen, Speiseleitungen und Masten. Der Fahrdraht ist gewöhnlich hartes, gezogenes Kupfer und 7 bis 8,25 mm im Durchmesser. Die Bahn von Baden nach Böslau benutzt Siliziumbronzedraht, dessen Durchmesser 7 mm beträgt. In manchen Fällen ist der obere Theil des Fahrdrahts mit einer hölzernen Schutzvorrichtung, die durch Metallklemmen in ihrer Lage festgehalten wird, bedeckt, um zu verhüten, dass herunterfallende Telephon- und Telegraphendrähte mit dem Trolleydraht einen Kontakt herstellen. Der am meisten benutzte Wagen ist der sogenannte Hamburger Typus, mit langer Plattform an jedem Ende und mit Sitzen für 20 Personen versehen. Die Gesamtlänge beträgt 8,4 m. In kleineren Städten variirt diese Totallänge zwischen 5,8 and 7 m. Der Verfasser giebt dann eine Beschreibung der verschiedenen Typen von Stromabnehmern oder Kontaktrollen. Die Fahrgeschwindigkeit ist in allen Fällen von den Behörden vorgeschrieben und beläuft sich gewöhnlich auf 15 km pro Stunde. In Strassen, wo wenig Verkehr herrscht, darf die Fahrgeschwindigkeit auf 18 km erhöht werden, muss jedoch in Strassen, die eng sind und in denen beträchtlicher Verkehr herrscht, auf 10 km reduzirt werden. In den Vorstädten ist eine Fahrgeschwindigkeit von 25 bis 30 km gestattet. Die Mehrzahl der grossen Kraftstationen arbeiten mit Kondensation und benutzen direkt gekuppelte Einheiten. Die Kessel sind solche des Wasserröhren-Typus, und der Kohlenverbrauch pro Kilowattstunde schwankt zwischen 0,8 und 5 kg. Ekonomiseure kommen manchmal zur Verwendung, und werden Speisewasser-Heizapparate stets benutzt. Schliesslich giebt der Verfasser noch eine kurze Beschreibung der industriellen und Bergbau-Bahnen.

Elektrisches Bahnwesen in Argentinien. Von E. Manville. [Seite 693.]

Herr Manville, ein Mitglied der wohlbekannten Ingenieur-Firma von Kincaid, Waller & Manville in London, die als Ingenieure bei dem Baue gewisser Trambahnen in Buenos Ayres fungirt haben, beschreibt die Bedingungen, unter denen Konzessionen für Trambahnen in Argentinien erlangt werden, sowie auch die zu überwindenden physikalischen und sonstige Probleme. Es herrscht in Argentinien eine bedeutende Abneigung gegen die Bewilligung von Konzessionen, die von langer Dauer sind, und die Gesellschaften stehen entschieden unter der Kontrolle der Stadtbehörde, welche für die Instandhaltung der Wegepflasterung, worin die Trambahnen liegen, eine Steuer von sechs Prozent der Bruttoeinnahmen auferlegt und den Trambahngesellschaften ausserdem noch andere Lasten, die zwar schwer aber nicht prohibitiv sind, aufbürdet. Drei Arten von Oberbau kommen — je nach dem Betrieb — in Buenos Ayres zur

Verwendung. Bei einer Art lagern die Schienen vollständig auf Beton, bei einer anderen auf Längsschwellen von Beton und bei der dritten Art auf einfachen Querschwellen ohne Beton. Bei dem Vertheilungssystem ist die höchste gestattete Spannung sehr gering, und wird dieses Resultat durch die Anwendung von negativen Zusatzmaschinen bewerkstelligt, während die positiven Leitungen, die nach den äussersten Enden des Bahnnetzes führen, positive Zusatzmaschinen besitzen. Das System mit oberirdischer Stromzuführung und das mit unterirdischer Stromzuführung in Argentinien sind beide ausgezeichnet; auch das rollende Material ist gut. Kraft wird hauptsächlich den dortigen Kraftstationen, von denen dort mehrere in grossem Maassstabe arbeiten, entnommen.

Die Ausführung von Bahnmotoren. Von W. B. Potter. [Seite 701.]

Der Verfasser ist Chefingenieur der Bahnabtheilung der General Electric Company. Er erklärt, dass die Pferdestärken der von dieser Gesellschaft gebauten Motoren auf einer willkürlichen Norm, welche auf einem temporären Steigen der Temperatur des Motors—75 Grad C. in einer Stunde unter Belastung—beruht, basirt sind, wobei die Temperatur der umgebenden Luft zu 25 Grad C. angenommen wird. Der Motor kann nicht beständig zu diesem Leistungsgrade in Betrieb gehalten werden, doch kann man ihn kurze Perioden lang ohne Nachtheil über dieses Maass hinaus arbeiten lassen. Die durchschnittliche Pferdestärke, die ein Motor den Tag über entwickelt, sollte nicht grösser als 30 Prozent der oben angegebenen Rate sein. Wo man elektrische Bremsen benutzt, sollte der Motor eine 20 bis 25 Prozent grössere Leistungsfähigkeit besitzen als da, wo dieselben nicht zur Verwendung kommen. Unter gewöhnlichen Stadtverhältnissen sollte die in Motoren erforderliche Pferdestärke das Gesamtgewicht in Tonnen multiplizirt mit der maximalen Fahrgeschwindigkeit in Meilen pro Stunde auf ebener Fläche und durch 5 dividirt betragen. Wenn die Maximal-Geschwindigkeit nicht bekannt ist, so kann für dieselbe die doppelte planmässige Fahrgeschwindigkeit angenommen werden. Indessen sollte man diese Regel mit Vorsicht anwenden, da sie nur die minimale Leistung unter gewöhnlichen Verhältnissen anzeigt. Bei gewöhnlichem Strassendienst beträgt die Zugkraft während Beschleunigung zwischen 10 und 15 Prozent der beförderten Belastung; bei Hochbahn- und Vorortbetrieb beträgt sie gewöhnlich 5 bis 7½ Prozent, während sie bei Güterbeförderung, wobei langsame Fahrgeschwindigkeiten angewendet werden, 1½ oder 2 Prozent nicht übersteigen mag. Bei gewöhnlichem Dienst sollte das Gewicht auf den Laufrädern wenigstens sechs Mal das der erforderlichen Zugkraft sein. Die annähernde Leistung einer Kraftstation für irgend einen gegebenen Dienst beträgt ungefähr 100 Wattstunden pro Tonnenmeile bei gewöhnlicher Fahrgeschwindigkeit.

Elektro-pneumatisches Kontrolsystem für Bahn- und andere Motoren. . . . . . [Seite 703.]

Dieses System kommt in Pittsburgh und Wilmerding zur Verwendung, wo zwei oder mehrere Motorwagen zu einem Zuge zusammengestellt sind und jeder Wagen seinen eigenen Kontroller hat; dadurch entsteht die Nothwendigkeit, die Kontroller in genauen Synchronismus zu stellen, um sämtliche Motoren mit derselben Geschwindigkeit laufen lassen zu können. Die Thätigkeit sämtlicher Kontroller wird von der vorderen Plattform des ersten Wagens aus geleitet und durch Luftkraft bewerkstelligt. Oben an jedem Kontroller befinden sich zwei Cylinder, von denen einer einen Sperrkegel trägt, der in ein Sperrrad, welches oben am Kontroller angebracht ist, eingreift. Die Luftcylinder werden durch eine kleine elektrische Batterie, die mittelst eines kleinen elektrischen Ausschalters vorn im Führerstand in Betrieb gesetzt wird, übereinstimmend in Aktion gebracht, Der zweite Luftcylinder dient dazu, um den Kontroller auf O-Stellung zurückzubringen, und wird ebenfalls durch den Motorführer auf der vorderen Plattform in Thätigkeit gesetzt. Der Momentausschalter ist so angeordnet, dass er die Kontroller, falls er sich öffnen sollte, auf die Ausschaltungsseite wirft. Wenn man die Luftbremsen ansetzt, kehren sämtliche Kontroller automatisch nach der Ausschaltungsseite zurück. Der Luftkompressor, den eine Abbildung veranschaulicht, ist ebenfalls von neuartigem Typus und besteht aus einer rotirenden Verbundpumpe, die von einem kleinen Motor direkt getrieben wird. Die in den Drehgestellen für die Motoren verwendete Federunterlage ist von derjenigen des Wagens vollständig abgesondert gehalten.

Bedeutender Fabrikant elektrischer Artikel. . [Seite 708.]

Besondere Spezialität bilden Draht und Schienenverbindungen.

Apparate für Kraftübertragung in New York. . [Seite 709.]

Gegenstand der Beschreibung bilden in diesem Artikel die Wechselstrommaschinen, die rotirenden Umwandler und Umformer, die von der Metropolitan Strassenbahngesellschaft bei ihrer Anlage verwendet werden sollen. Die Krafterzeugungsmaschinen sind solche mit rotirenden Feldern und äusseren feststehenden Ankern. Jede Maschine besitzt eine Leistungsfähigkeit von 2500 kw und wird einen Dreiphasenstrom von 6600 Volt bei einer Frequenz von 25 Perioden pro Sekunde erzeugen und mit 250 Umdrehungen in der Minute laufen. Das umlaufende Feld weist 40 Pole auf, ist direkt auf der Maschinenwelle montirt und auch gut ventilirt. Jede Spule ist mit einem Wechselstrom von 25000 Volt geprüft. Der Anker ist aus Gusseisen hergestellt und mit gleitenden Grundplatten versehen, so dass man ihn seitwärts schieben kann, bis er von dem umlaufenden Feld ganz entfernt ist; auf diese Weise wird das Inspiziren und Repariren des Ankers sowohl wie auch des Magnetfelds wesentlich erleichtert. Das rotirende Feld besteht aus einem Stahlringe, der fest mit einem gusseisernen Rahmen verbolzt ist; dieser Rahmen ist keilartig an der Maschinenwelle befestigt. Die erniedrigenden Umformer in den Stationen, wo sich die rotirenden Umwandler befinden, sind für eine Leistung von je 250 kw bestimmt, und werden drei dazu benutzt, um jeden rotirenden Umwandler in Gang zu setzen. Die primäre Wickelung des Transformators ist auf 6000 Volt und die sekundäre auf 350 Volt berechnet. Die Umformer werden durch Luft, welche durch die Umformer geblasen wird, gekühlt; bei voller Belastung stellt sich der Nutzeffekt der Umformer auf 98,22 Prozent. Die rotirenden Umwandler besitzen eine Leistungsfähigkeit von je 990 kw und arbeiten mit 214 Umdrehungen pro Minute. Das Magnetfeld besitzt achtzehn Pole, die aus Gusseisen angefertigt sind. Die Ankerwickelung ist aus Kupferstäben hergestellt. Die Bürsten an der Gleichstromseite des rotirenden Umwandlers sind aus Kupfer, und arbeitet der rotirende Umwandler als Sechsphasen-Maschine. Das Anlaufen der rotirenden Umwandler wird von dem Gleichstrom mit Hülfe von Strom, den Akkumulatorenbatterien liefern, bewerkstelligt.

Neuer Typus einer Compound Maschine. . . [Seite 711.]

Die charakteristische Neuerung dieser Maschine besteht der Hauptsache nach in der Art und Weise, wie die Einströmungsventile an den Niederdruck-Cylindern in Thätigkeit gesetzt werden. Diese Ventile werden theils von einem festen Excenter an der Maschinenwelle und zum Theil auch von demselben Excenter, welches die Thätigkeit der Ventile an dem Hochdruck-Cylinder bewirkt, in Thätigkeit gesetzt. Die letztgenannten Ventile werden natürlich von dem Regulator kontrollirt. Man behauptet, dass durch ein solches Verfahren, die Niederdruck-Ventile in Thätigkeit zu setzen, die Nachtheile, welche dadurch entstehen, dass man sie ganz und gar von einer festen excentrischen Scheibe an der Maschinenwelle oder genau in Uebereinstimmung mit den Hochdruckventilen in Thätigkeit setzt, vermieden werden.

Pufferbatterien für Bahnverkehr. . . . . . [Seite 712.]

Die Beschreibung betrifft eine wohlbekannte englische Pufferbatterie. Die Platten werden mittelst des Planté'schen Prozesses, mit Schwefelsäure allein, gebildet, was ungefähr sechs Wochen in Anspruch nimmt. Sämtliche Platten sind mit einer langen Stange ohne Schrauben verbunden. An der Seite der Zellen kommen mit Ausnahme von Glas und Blei keine anderen Stoffe zur Verwendung, und werden diese Pufferbatterien unter Garantie zu einem Preise, der 3 bis 6 Prozent ihrer Kosten beträgt, in Stand gehalten. In Grossbritannien und anderen Ländern werden sie als Regulirungs-Vorrichtung in Kraftstationen in ausgedehntem Maasse benutzt.

Neuer Typus von Strassenbahnmotoren. . . [Seite 713.]

Zur Beschreibung kommen fünf Motortypen, die vor Kurzem von derselben Gesellschaft in den Markt gebracht sind und in Bezug auf Grösse von 30 PS bis zu 150 PS variiren. Die ersten zwei beschriebenen (No. 68 und No. 69) sind so eingerichtet, dass der ganze Motor, wenn man vier Bolzen entfernt und ihn von den Federn, die ihn tragen, loskuppelt, mittelst einer Hebeschraube, die in einen Schacht läuft, unten von dem Wagen her entfernt werden kann. Ein mit diesen Motoren ausgerüsteter Wagen wechselt die Motoren jeden anderen Tag, damit eine sorgfältige Inspizirung daran vorgenommen werden kann. Sie sind sowohl zum Schmieren mit Fett als auch zur Oelschmierung eingerichtet, und wird das Oel zwischen den Transmissionsrädern an solchen Stellen eingeführt, wo der geringste Druck herrscht. Der dritte Motor (No. 56) ist dazu bestimmt, auf dem Wagen inspizirt und nicht oft demontirt zu werden. Derselbe ist aus zwei Theilen, die in der Mitte mit Scharnieren versehen sind, zusammengesetzt, und durch das Abschrauben eines Bolzens vermag man die untere Hälfte in einen Schacht hinabzuschwingen; dabei kann der Anker entweder in der oberen oder unteren Hälfte—je nach Wunsch—zurückbehalten werden. Der vierte Motor (No. 70) und der fünfte Motor (No. 50 C) sind für schweren Dienst bestimmt und besitzen je eine Leistungsfähigkeit von 110 bis 150 PS. Ausserdem sollen sie auf Drehgestellen montirt werden, die man unter dem Wagen herausschieben kann, so dass man dann die obere Hälfte des Motors zu entfernen im Stande ist. Sämtliche Motoren sind gegen Staub und ablaufendes Wasser geschützt und mit laminirten Polenden versehen, die, anstatt in die Joche eingegossen zu sein, mit denselben verbolzt sind.

Schienenstösse. Von W. F. Ellis, C. E. . . . [Seite 715.]

Die frühere Form von Laschenstossverbindung wird auf Fig. 2 und 3 veranschaulicht. Diese hat bei der gewöhnlichen Gleiskonstruktion durch die auf Flg. 1 und 4 dargestellte Form eine Verbesserung erfahren. Der Verfasser hält dieselben nicht für wünschenswerth, indem er unter anderen Gründen auch den Grund anführt, dass die Schiene in die Schwelle—wie aus Fig. 4 erhellt—einschneidet, was zur Folge hat, dass die Lasche die Bolzen zu straff anzieht. Fig. 5 und 6 veranschaulichen einige Uebelstände, welche sich mit der gewöhnlichen Lasche ergeben und die dann entstehen, wenn die Löcher nicht richtig gebohrt sind. Um diesem Uebelstande abzuhelfen, empfiehlt der Verfasser den auf Fig. 7 und 8 abgebildeten Stoss, der an Vignole-Schienen angebracht wird. Fig. 9 stellt den gewöhnlichen Stoss dar, den man an der amerikanischen Normalschiene anbringt, und Fig. 10 den verbesserten Schienenstoss.

Neue Koke-Werke. . . . . . [Seite 716.]

Beschrieben wird eine neue Fabrik, die sich mit der Herstellung von Kokebürsten befassen will. Dieselbe liegt in den Kohlen- und Koke-Gegenden Pennsylvaniens, und soll in den Werken zum Brennen und anderen Zwecken Naturgas in ausgedehntem Maasse zur Verwendung kommen.

Bahnwagentritte, auf denen man nicht ausgleiten kann. [Seite 716.]

Derartige Tritte sind aus Stahlrippen angefertigt, wobei Blei in die offenen Höhlungen gegossen ist. Sie werden in ausgedehntem Maasse für Bahnwagentritte und Stufen, die zu den Hochbahnstationen hinaufführen, benutzt.

Britischer Fabrikant von Hartgussrädern. . . [Seite 716.]

Die hier erwähnte Firma macht geltend, dass sie, was die Herstellung von Bahnwagenrädern aus Hartguss in Grossbritannien betrifft, bahnbrechend gewesen sei.

Gasmaschinen für elektrischen Bahndienst. . . [Seite 717.]

Die Beschreibung betrifft einen neuen Gasmaschinentypus zum Treiben elektrischer Stromerzeugungs-Maschinen ; gebaut werden sie von 10 bis zu 650 PS, mit zwei oder drei Cylindern je nach der Grösse. Der Durchschnitt der abgebildeten Maschine ist durch einen Cylinder einer mit 3 Cylindern ausgestatteten Maschine, bei der sämtliche Cylinder vollständig gleich sind, geführt. Die Maschine ist einfach wirkend, und jedes Piston erhält bei jedem zweiten Hub einen Stoss. Ehe das Gas durch Oeffnung M und das Ventil J einströmt, wird es mit Luft vermischt, wird durch einen elektrischen Funken an F entzündet und nachher durch das Ausblaseventil E und die Mündung O nach aussen geleitet. Das Verfahren zum Reguliren der Geschwindigkeit unterscheidet sich gänzlich von dem der meisten Gasmaschinenfabrikate, bei denen die Anzahl der Entladungen, je nachdem es die Kraft erfordert, verschieden ist. Bei der abgebildeten Maschine tritt bei jedem zweiten Hub in jedem Cylinder eine Entladung ein, doch richtet sich der Betrag des zugelassenen Gases nach den Erfordernissen der Belastung. Der Regulator, der zu diesem Zwecke vorhanden, ist auf einer Abbildung wiedergegeben. Diese Maschinen kommen bereits an einer 5 km langen Linie in Huntington, New York, zur Verwendung, wo sie zwei 37 kw-Dynamos treiben.

Geschichte einer bedeutenden deutschen Fabrikgesellschaft. [Seite 719.]

Es giebt dieser Artikel eine Darstellung der fortschreitenden Entwicklung der Allgemeinen Elektricitäts-Gesellschaft, die im Jahre 1882 gegründet und nunmehr ein Kapital von 47 Mill. Mark und einen Ueberschuss von 18 Mill. Mark aufweist; sie beschäftigt mehr als 12000 Arbeiter. Sämtliche Maschinenwerkzeuge in den Werken in Berlin werden direkt von elektrischen Motoren in Thätigkeit gesetzt. Den Strom liefert ein Maschinenhaus. Die Gesellschaft hat so viele Aufträge, dass die Werke Tag und Nacht im Gange sind. Besonders hervorgehoben wird die Drehstrom-Maschinerie der Gesellschaft, ein System, welches in den Werken für die Kraftvertheilung benutzt wird. Aus dieser Klasse Apparate hat die Gesellschaft eine besondere Spezialität gemacht.

Neuartiges System mit unterirdischer Stromzuführung und Oberflächenkontakt. . . . . . [Seite 721.]

Die Abbildung zeigt den Durchschnitt eines Kastens, der dazu dient, die Kontaktschienen todt zu halten, ausgenommen wenn der Wagen passirt. Die Stange an 4 wird von einer an dem Wagen angebrachten Kontaktvorrichtung zurückgestossen, was ein Umdrehen von Stange 3 zur Folge hat; dies wiederum bewirkt das Umdrehen von Scheibe 9 und stellt so die richtigen Kontakte her. Der Strom kann dann von der Strassenoberfläche oder von der regulären Untergrundleitung entnommen werden. Federn bringen die Theile in ihre ursprüngliche Lage zurück.

Vervollkommnung an elektrischen Bremsen. . [Seite 721.]

Die Bremse, die beschrieben wird, ist eine solche, welche aus einer gusseisernen Scheibe, die keilartig an der Wagenachse befestigt ist, sowie aus einem kreisförmigen elektromagnetischen Backen besteht, der so gehalten wird, dass er sich nicht drehen kann und durch Strom aus den Motoren, die als Generatoren arbeiten, gegen die Scheibe gepresst wird. Ein Diagramm ist beigefügt, welches die elektrischen Verbindungen des benutzten Kontrollers veranschaulicht.

Bedeutende Chicago'er technische Gesellschaft, die zugleich Kontrakte übernimmt. . . . . . [Seite 722.]

Luftbremsen. . . . . . [Seite 723.]

Einige Einzelheiten betreffs zweier Luftbremsetypen, die von einer bekannten Gesellschaft hergestellt werden, bilden den Gegenstand dieses Artikels. Bei jeder derselben wird der Luftkompressor von der Achse mit Hülfe von Zahnradübersetzung getrieben. Der Kompressor ist so eingerichtet, dass er nur dann arbeitet, wenn der Druck in dem Behälter unter eine bestimmte Grenze sinkt. Die Gesellschaft baut auch eine Luftbremse, die mit einem Motorkompressor, wie sie bereits in der April-Nummer beschrieben worden ist, benutzt wird. Illustrationen des obenerwähnten Kompressors sind beigegeben, ebenso solche des Betriebsventils auf der Plattform.

Neuer Typus eines Heizapparats. . . . . [Seite 724.]

Fig. 1 stellt einen elektrischen Heizapparat für Bahnwagen, deren Sitzplätze der Länge nach angeordnet sind, dar. Der Heizapparat ist aus zwei Spulen von unzerstörbarem Draht angefertigt, und sind dieselben an einer starken Asbestschnur, welche an den Enden an runden gerillten Porzellan-Isolatoren befestigt ist, aufgehängt. Die Schnur hält die Spulen an ihrem Platze, ohne jedoch dabei die Drähte irgendwie anzuspannen.

Instrument zum Messen von Elektrizität. . . [Seite 724.]

Die Abbildungen veranschaulichen ein Ampère- und Voltmeter, die von einem bedeutenden Fabrikanten in England unter Patenten, die Lord Kelvin bewilligt wurden, hergestellt werden. Derselbe Fabrikant verfertigt alle Arten von Messinstrumenten für Gleich- und Wechselströme.

Apparate zum Reinigen des Speisewassers sowie Heizapparate. [Seite 725.]

Man verwendet dieselben in Lokalitäten, wo Kalk oder sonstige feste Körper in dem Speisewasser enthalten sind; sie sollen dazu dienen, einen derartigen Stoff aus dem Wasser, ehe dasselbe in die Kessel gelangt auszuscheiden. Der Heizapparat, welcher beschrieben wird, ist ein offener Speisewasser-Heizapparat d.h. die Bestandtheile werden dadurch aus dem Wasser ausgeschieden, dass man das Wasser direkt der Thätigkeit des Dampfs aussetzt. Die Konstruktion des Heizapparats wird auf Fig. 1 veranschaulicht; derselbe besteht aus einer Reihe gekrümmter Pfannen, die aus Stahlplatten hergestellt sind. Wasser wird in die obere Pfanne geleitet, fliesst dann über den Rand in ein dünnes Gewebe ab und verbleibt an der Unterseite, bis der niedrigste Punkt erreicht ist, worauf es dann in die nächste Pfanne tröpfelt, und so weiter, bis es zur untersten Pfanne gelangt ist. Der Behälter, worin diese Pfannen sich befinden, wird mit Dampf angefüllt, und die in Auflösung versetzten Unreinigkeiten lagern sich auf der unteren Seite der Pfannen ab. Die Länge der letzteren beträgt ungefähr 1,8 m, und können dieselben behufs Reinigung leicht abgenommen werden. Fig. 2 illustrirt ein Werkzeug zum Bohren der Cylinder, welche die Pfannen halten.

Eine Sperrbremsenkurbel. . . . . . [Seite 725.]

Dieselbe ist, wie man aus der Abbildung ersehen kann, nur aus vier Stücken zusammengesetzt.

Neue, mit grosser Geschwindigkeit laufende Maschine. [Seite 726.]

Die betreffende Maschine ist eine englische Maschine des einfach wirkenden oder konstanten Drucktypus und mit zwei Cylindern nebst Kurbeln, die 180 Grad von einander liegen, oder drei Cylindern mit Kurbeln, die 120 Grad von einander plazirt sind, versehen. Die Abbildung stellt eine 250 pferdige Maschine dar, die mit einem Wechselstrom-Dynamo direkt gekuppelt ist.

Installirung einer grossen Akkumulatorenbatterie in Plymouth. [Seite 726.]

Dieselbe besteht aus 260 Zellen, die eine Leistungsfähigkeit von 120 Ampèren zu 480 Volt fünf Stunden lang zu entwickeln im Stande sind.

Ausblaseventile. . . . . . [Seite 726.]

Dieser Artikel enthält eine allgemeine und Profil-Ansicht eines Ausblaseventils für Kessel und Dampfröhren, und hat dasselbe bereits in hohem Grade Verbreitung gefunden. Die hauptsächlichsten charakteristischen Eigenschaften, welche die Profil-Abbildung wohl erkennen lässt, bestehen in einer besonderen Einrichtung, wodurch die Ansammlung von Kesselstein und Ablagerungen auf der Oberfläche der Scheibe im Ventil verhütet wird. Auch vermag man die Scheibe leicht umzukehren ; und kann man den Ventilsitz, wenn er abgenutzt ist, erneuern.

Langer Anhängewagen. . . . . . [Seite 727.]

Seiner ganzen Länge nach misst dieser Wagen 11,9 m. Er enthält zehn umwendbare und vier feststehende Sitze und weist Sitzplätze für siebenzig Personen auf. Der Wagen wiegt 8300 kg und ist auf Drehgestellen, von denen jedes nicht ganz 1810 kg wiegt, montirt.

Speisepumpen. . . . . . [Seite 727.]

Beschrieben wird eine Kesselspeisepumpe, die in Glasgow angefertigt ist und bei verschiedenen der grössten Ozeandampfer, sowie auch in vielen Kraftstationen zur Verwendung gelangt. Die Pumpe wird direkt von der Pistonstange getrieben, und ist kein todter Punkt vorhanden.

Oekonomische Krafterzeugung. . . . . [Seite 728.]

Der Ofen, welcher zum Verbrennen von Strassenkehricht — der hierbei als Heizmaterial dient — eingerichtet und in unseren Ausga-

ben für Mai und Juli 1898 beschrieben ist, hat seitdem eine bedeutende Verbreitung gefunden. Die Fabrikanten desselben stellen auch einen mechanischen Schürer dar, der, wie aus der veröffentlichten Probevornahme hervorgeht, ausgezeichnete Resultate liefert. Sie verfertigen ebenfalls eine Maschine, die dazu dient, um den Kohlensäuregehalt der von einem Ofen ausströmenden Gase zu bestimmen, indem auf diese Weise festgestellt wird, ob das richtige Luftquantum zu der Feuerbüchse zugelassen ist. Ein Verlust in Beziehung auf Sparsamkeit bildet die Folge, wenn zu viel oder zu wenig Luft bei der Verbrennung zur Verwendung kommt. Die Abbildung veranschaulicht eine derartige Vorrichtung.

Wagenbau-Werkstätten in Preston, England. . . [Seite 729.]

Gegenstand dieses Artikels, dem Abbildungen beigegeben, bildet die Beschreibung einer ausgedehnten Anlage, die vor Kurzem in England für den Bau von Wagen für Tram- und Kleinbahnzwecke fertig gestellt worden ist. Die Werke sind im Stande, jährlich 800 Drehgestellwagen gewöhnlicher Grösse zu fabriziren. Die gesamte Maschinerie wird durch elektrische Motoren, deren es 25 in den Werken giebt, getrieben. Die Kraft wird von einer Centralstation, die eine 225 pferdige Maschine nebst Dynamo enthält, erzeugt. Die Gesellschaft fertigt auch Untergestelle an, ist aber zugleich auch darauf eingerichtet, um Wagen, die mit irgend welchen Normal-Fabrikaten von Untergestellen ausgerüstet sind, liefern zu können. Die Abbildungen veranschaulichen einige der hauptsächlichsten Gebäude, sowie auch einige neuerdings gebaute Bahnwagen.

Automatische Schmierung. . . . . . [Seite 732.]

Dies bildet eine kurze Beschreibung eines, in St. Louis angewendeten, automatischen Schmierungssystems für Kraftstationen, Maschinen und Dynamos. Seit dessen Einführung hat man monatlich mehr als $300 (Mk. 1250) an Oelkosten und $150 (Mk. 625) an Arbeitskosten erspart. Das Oel wird mit Hülfe von Dampfpumpen nach den Trägern gepumpt, und erachtet man daher das Verfahren für wirksamer, als wenn man die Schwerkraft benutzte.

Frontlaternen für elektrische Bahnwagen. . . [Seite 732.]

Die Reflektoren dieser Frontlaternen sind gewellt und geben deshalb, wie man behauptet, ein intensiveres Licht.

Isolator für Leitungsschienen. . . . . [Seite 732.]

Derselbe besteht aus einem schmiedeeisernen Ständer, der zum Tragen eines Isolators bestimmt und worauf eine schmiedeeiserne Kappe montirt ist, welche die Leitungsschiene trägt. Diese Kappe hält die Schiene in horizontaler Richtung, gestattet jedoch einen kleinen Spielraum in vertikaler Richtung. Dadurch beabsichtigte man den Unannehmlichkeiten zu begegnen, die aus dem Brechen der Isolatoren entstanden, was früher stets deshalb passirte, weil die Schiene von den Isolatoren zu starr gehalten wurde.

Eine neue Dynamomaschine für Strassenbahnen. . [Seite 733.]

Zu den speziellen charakteristischen Eigenschaften dieser Dynamomaschine gehört das Verfahren, den Bürstenhalter in einer mit der Welle parallelen Richtung arbeiten zu lassen und das Bestreben der Bürsten, den Kommutator zu schneiden, aufzuheben; ferner das Entfernen der Polschuhe und Spulen, ohne das Joch oder den Anker ausser Ordnung zu bringen, und gründliche Ventilirung. Die Abbildung stellt eine Maschine von 800 kw für Oakland, Cal., dar.

Eine neue Verbindung aus Kupfer. . . . [Seite 733.]

Dieselbe besteht aus einem rechtwinkeligen Stück Kupfer von 76 mm Länge, 3 mm Dicke und 38 mm Höhe und wird innerhalb der Laschen mittelst Federn aus Stahl gegen die Schienen gepresst. Die Oberflächen sind amalgamirt.

Ausgedehnte Elektrizitäts-Werke in Chicago. . [Seite 734.]

Die Beschreibung betrifft die Werke der Siemens & Halske Gesellschaft in Amerika. Die Gesellschaft fabrizirt bis jetzt noch keine Bahnmotoren, baut jedoch sämtliche Arten Stromerzeugungs-Maschinen, einschliesslich Bahn-Dynamomaschinen in der Grösse bis zu 1500 kw, Motoren für Automobile, elektrische Bogenlampen, Wattmesser u. s. w. Das Muster der Bahn-Dynamomaschinen ist vor Kurzem geändert worden und auf der Abbildung vollständig wiedergegeben. Der Magnetrahmen ist aus Gusseisen, und sind die Polenden von besonderem Typus. Der Anker hat eine grosse Oberfläche und einen bedeutenden Durchmesser bei verhältnismässig geringer Tiefe. Dies gestattet eine gute Ventilirung mit einem unbedeutenden Spannungsunterschied zwischen den danebenliegenden Stromwenderstäben. Zahlreiche Luftleitungen laufen strahlenförmig durch den Anker. Die Speichen des Ankerrahmens sind so angeordnet, um Gebläseluft durch diese Kanäle senden zu können. Der Stromwender hat einen grossen Durchmesser, wiewohl er nicht ausserhalb der Ankerspulen und Felder, wie es gewöhnlich bei den ursprünglichen Maschinen von Siemens & Halske und den in Europa gebauten der Fall, plazirt ist. Die Bürstenhalter sind von einem besonderen Typus und dazu bestimmt, einen konstanten Druck der Bürsten gegen den Kommutator zu sichern. Die Herstellung von Motoren für Automobile ist eine Spezialität, und die Werke können wöchentlich 125 Motoren dieser Art anfertigen; dieselben besitzen eine Leistungsfähigkeit von 2 kw, sind indessen so eingerichtet, dass sie beständig zu 4 PS mit einer Steigung von mehr als 40 Grad C. laufen können. Die Gesellschaft baut auch sehr viele rotirende Umwandler.

Neue isolirende Klemmschraube. . . . . [Seite 737.]

Dieselbe kommt da zur Verwendung, wo zwei isolirte Drähte verbunden werden sollen. Die Enden der Drähte werden zunächst ihrer Isolirung entblösst, und schiebt man dann eine Messingmuffe über dieselben. Zwei durch die Muffe gehende Schrauben halten die Drähte fest. Die Muffe ist mit einem steifen Gummimantel und mit zwei weichen Gummikappen versehen, welche sodann aufgeschoben werden, so dass nun sämtliche Metalltheile vollständig isolirt sind. Die Verbindung der Drähte kann man dadurch aufheben, dass man die weichen Gummikappen abschiebt und dann die Schrauben lockert. Ganz speziell eignet sich diese Vorrichtung zur Herstellung der Verbindungen zwischen den aus Motorgehäusen herausragenden Drahtenden und denen an Wagen.

Momentausschalter. . . . . . [Seite 737.]

Ein solcher Ausschalter kann nicht geschlossen werden, ohne dass die Beschaffenheit des Kreisstroms normal ist, so dass demnach keine Gefahr für die Beschädigung der eingeschalteten oder in Betrieb befindlichen Apparate zu fürchten ist. Der Stromkreis öffnet sich sehr sorgfältig und das Entstehen von Lichtbogen wird auf ein Minimum beschränkt.

Abgangsdampf-Haube. . . . . . [Seite 737.]

In dieser Abgangsdampf-Haube wird das Wasser mittelst Centrifugalkraft von dem Dampf abgesondert.

Schöner Bahnwagen für Braintree, Massachusetts. . [Seite 738.]

Die Abbildung stellt einen mit 15 Bänken versehenen, offenen Bahnwagen dar, der sich auf elektrischen Sommerbahnen mit grossem Verkehr als sehr populär erwiesen hat. Derselbe hat eine Gesamtlänge von 12,9 m und eine Breite von 2,2 m. Die zweite Abbildung veranschaulicht ein neuartiges Untergestell, welches von denselben Fabrikanten gebaut wird. Es hat einen aussergewöhnlich kleinen Radstand und soll auf Bahnen, die Kurven mit kurzem Radius aufweisen, zur Verwendung kommen.

Bedeutende Chicago'er Glimmer-Gesellschaft. . [Seite 738.]

Bezug genommen ist hierbei auf eine Gesellschaft, die den ausgedehntesten Handel mit Glimmer in Amerika für sich in Anspruch nimmt.

Seife zum Wagenreinigen. . . . . , . [Seite 739.]

Die Beschreibung betrifft eine besondere Seife, die zum Wagenreinigen dient und von sehr vielen Dampfbahnen und Strassenbahngesellschaften Amerika's verwendet wird. Die Erfahrung hat diese Gesellschaften darüber belehrt, dass ein häufiges Reinigen sowohl die Farbe wie auch den Lack an den Wagen schützt, dass aber Wasser mit gewöhnlicher Seife nicht zweckentsprechend ist. Eine Anzahl Gesellschaften reinigen Wagen zweimal die Woche mit diesem Stoff, dagegen hält man an anderen Bahnen ein einmaliges Reinigen wöchentlich für hinreichend.

Toledo-Fremont & Norwalk'er elektrische Bahn. . [Seite 740.]

Die Länge dieser Bahn, die jetzt im Bau begriffen ist, beträgt 100 km. Die Kraftvertheilung geschieht mittelst des Dreiphasensystems zu 15000 Volt, die behufs Benutzung auf der Bahnstrecke in Gleichstrom umgewandelt werden.

Ein neues Unternehmen in Deutschland. . . [Seite 740.]

Die Firma, um die es sich hier handelt, hat die Agentur eines bekannten Fabrikanten von Wagenkasten übernommen. Die Wagenkasten werden nach Deutschland gesandt und dort an Ort und Stelle zusammengesetzt. Bestellungen auf Wagen dieser Art für Berlin sind erst vor Kurzem eingetroffen. Dieselbe Firma liefert auch Untergestelle und Luftbremsen.

Maschine zum Aufreissen alter Schienen. . . [Seite 740.]

Eine solche Maschine kann ungefähr 3 km Gleis pro Tag aufreissen, bricht auch die Schienen in jede Länge, gewöhnlich in Längen von 1,2 m bis 2,4 m. Die auf der Abbildung dargestellte Schiene ist 150 mm hoch, doch ist die Maschine im Stande 225 mm hohe Schienen zu zerbrechen.

Drehgestell No. 14 B-3. . . . . . [Seite 741.]

Der Radstand dieses Drehgestells beträgt nur 1,22 m; es ist deshalb dazu bestimmt, bei Bahnen mit scharfen Kurven zur Verwendung zu kommen. Der Wagen hat ein mit Federung versehenes Kissen. Die Motoren werden aussen an den Achsen, anstatt zwischen denselben, mitgeführt, und die Bremsvorrichtung liegt zwischen den Achsen.

Trolleyruthenhalter mit Sperrung nebst Haspel. . [Seite 742.]

Die betreffende Vorrichtung dient dazu, um die Trolleyruthe zu verhindern, eine vertikale Richtung anzunehmen, im Falle die Rolle entgleisen sollte.

Atlas-Schienenstoss. . . . . . [Seite 742.]

Dieser Stoss ist in Amerika in ausgedehntem Maasse adoptirt, und sind zwei Arten desselben durch Abbildungen veranschaulicht.

Automatisches Sicherheits-Absperrventil. . . [Seite 742.]

Dasselbe ist dazu bestimmt, in die zwischen den Kesseln und Maschinen befindliche Hauptdampfröhre eingestellt zu werden und eine automatische Schliessung zu veranlassen, sobald ein Bruch in der Hauptröhre oder an der Maschine vorkommt, der zu einer leichten Verminderung des Dampfdrucks Anlass geben kann. Die Konstruktion erhellt aus der Abbildung, welche die Vorrichtung im Profil darstellt.

Rollenträger für Strassenbahnwagen. . . . [Seite 743.]

Die Träger für eine Achse werden sämtlich in einem Gehäuse gehalten, welches die Enden verbindet, so dass man sie herausheben und zu irgend einer Zeit wieder einsetzen kann. Die Rollen selbst haben eine gehärtete und geglättete Stahloberfläche. Die Gesellschaft garantirt eine Ersparnis von 10 bis 15 Prozent an der Kraft, die gebraucht wird.

Hydraulischer Schieber-Regulator. . . . [Seite 743.]

Diese Vorrichtung öffnet und schliesst den Schieber je nach dem Drucke in den Kesseln, wodurch der Kesseldruck konstant gehalten wird.

Oelfilter. . . . . . [Seite 743.]

Derselbe weist einige charakteristische Neuheiten auf und enthält auch eine Scheidevorrichtung, wodurch das überschüssige Oel und Wasser von der Kolbenstange, wie auch das, welches aus Ventilen läuft, abgesondert wird. Das Oel leitet man dann nach einer Raffinirkammer, wo es erhitzt und geklärt wird, und lässt es weiterhin durch Baumwollenabgang laufen, ein Prozess, durch den leichtere Unreinigkeiten ausgeschieden werden. Jeder Filter ist mit einem starken Vergrösserungsglase ausgestattet, so dass man damit das gereinigte Oel genau untersuchen kann.

Automatische Wagenkuppelungen. . . . . [Seite 744.]

Die Illustrationen veranschaulichen zwei Arten einer Wagenkuppelung, wie sie thatsächlich bei allen Hochbahnen in Amerika und vielen Bahnen auf der Strassenoberfläche zur Verwendung kommt. Mehr als 50000 sind gegenwärtig in Gebrauch. Diese Kuppelungsvorrichtungen werden auch in vielen europäischen Städten benutzt.

Kohlenkonveyor in Washington. . . . . [Seite 744.]

Diese Abbildung giebt eine Ansicht von dem Konveyor, wobei die Asche aus den Kesseln genommen und nach dem Aschenbehälter befördert wird. Der Tunnel ist ungefähr 61 m lang. Derselbe Kübel befördert die Kohlen nach den Kesseln.

Neu errichtete Fabrik für Luftbremsen. . . [Seite 747.]

Beschrieben wird die neue Fabrik einer Gesellschaft, die durch ihre Herstellung von Luftbremsen für Strassenbahnen bedeutenden Umsatz erzielt. Die ganze Kraft wird mittelst Elektricität oder komprimirter Luft durch die Fabrik vertheilt.

Bedeutende Drahtproducenten. . . . . [Seite 747.]

Die in Betracht kommende Gesellschaft erhebt Anspruch darauf, die umfangreichste individuelle Anlage, die existirt, was sowohl die Herstellung von elektrischen Leitungen wie auch von Drahtseil betrifft, zu besitzen. Alle Arten Drähte werden angefertigt.

Eine bedeutende britische Lieferungs-Firma. . . [Seite 748.]

Die betreffende Firma ist i. J. 1800 gegründet worden und führt alle Arten Messinstrumente, wobei sie aus Registrir-Instrumenten, wie sie in England von der Handelskammer vorgeschrieben sind, eine Spezialität macht.

Aufgespeicherte Luft zum Bremsen von Bahnwagen. [Seite 748.]

Bei diesem System wird die Luft in der Kraftstation ungefähr zu fünfzehn Atmosphären komprimirt und dann in Behältern auf den Wagen aufgespeichert. Vor ihrer Wirkung auf die Bremsen muss sie ein Reduktionsventil passiren, welches den Druck ungefähr auf drei Atmosphären reduzirt. Auf dem Wagen wird kein Kompressor mitgeführt. Die Gesellschaft, die ca. vor einem Jahre gegründet wurde, hat bereits gegen 42 Wagen mit befriedigenden Resultaten damit ausgerüstet und macht für diese Bremsen eine Reihe von Vorzügen geltend.

Neues Elektrizätswerk in England. . . . [Seite 749.]

Es beschreibt dies das Werk eines wohlbekannten Händlers mit elektrischen Bahnapparaten.

Table des Matières—Octobre, 1899.

Opération pratique des tramways en Amérique, en prenant Chicago pour example. . . . . . [Page 613.]

Le système des tramways à niveau de Chicago est opéré par dix compagnies indépendantes et le système de chemin de fer élevé par cinq compagnies. Plusieurs des lignes principales sont encore opérées par le système du cable ; mais la plus grande longueur des lignes est actuellement opérée par l'électricité, et on a l'intention de changer, le plutôt possible, le système du cable pour le système électrique. Les tramways à chevaux ont presque disparu de Chicago et ne se composent plus que de quelques lignes d'alimentation pour les lignes à cables. Les chemins de fer élevés sont tous opérés par l'électricité, formant un système de chemins de fer élevés opérés par l'électricité, de beaucoup le plus considérable qui existe dans le monde entier. Il y a naturellement à Chicago un grand nombre de stations de force motice pour alimenter ces propriétés indépendantes et, de presque toutes, nous donnons des illustrations qui montrent l'arrangement des machines, etc. Ces stations sont aussi représentées par un diagramme à échelle de telle sorte qu'un coup d'oeil suffit pour réaliser leurs dimensions relatives. Presque toutes les stations importantes sont sans condenseur, seulement trois ou quatre stations en étant pourvu. L'impossibilité d'obtenir une quantité suffisante d'eau à un prix raisonable a amené l'usage de tours et de tables à refroidir, au moyen desquelles l'eau pour la condensation est usée plusieurs fois. Les voies de Chicago, bien que n'étant pas particulièrement admirables, sont cependant dignes d'attention, surtout en ce qui regarde l'assemblage à la fonte des joints; assemblage qui a atteint là-bas un haut degré de perfection. La construction aérienne est très bonne quoique simple et l'on s'est efforcé non pas d'obtenir des effets d'ornementation mais bien le moins d'obstruction possible aux rues. Uue description des méthodes de construction employées sur le Northwestern Elevated accompagnée d'illustrations conclut cet article.

Opération pratique des tramways en Allemagne. Par Louis J. Magee. . . . . [Page 647.]

Cet article contient une description très valuable de l'opération allemande par le directeur administrateur de l'Union Elektricitäts Gesellschaft, l'une de plus grandes compagnies manufacturières de l'Allemagne. La propiété des tramways en Allemagne fait l'objet d'une longue discussion. La relation des grands syndicats, ou groupes financiers, à l'industrie des tramways est mise en avant et on peut difficilement évaluer trop haut l'influence qu'ont eu ces syndicats sur le développement rapide de l'Allemagne industrielle. La particularité principale de l'opération des tramways en Allemagne, qui la distingue de ce qui se passe en Amérique, est l'usage d'un mélange de tractions électriques. Les voitures sont opérées avec des accumulateurs dans le centre des villes et au moyen de fils de trolleys dans les faubourgs. Une autre chose faite en Allemagne à l'exclusion de l'Amérique et de tout autre pays est la construction de poteaux d'ornement servant à la fois au support des fils de trolleys, à l'éclairage, etc, M. Magee décrit d'une manière très intéressante les détails de coutume allemande en ce qui concerne les stations de force motrice, les voies, les constructions aériennes, le matériel roulant, etc. Il est évident que l'Allemagne a porté l'art de l'ingénieur pour tramways électriques au point le plus élevé de développement.

Opérations pratiques des tramways électriques dans la Grande Bretagne. Par Sidney H. Short. . . . [Page 663.]

Le professeur Short a aggloméré dans cet article la plupart des particularités principales de l'opération pratique anglaise. Il explique les difficultés qui ont accompagné jusqu'ici, dans ce pays, le développement de cette industrie. Difficultés dues aux restrictions imposées par l'action parlementaire et par le désir grandissant de possession municipale à l'encontre d'entreprises privées. Les détails techniques de construction des voies, des lignes aériennes, du matériel roulant, sont donnés avec beaucoup de soins et accompagnés de nombreuses illustrations.

Caractère financier des grands systèmes de tramways du monde entier. Par Edward E. Higgins. . . . [Page 680.]

Cet article est une compilation des statistiques du métrage kilométrique, du capital engagé, des recettes et des dépenses des systèmes de tramways dans les villes de plus de 500000 habitants de tous les pays du monde. Cette compilation est arrangée de manière à montrer les profits comparés et les oportunités pour les placement des capitaux.

Opération pratique des tramways électriques dans l'Autriche-Hongrie. Par E. A. Ziffer. . . . . [Page 685.]

Le premier railway électrique établi, en Autriche, pour le transport des voyageurs fut inauguré en 1883. Il avait 4 km. de long. Le premier railway électrique de Hongrie date de 1889. Il était construit d'après le système du conduit souterrain. Une gravure montre ce conduit. On s'en sert beaucoup à Budapest et on l'installe à présent à Vienne. Le système du trolley est cependant d'un usage général. Des concessions sont octroyées par le gouvernement à des compagnies particulières, mais la durée de ces concessions est limitée à 60 ans. Les municipalités ont, elles aussi, le droit de construire et d'opérer des tramways. Tous les chemins de fer d'une importance secondaire sont exempts des impôts gouvernmentaux pour une période de vingt ans, dans quelques cas ils sont aussi exempts d'impôts municipaux. L'auteur donne une liste des railways électriques, avec leur longueur moyenne, la largeur de la voie, le nombre de voyageurs transportés et les recettes. Les rails dans les villes sont posés sur une couche, soit de béton soit de pierre concassée, d'une épaisseur de 30 cm., leur poids varie de 34 à 43 kg. par m. En dehors des limites des villes on se sert de rails Vignole, d'un poids variant entre 21 et 23,5 kg. par m., posés sur des traverses de bois ou de métal. L'auteur continue en décrivant les différents manières d'assemblage de rails, de fils d'alimentation et de poteaux. Le fil du trolley est généralement fait en cuivre dur, étiré, d'un diamètre variant de 7 à 8,25 mm. Le Baden-Böslau use un fil de silicon-bronze de 7 mm. de diamètre. Dans quelques cas le dessus du fil de trolley est couvert d'un protecteur en bois, tenu en place par des emboîtures métalliques, qui a pour but d'empêcher des fils de téléphones ou de télégraphe, brisés, d'établir un contact. La

voiture la plus employée est la voiture du soit-disant Hambourg type, avec une longue plateforme à chaque extrémité et de la place pour 20 passagers assis. La longueur totale est de 8,4 m. Dans les petites villes la longueur totale des voitures varie entre 5,8 et 7 m. L'auteur suit avec une description des différents types de réceptacles pour courant ou trolley. La vitesse est toujours prescripte par les autorités, elle est généralement de 15 km. à l'heure. Elle peut être portée à 18 km. dans les rues où la circulation n'est pas considérable, mais elle doit être réduite à 10 km. dans les rues étroites ou très prises par la circulation. Dans les faubourgs une vitesse de 25 à 30 km. par heure est permise. La plupart des stations de force motrice opèrent des condenseurs et emploient des unités directes. Les chaudières sont du type tubulaire et la consommation de charbon par kw.-heure varie entre 0,8 et 0,5 kg. On se sert quelquefois d'économiseurs, et toujours de chaudières pour eau d'alimentation. L'auteur conclut par une courte description de lignes industrielles et minières.

Opération pratique des tramways dans la République Argentine. Par E. Manville. . . . . [Page 693.]

M. Manville, un membre de la maison d'ingénieurs bien connus, Kincaid, Waller & Manville, de Londres, qui ont été retenus comme ingénieurs pour la construction de certains tramways à Buenos Ayres, décrit les conditions sous lesquelles on obtient des concessions de tramways dans la République Argentine et aussi les problèmes physiques et autres que l'on a à surmonter. Les autorités éprouvent une répugnance considérable à octroyer des concessions de longue durée et les compagnies sont complètement sous le contrôle des municipalités qui imposent une taxe de six pour cent sur les recettes brutes pour l'entretien du pavé des rues où passent les tramways et imposent aux compagnies d'autres charges qui sont lourdes sans êtres prohibitives. On se sert de trois sortes de voies à Buenos Ayres, suivant la circulation. Dans l'une, les rails sont supportés par une base toute en béton, dans l'autre le béton n'existe que le long des rails, et dans la troisième les rails sont simplement fixés sur des traverses sans béton. Dans le système de distribution, la forme maxima de potentiel permis est très petite. On obtient ce résultat par l'emploi de dynamos auxiliaires négatives tandis que les feeders positifs conduisant aux extrémités du système sont munis de dynamos positives. La construction aérienne et le système de feeders souterrains sont excellents dans la République Argentine et le matériel roulant est bon. La force motrice est obtenue principalement des stations locales de force motrice dont plusieurs fonctionnent sur une grande échelle.

Les actions de moteurs de railways. Par W. B. Potter. [Page 701.]

L'auteur est l'ingénieur en chef de la division des railways de la General Electric Company. Il constate que la force en chevaux des moteurs construits par la compagnie est évaluée d'après un étalon arbitraire, basé sur l'élevation temporaire de la température du moteur de 75 degrés centigrades pendant une heure et sous chargement complet, la température de l'air environnant étant supposée être 25 degrés centigrades. Le moteur ne peut pas être opéré à ce train de rendement continuellement, mais on peut l'opérer pour de courtes durées et sans le déteriorer à un train plus élevé. La force en chevaux moyenne supportée par un moteur pendant une journée ne devrait pas dépasser 30 pour cent de son évaluation obtenue comme ci-dessus. Quand des freins électriques sont en usage le moteur devrait avoir une capacité de 20 à 25 pour cent plus grande que quand ils ne sont pas en usage. Dans des conditions ordinaires de ville la force en chevaux requise dans les moteurs devrait être le poids total en tonnes multiplié par la vitesse maxima, en miles, et par heure sur une surface à niveau, le tout divisé par 5. Si la vitesse maxima n'est pas connue on peut la considérer double celle de l'horaire. Cette règle devrait, cependant, être appliquée avec précaution; elle indique seulement la capacité minima sous des conditions ordinaires. Dans le service ordinaire des rues l'effort de traction pendant l'accélération est d'entre 10 et 15 pour cent du poids charié. Dans le service élevé ou suburbain il est généralement de 5 à 7½ pour cent, tandis que dans le transport des marchandises où la vitesse est réduite, il peut ne pas exéder 1½ ou 2 pour cent. Dans le service ordinaire le poids sur les roues de support devrait être au moins six fois l'effort de traction nécessaire. La capacité approximative d'une station de force motrice pour n'importe quel service est d'environ 100 watts heures par tonne mile avec des vitesses ordinaires.

Système électro-pneumatique pour contrôler les moteurs de railways et autres. . . . . . [Page 703.]

Ce système est en usage à Pittsburgh et à Wilmerding où l'on forme des trains de deux ou plusieurs voitures à moteurs. Comme chaque voiture a son contrôleur, il est nécessaire que tous ces contrôleurs soient opérés en exact synchronisme de manière à ce que tous les moteurs aillent à la même vitesse. L'opération de tous les contrôleurs est dirigée de la plateforme de devant de la première voiture et est accomplie par l'air comprimé. Au dessus de chaque contrôleur sont deux cylindres dont l'un renferme une tige à pignon qui s'engage dans une roue dentée sur le dessus du contrôleur. Les cylindres à air sont opérés en unisson par une petite batterie électrique manoeuvrée par un petit commutateur électrique dans le premier vestibule. Le seconde cylindre à air sert à ramener le contrôleur à la position O, et est aussi opéré par le motorman de la première plateforme. L'interrupteur du circuit est arrangé de manière à fermer les contrôleurs dans le cas où il s'ouvrirait. Si les freins électriques sont appliqués, tous les contrôleurs sont automatiquement fermés. L'appareil à comprimer l'air, dont nous donnons une illustration, est aussi d'un nouveau type. Il consiste d'une pompe compound rotative opérée directement par un petit moteur. Dans les trucks en service, les ressorts qui supportent les moteurs sont entièrement distincts de ceux qui supportent la voiture.

Un grand manufacturier de matériel électrique. . [Page 708.]

Il fait une spécialité de la manufacture de fils métalliques et de joints de rails.

Appareils pour transmission de la force motrice à New York. [Page 709.]

Cet article donne la description des générateurs de courant alternatif, des convertisseurs rotatifs et des transformateurs dont se servira le Metropolitan Street Railway de New York. Les générateurs sont du système à inducteur mobile, avec des armatures extérieures stationaires. Chaque machine a une capacité de 2500 kw. et produira du courant trois-phasé de 6600 volts, avec une fréquence de 25 cycles par seconde et marchant à la vitesse de 75 révolutions par minute. L'inducteur a 40 pôles, et est monté directement sur l'axe de la machine. Il est bien ventilé. Chaque bobine est essayée avec un courant alternatif de 25000 volts. L'armature fixe est en fer fondu et munie de plaques de fondation glissantes de manière à pouvoir être poussée de côté, en dehors de l'inducteur ce qui permet un libre accés, pour inspection et réparations, soit à l'armature soit à l'inducteur. Ce dernier est composé d'un anneau d'acier fermement bouloné à un cadre de fer fondu qui est fixé par une clef à l'axe de la machine. Les transformateurs aux stations de convertisseurs rotatifs sont de 250 kw. chacun et il en faut trois pour opérer chacun des convertisseurs rotatifs. L'enroulement primaire du transformateur est désigné pour 600 volts, et le secondaire pour 350 volts. Les transformateurs sont refroidis par un appel d'air qui les traverse; ils ont à chargement complet, une efficacité de 98,22 pour cent. Les convertisseurs rotatifs sont de 990 kw. chacun et opèrent à 214 révolutions par minute. L'inducteur a dix huit pôles en fer fondu. L'enroulement de l'armature est en barres de cuivre. Les brosses sur l'éxtrémité alternative du convertisseur rotatif sont en cuivre et ce convertisseur rotatif opère comme une machine six-phasé. Les convertisseurs rotatifs sont mis en mouvement avec un courant direct au moyen du courant fourni par une batterie d'accumulateurs.

Nouveau type de machine compound. . . . [Page 711.]

Le point nouveau essentiel de cette machine consiste dans la méthode d'opérer les soupapes d'admission aux cylindres de basse pression. Ces soupapes sont opérées en partie par un excentrique fixé sur l'axe de la machine et en partie par le même excentrique qui opère les soupapes du cylindre de haute pression. Ces dernières oupapes sont naturellement contrôlées par le gouverneur. On prétend que cette manière d'opérer les soupapes de basse pression, supprime les inconvénients provenant de l'opération exclusive par un excentrique fixe sur l'axe de la machine ou exactement en unisson avec les soupapes de haute pression.

Accumulateurs pour traction. . . . . . [Page 712.]

C'est la description d'un accumulateur anglais bien connu. Les plaques sont formées par le procédé Planté, avec de l'acide sulphurique seulement, et durent à peu près 6 semaines. Les plaques sont toutes jointes à une longue barre sans vis. On n'emploie sur le côté des piles pas d'autre matériel que du verre et du plomb et les batteries sont maintenues, sous une guarantie, à un prix variant entre 3 et 6 pour cent de leur coût. On se sert beaucoup de ces accumulateurs en Grande Bretagne et ailleurs comme régulateurs pour les stations de force motrice.

Nouveau type de moteurs pour tramways. . . [Page 713.]

Cet article donne la description de cinq types de moteurs récemment mis en vente par la même compagnie et qui varient en dimensions depuis 30 chevaux jusqu'à 150 chevaux. Les deux premiers moteurs décrits (Nos. 68 et 69) sont arrangés de telle sorte qu'en enlevant 4 boulons et séparant les ressorts qui le suspendent, le moteur entier peut être enlevé du dessous de la voiture par un cric à vis placé dans la fosse. Une voiture équippée avec ces moteurs en change généralement tous les deux jours, ce qui permet une inspection soigneuse. Ces moteurs sont arrangés pour lubrification soit par la graisse, soit par l'huile, et l'huile est versée entre les roues dentées, là ou la pression est la moindre. Le troisième moteur (No. 56) est distiné à être inspecté étant sur la voiture et à n'être pas souvent enlevé. Il est composé de deux parties réunies au centre par des charnières et par dévissant un boulon la partie inférieure peut être ouverte dans la fosse, tandis que l'armature peut rester dans la partie supérieure ou inférieure, à volonté. Le quatrième moteur (No. 70) et le cinquième moteur (No. 50 C) sont destinés à de gros travaux et sont respectivement de 110 et de 150 chevaux. Ils sont destinés à être montés sur des trucks que l'on peut faire rouler de dessous la voiture et on enlève alors la partie supérieure du moteur. Tous les moteurs sont à l'épreuve de la poussière et de l'eau et sont pourvus de barres polaires laminées, au lieu d'être fondues, dans l'empiècement.

Joints de rails. Par W. F. Ellis, C. E. . . . [Page 715.]

L'ancienne forme d'assemblage au moyen de plaques allongées se voit dans les Figs. 2 et 3. Ceci a été amélioré dans la construction ordinaire des voies par la forme que montrent les Figs. 1 et 4. L'auteur ne considère aucune de ces formes recommandables. Parmi d'autres raisons il montre par la Fig. 4 que le rail coupe la traverse ce qui cause la plaque allongée à forcer sur les boulons. Les Figs. 5 et 6 montrent des embarras occasionés par les plaques allongées ordinaires quand les trous ne sont pas exactement percés. Comme remède l'auteur recommande le joint que montrent les Figs. 7 et 8 appliqué à un rail Vignole. La Fig. 9 montre le joint ordinaire appliqué au rail modèle américain et la Fig. 10 le joint perfectionné appliqué au même rail.

Nouvelle fabrique de charbon. . . . . . [Page 716.]

C'est la description d'une nouvelle fabrique qui va entreprendre la manufacture de brosses de charbon. Elle est située dans la région charbonnière de la Pennsylvanie et on emploiera beaucoup le gaz naturel pour chauffer les fours et autres usages.

Marches non glissantes pour voitures. . . . [Page 716.]

Ces marches sont faites d'acier côtelé avec du plomb fondu coulé dans les rainures. On s'en sert beaucoup comme marchepieds de voitures et aussi sur les escaliers des stations de chemins de fer élevés.

Manufacture anglaise de roues en fer trempé. . [Page 716.]

La maison dont s'occupe cet article prétend être l'innovatrice, en Angleterre, de la manufacture de roues en fer trempé.

Machines à gaz pour service de railways électriques. [Page 717.]

Cet article décrit un nouveau type de machine à gaz pour opérer des générateurs électriques, de 10 à 650 chevaux, avec deux ou trois cylindres suivant leur dimension. La section de la machine dont la gravure est ci-jointe est la coupe d'un cylindre d'une machine à trois cylindres, tous ces trois cylindres étant absolument pareils. La machine est à simple action, et chaque piston reçoit une impulsion une fois sur deux. Le gaz est mélangé à l'air avant son admission au cylindre par l'ouverture M et la soupape J. Le gaz est enflammé par une étincelle électrique à F, et est ensuite chassé à travers la soupape de sortie E et la décharge O. La méthode employée pour gouverner la vitesse est entièrement différente de celle de la plupart des autres marques de machines à gaz, en ce que le nombre des explosions est varié suivant les besoins de la force motrice. Dans la machine dont nous donnons l'illustration une explosion est produite dans chaque cylindre à chaque second coup de piston, mais la quantité de gaz employé varie suivant les besoins du chargement. Le gouverneur qui permet d'obtenir ce résultat est l'objet d'une illustration. Ces machines ont été en usage sur une ligne de 5 km. de lougueur à Huntington, Etat de New York où elles opéraient deux générateurs de 35 kw.

L'histoire d'une importante compagnie manufacturière allemande. [Page 719.]

Cet article décrit les progrès de l'Allegemeine Elektricitäts Gesellschaft, qui fut organisée en 1882 et a maintenant un capital de 47 millions de marks, un surplus de 18 millions de marks et emploie plus de 12000 ouvriers. Tous les outils dans les usines, à Berlin, sont opérés directement par des moteurs électriques. Le courant est fourni par une station de force motrice. Cette compagnie a tellement de commandes que les usines marchent nuit et jour. Une mention spéciale est faite de la machinerie trois-phasé de la compagnie, et c'est ce système qui est employé pour distribuer la force motrice dans les usines. La compagnie s'est fait une spécialité de ce genre d'appareils.

Amélioration des freins électriques. . . . . [Page 721.]

Le frein décrit consiste en un disque de fer fondu fixé par une clef à l'essieu de la voiture, et d'un sabot circulaire électro magnétique, tenu de telle manière qu'il ne puisse pas tourner. Il est pressé contre le disque par un courant venant des moteurs qui agissent comme générateurs. Nous donnons un diagramme montrant les communications électriques du contrôleur dont on se sert.

Nouveau type d'un système à conduit et à contact de surface. [Page 721.]

La gravure montre une coupe d'une boite destinée à tenir les rails de contact dépourvus de courant, excepté au passage des voitures. La barre 4 est poussée en arrière par un appareil de contact qui se trouve sur la voiture. Ceci fait tourner la barre 3 qui en entraînant le disque 9 produit les contacts nécessaires. Le courant peut alors être pris soit de la surface de la rue soit du conduit régulier. Des ressorts renvoient toutes ces parties à leur première position.

Freins à air comprimé. . . . . . [Page 723.]

Cet article donne quelques détails sur deux types de freins à air comprimé faits par une compagnie bien connue. Dans chacun de ces freins la machine à comprimer l'air est actionnée par l'essieu au moyen de roues dentées. La machine à comprimer est arrangée de telle sorte qu'elle ne fonctionne que lorsque la pression dans le réservoir tombe au dessous d'une certaine limite. La même compagnie construit aussi un frein à air pour service avec une machine à comprimer à moteur décrite dans notre numéro d'Avril. Nous donnons des vues de la première de ces deux machines à comprimer et aussi de la soupape d'opération qui se trouve sur la plateforme. Cette soupape comporte une mesure de pression.

Instruments pour mesures électriques. . . . [Page 724.]

Les gravures montrent un ampèremètre et un voltmètre fait par un important manufacturier d'Angleterre d'après des brevets pris par Lord Kelvin. Le même manufacturier fait aussi toutes sortes d'intruments de mesures pour courants directs ou alternatifs.

Nouveau type de machine à chauffer les voitures. . [Page 724.]

La Fig. 1 montre un chauffeur électrique pour des voitures à sièges longitudinaux. Ce chauffeur est fait de deux bobines de fil non-corrosif suspendues à une forte corde d'asbestos (B) attachée par ses extrémités à des isolateurs de porcelaine ronds et évidés (D.) La corde tient les bobines en place sans occasioner de tension au fil.

Une poignée de freins à roue dentée. . . . [Page 725.]

Cette poignée, comme le montre la gravure, n'est composée que de 4 pièces.

Appareils pour purifier et chauffer l'eau d'alimentation. [Page 725.]

Ces appareils sont en usage dans les endroits où l'eau d'alimentation contient de la chaux et autres solides: ils ont pour but de débarasser l'eau de ces produit avant son introduction dans les chaudières. L'appareil dont cet article donne la description est un appareil ouvert pour chauffer l'eau d'alimentation, c'est à dire que l'expulsion des corps étrangers a lieu par l'exposition directe, à l'action de la vapeur, de l'eau qui les contient. La Fig. 1 montre la manière dont cet appareil est construit. Il consiste en une série de bassins en plaque d'acier. L'eau entre dans le bassin supérieur et coule le long des bords en une mince couche adhérant au dessous jusqu'à ce qu'elle atteigne le point le plus bas d'où elle tombe dans le bassin suivant et ainsi de suite jusqu'au fond de la série des bassins. Le réceptacle qui contient ces bassins est rempli de vapeur et les impuretés conteues en solution dans l'eau sont déposées sur le dessous des bassins. Ceux-ci ont une longueur d'environ 1,8 m et peuvent facilement s'enlever pour le nettoyage. La Fig. 2 donne l'illustration d'un outil servant à percer les cylindres qui tiennent les bassins.

Soupapes d'échappement. . . . . . [Page 726.]

Cet article contient une vue générale et une coupe d'une soupape d'échappement pour chaudières et tuyaux à vapeur, qui a obtenu une proéminence considérable. Les points principaux se voient dans l'illustration de la coupe et consistent en un arrangement qui empêche le dépôt d'écaille et de sédiment de se produire sur le haut du disque de la soupape. Le disque peut aussi se renverser facilement et la base de la soupape peut être changée lorsqu'elle est usée.

Nouvelles machines à grande vitesse. . . . [Page 726.]

Ces machines sont de marque anglaise et du type connu comme machines à action unique ou constante Elles sont arrangées avec deux manivelles de cylindre écartées à 180 degrés ou avec trois cylindres aux manivelles écartées de 120 degrés. L'illustration montre une machine de 250 chevaux accouplée directement à un générateur à courant alternatif.

Grande installation d'accumulateurs à Plymouth. . Page 726.]

Cette installation consiste de 260 piles produisant pendant cinq heures 120 ampères à 480 volts.

Longue voiture sans moteur. . . . . . [Page 727.]

Cette voiture a 11,9 m de longueur totale. Elle contient 10 sièges à dossiers réversibles et quatre sièges fixes: 70 passagers peuvent s'y asseoir. La voiture pèse 8300 kg. et est montée sur des double trucks qui pèsent chacun moins de 1810 kg.

Pompes d'alimentation. . . . . . [Page 727.]

Cet article décrit une pompe d'alimentation pour chaudière manufacturée à Glasgow et qui est en service sur un grand nombre de paquebots et dans de nombreuses stations de force motrice. La pompe est manoeuvrée directement par la tige de piston et il n'y a pas de point mort.

Economique production de force motrice. . . [Page 728.]

La fournaise construite pour brûler les ordures comme combustible, et, que nous avons décrite dans nos numéros du Mai et de Juillet 1898, a depuis lors été employée d'une manière étendue. Les manufacturiers de cette fournaise font aussi un chauffeur mécanique que

donne d'excellents résuitats comme le montre l'essai dont nons publions le résultat. Ils fabriquent aussi une machine pour déterminer la quantité d'acide carbonique et le gaz échappant de la fournaise, ce qui indique si la quantité convenable d'air a été admise dans la chambre de chauffe. Une perte d'économie se produit si trop ou trop peu d'air est usé dans la combustion. L'illustration montre cet appareil.

Usines pour la construction de voitures à Preston, Angleterre. [Page 729.]

Cet article donne des vues et une description d'une grande usine récemment completée pour la construction en Angleterre de voitures de tramways et de légers wagons. Cette usine peut produire par an 800 voitures de dimensions ordinaires à double trucks. Toute la machinerie y est opérée par des moteurs électriques qui sont au nombre de 25 dans l'usine. La force motrice est produite dans une station centrale qui contient une machine et générateur de 325 chevaux. La compagnie manufacture aussi des trucks, mais est néanmoins préparée à fournir des voitures pourvues de trucks de n'importe quelle marque connue. Nous donnons des vues de quelques uns des bâtiments principaux et de voitures construites récemment.

Isolateur pour troisième rail. . . . . . [Page 732.]

Cet appareil consiste d'un rail de fer malléable destiné à porter un isolateur sur lequel est monté un couronnement de fer qui supporte le troisième rail. Ce couronnement tient le rail dans un alignement horizontal tout en lui permettant un léger jeu vertical. Le but de cet appareil est d'obvier aux inconvénients qu'occasionnait la casse d'isolateurs. Cette casse se produisait auparavant parceque le rail était tenu en place d'une manière trop rigide par les isolateurs.

Lanternes d'avant pour tramways électriques. . [Page 732.]

Les réflecteurs pour ces lanternes sont à surface zinguée ce qui, prétend-on, donne une lumière plus vive.

Lubrification automatique. . . . . . [Page 732.]

Cet acticle donne une courte description d'un système de lubrification automatique pour les stations de force motrice, les machines et les générateurs. Il est en usage à St. Louis. Depuis son installation on a économisé plus de $300 par mois sur le coût de l'huile et $150 par mois sur le coût de la main d'oeuvre. L'huile est amenée aux supports par une pompe à vapeur, ce qui fait considérer le système plus effectif que si l'on se servait de la gravité.

Un nouveau joint en cuivre. . . . . . [Page 733.]

C'est une pièce de cuivre rectangulaire d'environ 76 mm. de longueur, 3 mm. d'épaisseur et 38 mm. de hauteur. On la presse au moyen de ressorts d'acier contre les rails en dedans des plaques allongées. Les surfaces sont amalgamées.

Nouveau générateur pour tramways. . . . . [Page 733.]

Parmi les points spéciaux de ce générateur sont: une méthode d'opérer la pièce qui tient la brosse dans une direction parallèle à l'axe ce qui dispose de la tendance qu'ont les brosses à couper le commutateur; l'enlèvement des pièces polaires et des bobines sans déranger l'empiècement ou l'armature; une ventilation complète. La gravure montre une machine de 800 kw. pour Oakland, Californie.

Importantes usines électriques à Chicago. . . [Page 734.]

C'est la description des usines de la Siemens & Halske Co. d'Amérique. Cette compagnie n'a pas encore fait de moteurs de railways, mais elle construit des générateurs de toute espèce, parmi lesquels des générateurs de railways d'une capacity de 1500 kw., des moteurs pour automobiles, des lampes à arc électrique, des wattmètres, etc. Le modèle des générateurs pour railways a récemment été changé et est l'objet d'illustrations complètes. Le cadre de l'aimant est en acier fondu, et les pièces polaires sont d'un type spécial. L'armature a une grande surface et un fort diamètre tandis que sa profondeur est relativement petite. Ceci donne une bonne ventilation, avec une petite différence de potentiel entre les barres adjacentes du commutateur. Des conduits d'air rayonnent à fréquent intervalle à travers l'armature et les rais du cadre de l'armature sont arrangés de manière à lancer des bouffées d'air par ces passages. Le commutateur a un diamètre considérable, quoiqu'il ne soit pas placé en dehors des bobines et des conducteurs de l'armature, comme c'est le cas dans les premières machines de Siemens & Halske et les machines européennes. Les supports des brosses sont d'un type spécial destiné à assurer une pression constante des brosses contre le commutateur. La manufacture des moteurs d'automobiles est une spécialité de la compagnie et les usines peuvent manufacturer 125 moteurs de cette sorte par semaine. Ils ont une capacité de 2 kw. mais sont destinés à marcher continuellement à 4 chevaux avec une augmentation de température ne dépassant pas 40 degrés centigrades. La même compagnie construit aussi un grand nombre de convertisseurs rotatifs.

Tête de vapeur à épuisement. . . . . . [Page 737.]

Dans cette tête de vapeur à épuisement l'eau est séparée de la vapeur à l'aide de la force centrifuge.

Interrupteurs de circuit. . . . . . [Page 737.]

Cet interrupteur ne peut être fermé que si les conditions du circuit sont normales, de sorte qu'il n'y pas de danger d'âbimer les appareils de circuit ou d'opération. Le circuit est ouvert avec beaucoup de soin et la production d'arcs est réduite à un minimum.

Nouveau joint isolateur. . . . . . [Page 737.]

Ce joint sert à unir deux fils isolés. On commence par enlever la matière isolante de l'extrémité des deux fils puis on les glisse dans un manchon de cuivre. Deux vis qui traversent ce manchon tiennent les fils en position. Ce manchon a une enveloppe de caoutchouc durci et deux chapes de caoutchouc mou que l'on fait alors glisser par dessus le joint, isolant complètement toutes les parties métalliques. Les deux fils peuvent être séparés en retirant les chapes et desserrant les vis. Ce joint est spécialement adapté pour établir les communications entre les extrémités des fils projetant des enveloppes de moteurs sur les voitures.

Une jolie voiture pour Braintree, Massachusetts. . [Page 738.]

Cette illustration montre une voiture ouverte à 15 bancs qui a joui d'une grande popularité sur les railways électriques d'été qui ont un trafic considérable. Cette voiture a une longueur totale de 13,9 m. et une largeur de 2,2 m. La seconde gravure montre un nouveau truck construit par la même maison. La distance entre les essieux est exceptionnellement petite ce qui rend ce truck très pratique sur les lignes qui ont des courbes de petit rayon.

Compagnie importante de mica à Chicago. . . [Page 738.]

Cet article parle d'une compagnie qui prétend faire le commerce le plus étendu de mica en Amérique.

Savon pour nettoyer les voitures. . . . . . [Page 739.]

Cet article décrit un savon spécial pour nettoyer les voitures qui a été adopté par un grand nombre de compagnies de chemins de fer et de tramways en Amérique. Les expériences qu'ont faites ces compagnies leur ont demontré que de fréquents nettoyages conservent la peinture et le vernis des voitures, mais que l'eau avec du savon ordinaire n'est pas très désirable pour cet usage. Un certain nombre de compagnies nettoient leurs voitures avec ce savon deux fois par semaine, tandis que d'autres compagnies considèrent une par semaine tout à fait suffisant.

Le railway électrique Toledo, Fremont & Norwalk. [Page 740.]

Cette ligne a 100 km. de long et est actuellement en construction. La force motrice y est destribuée par le système trois-phasé à 15000 volts changées en courant direct pour service sur la ligne.

Machine pour arracher les vieux rails. . . . [Page 740.]

Cette machine peut arracher les rails d'environ 3,2 km. de voie par jour; elle brise les rails de la longueur que l'on vent, généralement entre 1,2 et 2,4 m. Le rail que montre la gravure a 150 mm. de hauteur, mais la machine peut briser des rails de 225 mm. de hauteur.

Une nouvelle entreprise en Allemagne. . . [Page 740.]

La maison dont il est question a pris l'agence d'un fabricant bien connu de caissons de voitures. Ces caissons sont expédiés en Allemagne où ils sont montés. Une commande pour voitures de cette sorte a été récemment reçue de Berlin. La même maison fournit aussi des trucks et des freins à air comprimé.

Double truck 14 B-3. . . . . . [Page 741.]

Ce truck a seulement 1,22 m. de distance entre les essieux et est destiné au service des lignes à fortes courbes. La voiture est bien suspendue. Les moteurs sont placés en dehors des essieux au lieu d'être entre eux; et c'est l'appareil des freins qui est entre les essieux.

Garde perche de trolley et dévidoir. . . . [Page 742.]

Cet instrument est destiné à empêcher la perche de trolley de bondir à une position verticale dans le cas où la roue quitte le fil de trolley.

Joint de rails Atlas. . . . . . [Page 742.]

Ce joint est devenu d'un usage très commun en Amérique. Nous donnons l'illustration de ses deux formes.

Soupape de sûreté automatique. . . . . [Page 742.]

Cette soupape de fermeture est distinée à être placée dans le tuyau principal entre les chaudières et les machines. Elle se ferme automatiquement quand il se produit dans le tuyau principal où à la machine une brisure suffisante pour réduire légèrement la pression de la vapeur. Sa construction est indiquée dans la coupe de cette invention qui figure parmi nos gravures.

Régulateur hydraulique de la clef de tirage. . . [Page 743.]

Cette invention ouvre ou ferme la clef de tirage suivant la pression dans les chaudières, de manière à tenir cette pression constante.

Supports à billes pour tramways. . . . . [Page 743.]

Les supports pour un essieu sont tous contenus dans une boîte renfermant les extremités de manière à pouvoir être enlevés et replacés à volonté. Les billes elles mêmes sont en acier durci et poli. La compagnie garantit une économie de force motrice variant entre 10 et 15 pour cent.

Filtre à huile. . . . . . [Page 743.]

Ce filtre renferme quelques nouveaux points et contient aussi un séparateur au moyen duquel l'huile de déchêt et l'eau provenant de la tige de piston et de la soupape de fuite sont séparées. L'huile est alors amenée à une chambre de rafinage où elle est chauffée et clarifiée. On la filtre ensuite à travers les déchêts de coton ce qui la débarasse des legères impuretés. Chaque filtre est pourvu d'un fort verre grossissant qui permet d'inspecter l'huile purifiée.

Appareil à transporter le charbon à Washington. . [Page 744.]

La gravure montre une vue de cet appareil prenant les cendres aux chaudières et les charriant à la fosse à cendres. Le tunnel a environ 61 m. de long. Le même sceau apporte le charbon aux chaudières.

Accouplement automatique pour wagons. . . [Page 744.]

Les gravures montrent deux types d'une marque d'accouplements de wagons dont on se sert, pour ainsi dire, sur tous les chemins de fer élevés en Amérique ainsi que sur un grand nombre de lignes à niveau. Plus de 50000 de ces accouplements sont maintenant en usage. On s'en sert aussi dans beaucoup de villes d'Europe.

Grande production de fils métalliques. . . . [Page 747.]

La compagnie mentionnée prétent posséder l'usine la plus importante qui existe pour la production de conducteurs électriques et de fil de fer. Toute espèce de fils métalliques y sont manufacturés.

Nouvelle usine à freins. . . . . . [Page 747.]

Cette article décrit la nouvelle usine d'une compagnie qui manufacture énormément de freins à air comprimé pour tramways. Toute la force motrice est distribuée à travers l'usine par l'électricité ou l'air comprimé.

Une importante maison de commere anglaise. . [Page 748.]

La maison a été établie en 1800 et vend toute espèce d'instruments de mesure, faisant une spécialité des instruments d'enrégistrement requis en Angleterre par le Board of Trade.

Air emmagasiné pour les freins de voitures. . [Page 748.]

Par ce système l'air est comprimé dans la station de force motrice à environ 15 atmosphères et est alors emmagasiné dans les réservoirs des voitures. Avant d'être appliqué aux freins cet air passe à travers une soupape de réduction qui réduit la pression à environ trois atmosphères. Les voitures ne sont pourvues d'aucune machine à comprimer. La compagnie qui s'est formée il y a un an environ, a déjà équipé 43 voitures par ce système qui a donné des résultats satisfaisants et qui, prétend-elle, a de nombreux avantages.

Quelques récents travaux électriques en Angleterre. [Page 749.]

C'est la description des ouvrages d'un fabricant bien connu d'appareils pour railways électriques.

Resúmen de los Artículos—Octubre, 1899.

Práctica ferro-carrilera eléctrica en América como se ejemplifica en Chicago. . . . . . [Pág. 613.]

Los sistemas de la superficie ferro-carrilera de Chicago son operados por diez compañias independientes y el sistema del ferro-carril elevado por cinco. Algunas de las principales líneas corren aun por el sistema de cable, pero, la mayor parte del derecho de peage por milla, es actualmente eléctrico y se intenta, tan pronto como sea posible, cambiar las líneas de cable por las eléctricas. Los ferro-carriles caballares han casi desaparecido de Chicago, habiendo solo unas pocas líneas alimentadoras para las de cable. Las elevadas son todas operadas por electricidad, formando, de mucho, los mayores sistemas eléctricos elevados en el mundo. Hay naturalmente un gran número de estaciones de fuerza motríz en Chicago que corren estas propiedades independientes y se dan ilustraciones de la mayor parte de ellas demostrando el arreglo de la maquinária etc. asícomo en diágramas escalonando de tal modo los tamaños relativos de las estaciones cuyas pueden prontamente verse. Casi todas las mayores estaciones de fuerza motríz son corridas sin condensantes y hay solo en la ciudad tres ó cuatro de ellas. La incapacidad de tener suficiente abastecimiento de agua á una tasa razonable, ha inducido al uso de remendar torreones y bancos por los cuales el agua para la condensación es usada varias veces. La superconstrucción de Chicago, si bien nada tiene que admirarse en ella particularmente, es, sin embargo, digna de atención y especialmente con respecto á los enganches soldados cuyos se han llevado aquí á un alto grado de perfección. La construcción aérea ó superior es muy buena aunque sencilla habiéndose dado ó hecho poca atención al ornato y sí mas bien á los estorbos ú obstrucciones que pudiera ocasionar á las calles. Cierra este artículo con una descripción de los métodos de construcción de la nueva Northwestern Elevated con ilustraciones.

Práctica ferro-carrilera eléctrica en Alemánia. Por Louis J. Magee. [Pág. 647.]

Este artículo contiene una de las mas valiosas descripciones de la práctica alemana por el director gerente de la Union Elektricitäts Gesellschaft, una de las mayores compañias manufactureras de Alemánia. La propiedad de los tramvías alemanes es discutida largamente indicándose tambien las relaciones de los mayores sindicatos financieros ó grupos de la indústria de tramvías asícomo la influencia que dichos grupos han tenido sobre el rápido desarrollo en Alemánia y que dificilmente puede calcularse. La peculiaridad primordial de la práctica alemana, segun se distingue de la americana, es en el uso del sistema mixto de tracción eléctrica por la que, los carros son impelidos, en el centro de las cindades, por baterías de depósito y en las afueras, por el sistema aéreo de alambre. Otra de las cosas que Alemánia hace, que en nada se parezca, dada la misma extensión que la de América ó de cualesquiera otra parte del mundo, es en la construcción de los polos ornamentados, combinación de trolley y postes para el alumbrado, etc., todo esto, de una manera interesante y es evidente que Alemánia ha llevado la ciencia de la ingeniería eléctrica de tramvías á un alto estado de desarrollo.

Práctica ferro-carrilera eléctrica en la Gran Bretaña. Por Sidney H. Short. . . . . [Pág. 663.]

El profesor Short ha llevado junto con este artículo várias de las principales peculiaridades de la práctica inglesa y define las dificultades que han inducido al desarrollo de la indústria en aquel pais hasta la época presente debidas á las restricciones impuestas por la acción parlamentária y por el crecido deseo de la propiedad municipal como contraria á la empresa particular. Los detalles técnicos de la superconstrucción, construcción aérea ó superior, existencia de material etc. se ilustran y describen cuidadosamente.

Característicos financieros de los sistemas ferro-carrileros de las mayores ciudades del mundo. Por Edward E. Higgins. [Pág. 680.]

Una compilación de las estadísticas del derecho de peage por milla, inversión, recetas y gastos de los ferro-carriles en ciudades de más de 500000 habitantes en todo el mundo, arreglado de tal manera que demuestra los beneficios comparativos y las oportunidades para la inversión.

Práctica ferro-carrilera eléctrica en Austro-Hungría. Por E. A. Ziffer. . . . . [Pág. 685]

El primer ferro-carril eléctrico en Austria para el servicio de pasajeros fué abierto en 1883 y era de 4 km de extensión; el de Hungría en 1889. Esta última línea fué construida con el sistema de conducto subterráneo. Este conducto se demuestra en la pág. 687. Se usa extensamente en Budapest y está instalándose en Viena. El sistema del trolley, sin embargo, es el que generalmente se usa. Dánse aberturas por el gobierno general á compañias particulares, pero, su duración es limitada á sesenta años. Las municipalidades tienen tambien el derecho de construir y operar ferro-carriles urbanos. Todos los caminos ferro-carrileros de segunda importancia se hallan tambien libres de impuestos del estado por un período de 20 años y en algunos casos exentos de los de la municipalidad. El que escribe dá luego una lista de los ferro-carriles eléctricos, con un promedio de extensión, entrevía, la conducción de pasajeros y las recetas. Los rieles, en las ciudades, son trazados yá en concreto ó piedra picada á una profundidad de 30 cm y pesan desde 34 á 43 kg por m. En los afueras de los límites de la ciudad, úsanse los rieles Vignole, desde 21 á 23 kg por m sobre travesaños de madera ó de metal. Sigue describiendo, el que escribe, la práctica en las uniones de rieles, alimentadores y polos. El alambre del trolley es usualmente de cobre duro derretido, desde 7 á 8,25 mm de diámetro. La Baden-Böslau usa alambre silíceo bronceado, de 7 mm de diámetro. En algunos casos el tope ó parte superior alambre del trolley está cubierto por un protector de madera sujeto á su puesto por pinzas de metal, afin de prevenir la caida de alambres telefónicos ó de telégrafo y evitar así todo contacto. El carro mas popular es el llamado tipo Hamburg con una plataforma larga á cada extremo y una capacidad de asientos para 20 pasajeros. El largo, sobre todo, es de 3,4 m. En las ciudades pequeñas los carros varían desde 5,8 á 7 m de extensión sobre todo. El que escribe, describe luego los tipos de corriente, colectores ó trolleys. La velocidad en todos casos está prescrita por las autoridades y es usualmente de 15 km por hora. Esta puede ser aumentada á 18 km en las calles de poco tráfico, pero, debe reducirse á 10 km en las calles que son estrechas y adonde haya tráfico considerable. En los suburbios se permite una velocidad desde 25 á 30 km por hora. La mayor parte de las grandes estaciones de fuerza motríz operan condensantes y usan unidades directas conexionadas. Las páilas son del tipo de tubería de agua y el consumo de carbón por kw hora varía desde 8 á 8,5 kg. Usanse, algunas veces, economizadores y siempre los calentadores alimentadores de agua. Sigue, el que escribe, describiendo brevemente los caminos ¡ndustriales y mineros.

Práctica ferro-carrilera eléctrica en la Argentina. Por E. Manville. . . . . [Pág. 693.]

El Señor Manville, quien es miembro de la muy conocida firma de ingeniería de Kincaid, Waller & Manville, de Lóndres, quienes asímismo se han ocupado, como ingenieros, de la construcción de ciertos tramvías en Buenos Aires, describe condiciones bajo las cuales se obtienen las concesiones de tramvías en la Argentina, lo propio los problemas físicos y otros que puedan sobrevenir. Hay considerable repugnancia en conceder largo tiempo para franquícias

en la Argentina y las compañias se hallan decididamente bajo el mando de la municipalidad cuya impone un impuesto de seis por ciento sobre los productos brutos para la conservación del adoquinado ó pavimento de los caminos en los que se hallan situados los tramvías y coloca otros cargos sobre las compañias de los mismos cuyos son fuertes si bien nó prohibitivos. Usanse tres clases de superconstrucciones en Buenos Aires, segun sea el tráfico. En una, los rieles están sostenidos sobre una base de concreto completo; otra, sobre largueros de concreto longitudinales, y en el tercero sobre travesaños transversales sencillos sin concreto. En el sistema de distribución, la forma potencial máxima permitida es muy pequeña, siendo llevado á cabo este resultado por el uso de los dinamos auxiliares (boosters) negativos, mientras que alimentadores positivos, cargando á los puntos extremos del sistema, tienen dinamos auxiliares positivos. La construcción aérea ó superior y el sistema de alimentador subterráneo, en la Argentina, es escelente y la existencia de material es tambien buena. La fuerza motríz se obtiene principalmente de las estaciones locales cuyas son varias trabajando en grande escala.

Funcionamiento de los motores ferro-carrileros. Por W. B. Potter. . . . . [Pág. 701.]

El que escribe es ingeniero gefe del departamento ferro-carrilero de la General Electric Company. Manifiesta que la fuerza motríz caballar de los motores construidos por su compañia, son avalorados segun un modelo arbitrario, basado en una subida temporal de la temperatura del motor á 75 grados centígrado en una hora bajo una carga llena y aquella presumiendo ser, por el aire que la rodea, de 25 grados centígrado. El motor no puede ser operado á dicho avalúo de producto contínuo, pero, puede trabajarse arriba del citado avalúo, á cortos intérvalos de tiempo sin perjuicio. El promedio de la fuerza motríz caballar, conducido por un motor durante el dia, no debiera ser mayor de 30 por ciento del avalúo antes mencionado. Cuando se usan retrancas eléctricas, el motor debiera ser de 20 á 25 por ciento, mayor de capacidad, que cuando no se usan. Bajo las condiciones ordinarias de la ciudad, la fuerza motríz caballar, requerida para los motores, debiera ser en su peso total de toneladas multiplicadas por la velocidad máxima de millas por hora á nivel y divididas por 5. Si la velocidad maxíma es desconocida, puede tomarse como la doble de la cédula de dicha velocidad. Esta regla debiera, sin embargo, ser aplicada con cautela y solo indica la capacidad mínima bajo condiciones ordinarias. En el servicio ordinario de calle, el esfuerzo tractivo, durante la aceleración, es entre 10 y 15 por ciento de la carga que conduce. En el servicio elevado ó suburbiano es generalmente desde 5 á 7½ por ciento, mientras que, en trabajo de flete, adonde se usan velocidades despaciadas, puede que no exceda de 1½ ó 2 por ciento. En el servicio ordinario, el peso de las ruedas viajando, debiera ser, á lo menos, seis veces mayor del esfuerzo tractivo que se requiera. La capacidad aproximada de una fuerza motríz, de la estación, para cualquier servicio, es de cerca 100 horas watt por tonelada y milla á velocidades ordinarias.

Sistema electro-neumático para refrenar ferro-carriles y otros motores. . . . . . [Pág. 703.]

Este sistema está en uso en Pittsburgh y Wilmerding, adonde dos ó mas carros motores se ponen ó arreglan dentro de un tren y cada carro tiene su propio registrador, haciéndose necesario, para dichos registradores, ser movidos en sincronismo igual ó exacto, de manera que, todos los motores corran á una misma velocidad. La operación de todos los registradores, es dirijida desde la plataforma del frente del primer carro y se ejecuta por fuerza motríz de aire. En el tope ó parte superior de cada registrador, hay dos cilindros de aire, uno de los cuales conduce un linguete ó retén que se engrana con una rueda de trinquete en la parte superior del registrador. Los cilindros de aire son operados en armonía por una batería eléctrica pequeña y por un conmutador eléctrico, pequeño tambien, al frente de la casilla del maquinista. El segundo cilindro de aire, es para retornar el registrador á una posición O, y es operado tambien por el hombre encargado del motor en la plataforma del frente. El circuito del rompedor ó partidor, está de tal modo arreglado, que impulsará los registradores á una posición opuesta ó hácia afuera, en el caso de que se abrieran. Si se aplican las retrancas de aire, todos los registradores retornan automáticamente á la posición opuesta ó hácia afuera antes mencionada. El comprimidor de aire que se ilustra es tambien de nuevo tipo y consiste de una bomba de dos cilindros rotativa directamente impulsada por un motor pequeño. En las carretillas de carro que se usan, el muelle de apoyo para los motores, se guarda de una manera enteramente distinta que la del muelle de apoyo de los carros.

Un gran fabricante de efectos eléctricos. . . . [Pág. 708.]

Hace una especialidad de alambre y uniones de rieles.

Aparato de fuerza motríz de transmisión en Nueva York. [Pág. 709.]

Esta es una descripción de los generadores de corriente alternante, convertidores rotativos y transformadores para ser usados por la Metropolitan Street Railway, de Nueva York. Los generadores son del tipo giratorio de influencia magnética, con armaduras externas estacionárias. Cada máquina tiene una capacidad de 2500 kw, generará una corriente de tres fases de 6600 volts á una frecuencia de 25 ciclos por segundo y correrá á 75 revoluciones por minuto. La influencia magnética giratoria tiene 40 polos y está montada directamente con el eje de la máquina. Está muy bien ventilada. Cada carrete-boblar es probado con una corriente alternante de 25000 volts. La armadura es de hierro fundido y arreglada con una base de planchas corredizas de manera que pueda removerse á un lado hasta verse límpia ó libre de la influencia magnética, lo que permite ó dá acceso á una inspección y reparaciones, á ambos, esto es, á la armadura y la influencia magnética. La influencia magnética giratoria está compuesta de un anillo de acero, cuyo está firmemente empernado á un bastimento de hierro fundido á rayo con el eje de la máquina. Los transformadores en su parte inferior al convertidor rotativo de las estaciones, son de 250 kw cada uno y tres son los requeridos para operar cada convertidor rotativo. La primera enrolladura del transformador está designada para 6000 volts y la segunda para 350 volts. Los transformadores se enfrian por aire cuyo se sopla dentro de ellos teniendo una eficiencia, á una carga llena, de 98,22 por ciento. Los transformadores rotativos son de 990 kw cada uno y operan á 214 revoluciones por minuto. La influencia magnética tiene diez y ocho polos hechos de hierro fundido. La enrolladura de la armadura es hecha de barras de cobre. Las escobillas, al extremo alternante del convertidor rotativo, son de cobre, y el mismo opera como una máquina de seis fases. Dáse salida á los convertidores rotativos de la corriente directa por medio de otra abastecida por baterías de depósito.

Nuevo tipo de máquinas de dos cilindros. . . [Pág. 711.]

La novedad principal de esta máquina consiste en el método de operar las válvulas de admisión en los cilindros de baja presión. Estas válvulas son operadas, en parte, de un excéntrico fijo en el eje de la máquina y de otra, por el del mismo excéntrico cuyo opera las válvulas en la alta presión del cilindro. Las últimas son, por supuesto, refrenadas por el moderador de excéntrica. Se pretende que por este método de operar la baja presión de las válvulas, se evitan las desventajas ocasionadas por operarlas enteramente de un excéntrico fijo en el eje de la máquina, ó, exactamente de acuerdo ó en armonía con las válvulas de alta presión.

Acumuladores para tracción. . . . . . [Pág. 712.]

Este describe un acumulador inglés bien conocido. Las planchas son formadas por el procedimiento de Planté, con ácido sulfúrico solamente y toma cerca de seis semanas. Las planchas están todas conexionadas á una barra larga sin tornillos. No se usan ningunos materiales mas que vídrio y plomo al lado de las celdas y las baterías son mantenidas bajo una garantía de un precio variando desde 3 á 6 por ciento de su costo. Hánse usado extensamente en la Gran Bretaña y en otras partes como reguladores de fuerza motríz en las estaciones.

Nuevo tipo de motores de ferro-carriles urbanos. . [Pág. 713.]

Este describe cinco tipos de motores recientemente puestos en el mercado por la misma compañia y varian en tamaño desde 30 á 150 caballos de fuerza. Los dos primeramente descritos (Nos. 68 y 69) están de tal modo arreglados que con remover cuatro pernos y desuniendo los muelles que lo suspenden, el motor entero puede removerse de debajo del carro por un gato ó cric corriendo en una excavación ó depósito. Un carro equipado con estos motores cambia comunmente de motores un dia por otro lo que permite una inspección cuidadosa. Están adaptados ya sea para grasa ó aceite lubricado y el aceite es alimentado entre los engranes adonde la presión es menor. El tercer motor (No. 56) está designado para ser inspeccionado mientras se halla en el carro sin desmontarlo con frecuencia. Está compuesto de dos partes engoznados en el centro y con destornillar un perno, la mitad de la parte inferior puede balancearse abajo dentro de una excavación ó depósito y la armadura puede retenerse ya sea en la mitad de la parte superior ó de la inferior si asi se desea. El cuarto motor (No. 70) y el quinto motor (No. 50 C) están designados para trabajo duro y son de 110 á 150 caballos de fuerza de capacidad cada uno. Están asimismo designados para ser montados en carretillas de carro cuyas pueden ser corridas debajo del carro y la mitad de la parte superior del motor puede luego removerse. Todos los motores son á prueba de polvo y á cubierto de agua, provistos ademas con piezas de polo laminadas, cuyas están empernadas á los enganches ó yugos, en lugar de ser fundidas dentro de estos.

Uniones de rieles. Por W. F. Ellis, C. E. . . [Pág. 715.]

La última forma de la conexión de la mordaza en la unión se demuestra en las Figs. 2 y 3. Esta se ha mejorado en la construcción del trayecto ordinario por la forma demostrada en las Fig. 1 y 4. Estas no son consideradas de desear por el que escribe, entre otras razones siendo la de que el riel se rompería ó cortaría dentro del travesaño, segun se demuestra en la Fig. 4, lo que causa que la mordaza forzaría los pernos. Las Figs. 5 y 6 demuestran dificultades con la mordaza ordinaria, producidas aquellas si los agujeros no son taladrados con propiedad. Como un remedio, el que escribe, recomienda la unión demostrada en las Figs. 7 y 8 aplicadas á los rieles Vignole. La Fig. 9 demuestra la unión ordinaria aplicada á los rieles americanos modelo y la Fig. 10 la unión mejorada.

Nueva fábrica de carbono. . . . . . [Pág. 716.]

Estos describen una nueva fábrica cuya se ocupará de la fabricación de las escobillas de carbono. Esta situada en las regiones carboníferas y de hulla carbonizada de Pennsylvania; se empleará asimismo, en gran escala, el gas natural en sus trabajos para hornear y otros propósitos.

Estribos ó marchas de carro que no resbalan. . . [Pág. 716.]

Estos estribos ó marchas son hechas de rebordes de acero con plomo vaciado dentro de las ranuras abiertas. Usanse muchísimo para estribos de carros y marchas para las estaciones de los ferro-carriles elevados.

Manufacturero inglés de ruedas de fundición maleable. [Pág. 716.]

La firma mencionada pretende ser la exploradora de la manufactura de ruedas de fundición maleable en la Gran Bretaña.

Máquinas movidas por el gas para el servicio ferro-carrilero eléctrico. . . . . . Pág. 717.]

Estas describen un nuevo tipo de máquinas movidas por gas para operar generadores eléctricos, construidos desde 10 á 650 caballos de fuerza, con dos ó tres cilindros, dependiendo del tamaño. La sección de la máquina presentada es por medio de un cilindro de una máquina de tres cilindros, estos tres siendo exactamente iguales. La máquina es de simple acción y cada émbolo recibe un impulso á cada golpe por segundo. El gas está mezclado con aire antes de ser admitido al cilindro por medio de la abertura M y de la válvula J. El gas es encendido por una chispa eléctrica en F y despues expelida por medio de la válvula expulsora E y la de la descarga O. El método de gobernar la velocidad es radicalmente diferente de la mayor parte de las máquinas movidas por gas hechas, en las que, el número de explosiones son variadas segun los requerimientos de fuerza motríz. En la máquina ilustrada ocurre una explosión en cada cilindro á cada golpe de segundo, pero, el montante de gas admitido es variado segun los requerimientos de la carga. Se ilustra el moderador de excéntrica para hacer esto. Estas máquinas han estado en uso en una línea de 5 km en Huntington, New York, operando dos generadores de 37 kw.

La historia de una gran compañia manufacturera alemana. [Pág. 719.]

Esta describe el progreso de la Allegemeine Elektricitäts Gesellschaft, cuya principió en 1882 y ahora tiene un capital de 47000000 de marcos ($12000000) y un excedente de 18000000 de marcos ($4500000) dando empleo á 12000 hombres. Todos los utensilios en los talleres de Berlin son operados directamente por motores eléctricos. La corriente se toma de un edificio ó planta de fuerza motríz. La compañia tiene tantas órdenes que los trabajos andan de dia y de noche. Se hace referencia especial á la maquinária de tres fases de la compañia y este sistema es usado para distribuir la fuerza motríz en los talleres. La compañia ha hecho una especialidad de esta clase de aparatos.

Perfeccionamiento en las retrancas eléctricas. . . [Pág. 721.]

La retranca descrita es una que consiste de un disco de hierro fundido á rayo con el pivote del carro y un zapato de freno circular electro-magnético cuyo está sostenido de tal modo que no puede girar, hallándose apretado contra el disco por la corriente de los motores que actúan como generadores. Dáse un diágrama enseñando la conexión eléctrica del registrador que se usa.

Nuevo tipo de conducto y sistema de contacto en la superficie. [Pág. 721.]

El grabado demuestra una sección de una caja para conservar muerto el contacto de los rieles escepto cuando pasa el carro. La barra 4 se vuelve atrás por un ingenio de contacto en el carro haciendo revolver la barra 3. Esto ocasiona que el disco 9 se revuelva y hace que los contactos sean apropiados. La corriente puede luego ser tomada de la superficie de la calle ó del conducto regular. Los muelles llevan las partes de vuelta á sus posiciones originales.

Una compañia importante de ingeniería y contratista en Chicago. [Pág. 722.]

Retrancas de aire. . . . . . [Pág. 723.]

Este artículo dá algunos particulares de dos tipos de retrancas de aire hechas por una compañia bien conocida. En cada una de ellas el freno con tornillo de presión es impelido del pivote por medio de engranes. Dicho freno, con tornillo de presión, está de tal modo arreglado que solo opera cuando la presión en el depósito cae bajo de un cierto límite. La compañia construye tambien una retranca de aire para usarla con un motor de tornillo de presión, descrito en nuestro número de Abril. Dánse las vistas del primer freno citado, lo propio que de la válvula operadora en la plataforma. La válvula conduce una vara ó probeta de presión.

Instrumento medidor eléctrico. . . . . . [Pág. 724.]

Los grabados demuestran un amperómetro y voltímetro hechos por un fabricante importante de Inglaterra bajo privilegios concedidos á Lord Kelvin. El mismo fabricante hace toda clase de instrumentos medidores para corrientes directas y alternantes.

Nuevo tipo de calentador para carro. . . . [Pág. 724.]

La Fig. 1 demuestra un calentador eléctrico para carros teniendo asientos longitudinales. El calentador está hecho de dos carretes-boblares de alambre incorrosivo suspendido de una cuerda sólida de amianto (B), unida á los extremos de unos aisladores de porcelana redondos acanalados (D). La cuerda conserva los carretes-boblares á puesto sin usar ninguna tensión en el alambre.

Purificadores de alimentadores de agua y calentadores. [Pág. 725.]

Estos se hallan en uso en las localidades adonde la cal ú otros sólidos están contenidos en el alimentador y son intencionados para extraer este material antes que el agua sea introducida dentro de las páilas, El que se describe es un alimentador-calentador abierto, esto es, los ingredientes se remueven del agua directamente por la acción del vapor. La construcción del calentador se demuestra en la Fig. 1. Consiste de una série de quícios encorvados hechos de plancha de acero. El agua es admitida al tope del quício y fluye sobre los bordes en una película delgada y se adhiere al lado de debajo hasta que llega á su ínfimo punto, goteando enseguida dentro del quício que le sigue y de este modo al fondo del juego de quícios. El receptáculo en el cual están contenidos dichos quícios se llena de vapor y las impurezas presas ó asidas en la solución, son depositadas en el lado de debajo de los quícios. Estos están hechos en longitudes de cerca 1,8 m y pueden prontamente removerse para limpiarlos. La Fig. 2 ilustra un instrumento para taladrar los cilindros y sostener los quícios.

Un mango de retranca dentado. . . . . [Pág. 725.]

Este está compuesto solo de cuatro piezas segun se demuestra en los grabados.

Instalación de una gran batería de pósito en Plymouth. [Pág. 726.]

Esta consiste de 260 celdas, teniendo un producto de 120 amperes á 480 volts para cinco horas.

Nuevas locomotoras de gran velocidad. . . . [Pág. 726.]

Esta es una locomotora inglesa de acción sencilla y del tipo de empuje constante, estando arreglada con dos manúbrios cilíndricos de 180 grados aparte, ó de tres cilindros con manúbrios colocados 120 grados aparte. La ilustración enseña una locomotora de 250 caballos de fuerza, acoplada directamente á un generador de corriente alternante.

Válvulas sopladoras. . . . . . [Pág. 726.]

Este artículo contiene una vista general y seccional de una válvula sopladora para páilas y tuberías de vapor, cuyas han obtenido y ganado una prominencia considerable. Las novedades principales se demuestran en la ilustración seccional y consisten de un arreglo por el cual la recaudación del empósito y sedimento en el tope del disco de la válvula se previene. El disco puede tambien revertirse facilmente y el asiento de la válvula puede removerse cuando se desgasta.

Gran carro de arrastre. . . . . . [Pág. 727.]

Este carro mide 11,9 m sobre todo. Contiene diez asientos reversibles y cuatro estacionarios con una capacidad de asientos para setenta pasajeros. El carro pesa 8300 kg y está montado sobre dobles carretillas de carro cuyas pesan menos de 1810 kg cada una.

Bombas alimentadoras. . . . . . [Pág. 727.]

Estas describen una páila con bomba alimentadora hecha en Glasgow, cuya está en uso en varios de los mayores vapores oceánicos y en varias estaciones de fuerza motríz tambiem, La bomba es impulsada directamente desde la varilla del émbolo y no hay ninguna punta muerta.

Fuerza motríz económica de generación. . . [Pág. 728.]

El horno construido para quemar la basura de la calle como combustible y descrito en nuestros números de Mayo y Julio de 1898, ha sido, desde entonces adoptado en una extensión considerable. Los fabricantes de esto hacen tambien un foguero mecánico cuyo dá escelentes resultados segun se demuestra por el texto publicado. Asímismo hacen una máquina para determinar el montante de ácido carbónico de los gases que pasan desde un horno, determinando tambien de este modo si el propio montante de aire ha sido admitido en el hogar. Una pérdida de economia resultará si se usa demasiado aire ó poco en la combustión. La ilustración enseña este ingenio.

Talleres de construcción de carros en Preston, Inglaterra. [Pág. 729.]

Estos dan las vistas y descripción de un extenso edificio recientemente concluido para la construcción de tramvías y carros ferro-carrileros lijeros en Inglaterra. Los talleres tienen una capacidad para la manufactura de 800 carretillas dobles de carro, de tamaño ordinario, por año. Toda la maquinaria es operada por motores eléctricos, de los cuales hay 25 en los talleres. La fuerza motríz es generada desde una estación central centeniendo una máquina y generador de 325 caballos de fuerza. La compañia manufactura tambien carretillas de carro y asímismo está preparada para abastecer carros equipados con cualesquiera de las carretillas de carro modelo que se construyan. Dánse vistas de algunos de los principales edificios y carros recientemente construidos.

Linternas de locomotora para carros eléctricos. . [Pág. 732.]

Los reflectores de estas linternas de locomotoras son corrugados produciendo, segun se pretende, una luz mas intensa.

Engrasación automática. . . . . . [Pág. 732.]

Esta es una corta descripción de un sistema de engrasación automática para las estaciones de fuerza motríz, máquinas y generadores en uso en St. Louis. Desde la instalación ha habido una economia de mas de $300 por més en el costo del aceite, y de $150 por més en el costo de labor. El aceite se bombea á los cojinetes por bombas de vapor y de ahí que el sistema se considere mas efectivo que si se usára la gravedad.

Aislador para el tercer riel. . . . . . [Pág. 732.]

Este consiste de un hierro maleable modelo intencionado para conducir un aislador, sobre el cual está montado un gárfio de hierro, maleable tambien, que sostiene el tercer riel. El gárfio sujeta el riel en alineación horizontal, pero, permite un juego ó movimiento vertical ligero. Fué intencionado para obviar la dificultad proviniente de la rotura de los aisladores que ocurrieron en el pasado á causa de que el riel estaba sujeto demasiado ríjido por los aisladores.

Nuevo generador para ferro-carril urbano. . . [Pág. 733]

Entre las novedades especiales de este generador hay un método para operar los mangos de las escobillas en una direccion paralela con el eje removiendo toda tendencia de las mismas en recortar ó tallar el conmutador, de la de remover las piezas del polo y carretes-boblares sin perturbar el yugo ó armadura asícomo tampoco la entera ventilación. El grabado enseña una máquina de 800 kw para Oakland, California.

Una unión nueva de bronce. . . . . . [Pág. 733.]

Esta es una pieza rectangular de bronce de cerca 76 mm de largo, 3 mm de espesor y 38 mm de alto, apretada contra los rieles dentro de las mordazas por medio de unos muelles de acero. Las superficies son amalgamadas.

Extensos trabajos eléctricos en Chicago. . . . [Pág. 734.]

Este describe los trabajos de la Siemens & Halske Company de América. La compañia no hace aun los motores ferro-carrileros, pero, fabrica toda clase de generadores, incluyendo generadores ferro-carrileros tan grandes como de 1500 kw, motores para automobiles, lámparas eléctricas de arco, metros watt, etc. El modelo de los generadores ferro-carrileros ha sido recientemente cambiado y se ilustra por completo. El bastimento del imán es de acero fundido, y las piezas del polo son de un tipo especial. La armudura tiene una gran superficie y diámetro, de una profundidad comparativamente pequeña. Esto dá una buena ventilación con pequeña diferencia potencial entre las barras adjuntas del conmutador. Conductos ó canales de aire radían frecuentemente por medio de la armadura. Los rayos del bastimento de la armadura están arreglados para echar soplos de aire por medio de dichos conductos. El conmutador es de gran diámetro si bien no está colocado afuera de los carretes-boblares é influencias magnéticas de la armadura, segun se acostumbra con las máquinas originales de Siemens & Halske y de las fabricadas en Europa. Los mangos de las escobillas son de un tipo especial y designados para asegurar una constante presión de las escobillas con el conmutador. La manufactura de motores para los automobiles es una especialidad y los talleres tienen una capacidad para manufacturar 125 motores de esta clase en una semana. Son de una capacidad de 2 kw, pero, están designados para marchar contínuamente á 4 caballos de fuerza con un aumento nó mas allá de 40 grados centígrado. La compañia fabrica tambien muchos convertidores rotativos.

Avance de vapor agotado. . . . . . [Pág. 737.]

En este avance de vapor agotado el agua es separada del vapor por fuerza centrífuga.

Rompedores de circuito. . . . . . [Pág. 737.]

Este rompedor no puede cerrarse á menos que la condición del circuito sea normal, de modo que no hay peligro que dañe el aparato en el circuito ó en operar. El mismo se abre muy cuidadosamente y el arqueo es reducido á su mínimo.

Nuevo conector aislador. . . . . . [Pág. 737.]

Este es para uso adonde dos alambres aislados tienen que conexionarse. Los extremos de los alambres están primeramente á descubierto de aislamiento con un dedal de bronce deslizado encima de ellos. Los dos tornillos, que pasan por medio del dedal, mantienen los alambres fuertes. Dicho dedal tiene una cubierta ó chaqueta de goma tiesa y dos casquillos de goma suave, cuyos se deslizan luego encima, aislando completamente todas las partes de metal. Los alambres pueden desunirse con deslizar afuera los casquillos de goma suave y luego aflojando los tornillos. Es especialmente adaptado para hacer las conexiones entre los extremos de los alambres proyectándose afuera de la envoltura del motor y de la de los carros.

Gran compañia de mica en Chicago. . . . [Pág. 738.]

Esta es una referencia de una compañia que pretende ser la mayor expendedora de mica en América.

Hermoso carro para Braintree, Massachusetts. . [Pág. 638.]

Este enseña un carro abierto de 15 bancos, cuyo ha obtenido mucha popularidad en los ferro-carriles eléctricos durante el verano teniendo un tráfico muy grande. Mide 13,9 m sobre todo y tiene un ancho de 2,2 m. El segundo grabado demuestra una nueva carretilla de carro construida por los mismos fabricantes. Tiene una base de rueda escepcionalmente pequeña y es intencionada para ser usada en los caminos con curvas de corto rádio.

Jabón para limpieza de carros. . . . . [Pág. 739.]

Este describe un jabón especial para la limpieza de carros cuyo ha sido adoptado por un gran número de ferro-carriles de vapor y compañias urbanas en América. La experiencia de estas compañias ha sido de que la frecuente limpieza preserva tanto la pintura como el barníz de los carros, no siendo de desear el agua con el jabón ordinario. Un número de compañias límpian los carros con este material dos veces á la semana, pero, en otros caminos una sola vez á la semana es considerada suficiente.

El ferro-carril eléctrico de Toledo, Fremont y Norwalk. [Pág. 740.]

Este camino es de 100 km de extensión y en la actualidad se está construyendo. La fuerza motríz es distribuida por el sistema de tres fases á 15000 volts cambiada á una corriente directa para uso de la línea.

Máquina para arrancar los rieles viejos. . . . [Pág. 740.]

Esta máquina puede arrancar cerca de 3,2 km de trayecto por dia, asícomo los rieles de cualquier longitud, usualmente desde 1,2 á 2,4 m. El riel que se demuestra en el grabado es de 150 mm de alto, pero, la máquina es capaz de arrancar los rieles de 225 mm de alto

Una nueva empresa en Alemánia. . . . . . [Pág. 740.]

La firma referida ha tomado la agencia de un fabricante bien conocido de cuerpos de carro. Estos son embarcados á Alemánia y puestos juntos en ese pais. Hánse recibido órdenes recientes para carros de esta clase para Berlin. La misma firma abasteció carretillas de carro y retrancas de aire.

La carretilla doble de carro No. 14 B-3. . . [Pág. 741.]

Esta carretilla de carro tiene una base de rueda de 1,22 m y es intensionada para el uso de caminos de curvas agudas. El carro tiene una solera con resorte de pasador. Los motores se conducen afuera de los pivotes en lugar de estar entre ellos y el aparejo de la retranca está entre los pivotes.

Enganche del riel Atlas. . . . . . [Pág. 742.]

Este enganche de riel ha sido adoptado extensamente en Amé rica é ilústranse dos formas.

Agarrador de polo de trolley y carretel. . . . [Pág. 742.]

Este es intencionado para prevenir que el polo del trolley brinque en una posición vertical en caso de que la rueda saltára del alambre del trolley.

Válvula de cierre automática de seguridad. . . [Pág. 742.]

Esta está designada para ponerse en la tubería principal de vapor, entre las páilas y las máquinas, y se cierra automáticamente cuando hay una rotura en la tubería principal ó en la máquina, lo suficiente para reducir levemente la presión del vapor. La construcción del ingenio se demuestra por el grabado seccional.

Regulador de tiro hidráulico. . . . . . [Pág. 743.]

Este ingenio abre y cierra el regulador de tiro segun sea la presión en las páilas, sosteniéndola constantemente en ellas.

Cojinetes de rodillo para los carros urbanos. . . [Pág. 743.]

Los cojinetes para un pivote están todos contenidos en una caja conexionando los extremos, de modo que puedan levantarse afuera y volverlos á colocar en cualquier tiempo que se desée. Los rodillos en sí son de superficie de acero duro y aguzados. La compañia garantiza una economia desde 10 á 15 por ciento de la fuerza motríz usada.

Filtradores de aceite. . . . . . [Pág. 743.]

Estos abrazan algunas nuevas formas y tambien contienen un separador por el cual el desperdicio del aceite y del agua de los derrames desde la varilla del émbolo, son separados. El aceite es luego puesto en un cuarto de refinar adonde se calienta y se clarifica. Mas luego se cuela por medio de desperdicios de algodón por el que se remueven las impurezas lijeras. Cada filtrador se provée con un lente fuerte de aumento para así poder inspeccionar la purificación del aceite.

Conductor de carbón en Washington. . . . [Pág. 744.]

El grabado enseña una vista del conductor de adonde las cenizas son tomadas de las páilas y conducidas al tanque de ellas. El túnel es de cerca 61 m de largo. El mismo balde conduce el carbón á las páilas.

Enganches automáticos para carros. . . . [Pág. 744.]

Los grabados enseñan dos tipos de una hechura de enganches para carros cuyos se usan prácticamente en todos los ferro carriles elevados de América y varios caminos de la superficie. Usanse, en la actualidad mas de 50000. Los enganches se usan tambien en muchas ciudades de Europa.

Nueva fábrica de una retranca de fuerza motríz. . [Pág. 747.]

Esta describe la nueva fábrica de una compañia que está haciendo grandes negocios en la fabricación de retrancas de aire para los carros urbanos. Toda la fuerza motríz es distribuida en toda la fábrica por electricidad ó aire comprimido.

Grandes productores de alambre. . . . . [Pág. 747.]

La compañia mencionada pretende tener la planta ó edificio individual mayor en existencia, para producir ambos, esto es, conductores eléctricos y cuerda de alambre. Se hacen toda clase de alambres.

Acumulación ó aire depositado para retrancar los carros. [Pág. 748.]

En este sistema el aire es comprimido en la estación de la fuerza motríz á cerca de 15 admósferas y es luego acumulado en depósitos en los carros. Antes de aplicarlo á las retrancas se pasa por medio de una válvula reducida la qué, á su vez, la comprime á cerca de tres admósferas. No se conduce ningun freno con tornillo de presión en el carro. La compañia que principió hace cerca de un año, ha equipado ya cerca de cuarenta y dos carros con resultados satisfactorios y reclama un número de ventajas para esta retranca.

Una gran casa inglesa de abastecimientos. . . [Pág. 748.]

Esta firma fué establecida en 1800 y negocia en toda clase de instrumentos medidores haciendo una especialidad para registrar los instrumentos requeridos en Inglaterra por la Junta de Comercio.

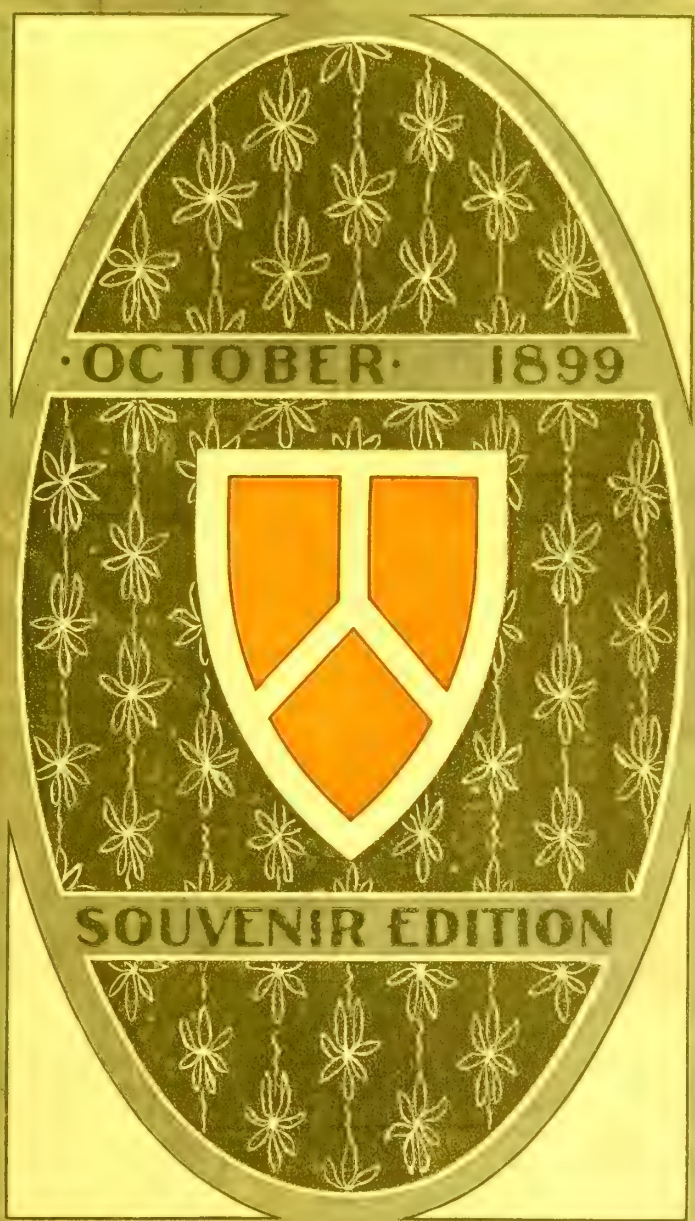
Algun trabajo eléctrico reciente en Inglaterra. . [Pág. 749.]

Este describe el trabajo de un expendedor bien conocido en aparatos eléctricos ferro-carrileros.

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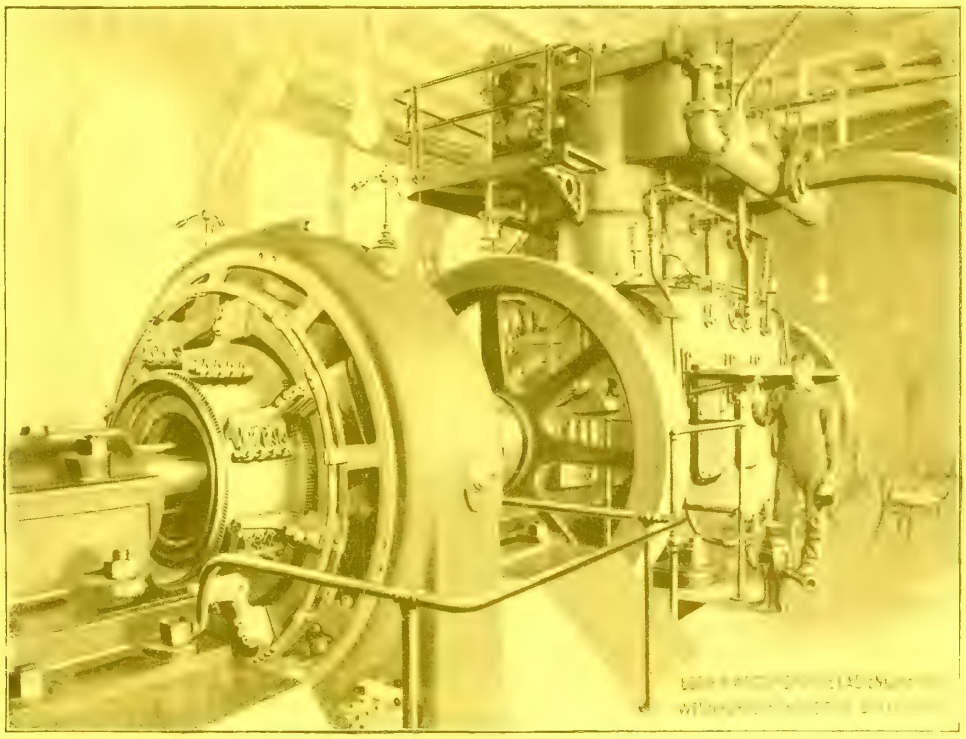
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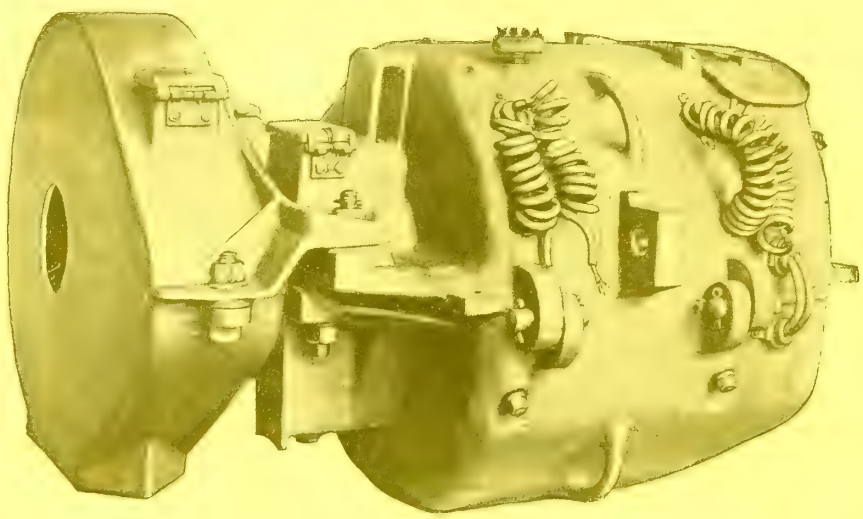
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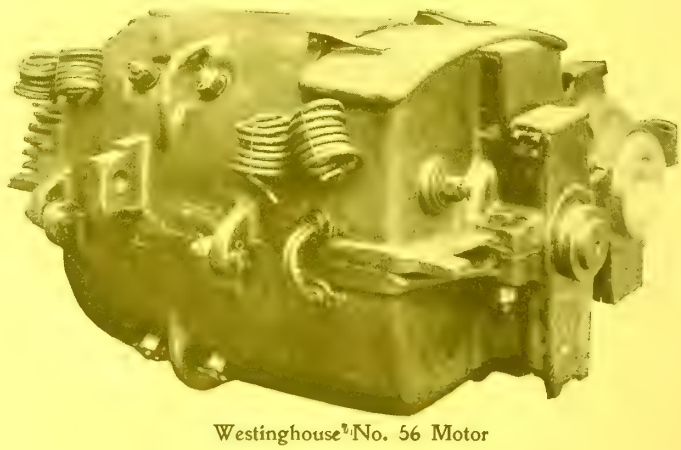
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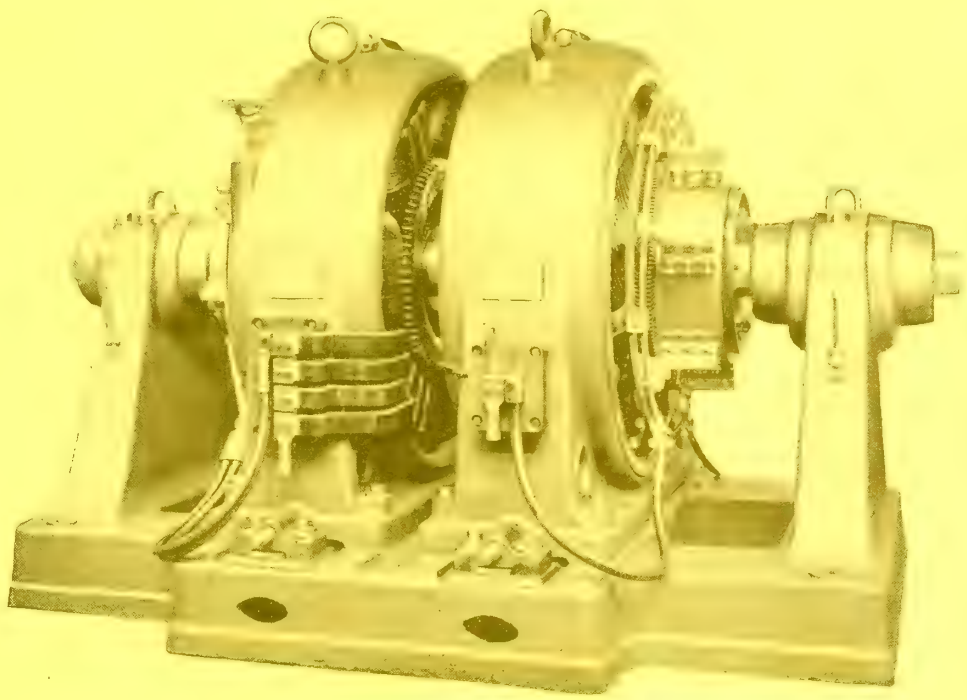
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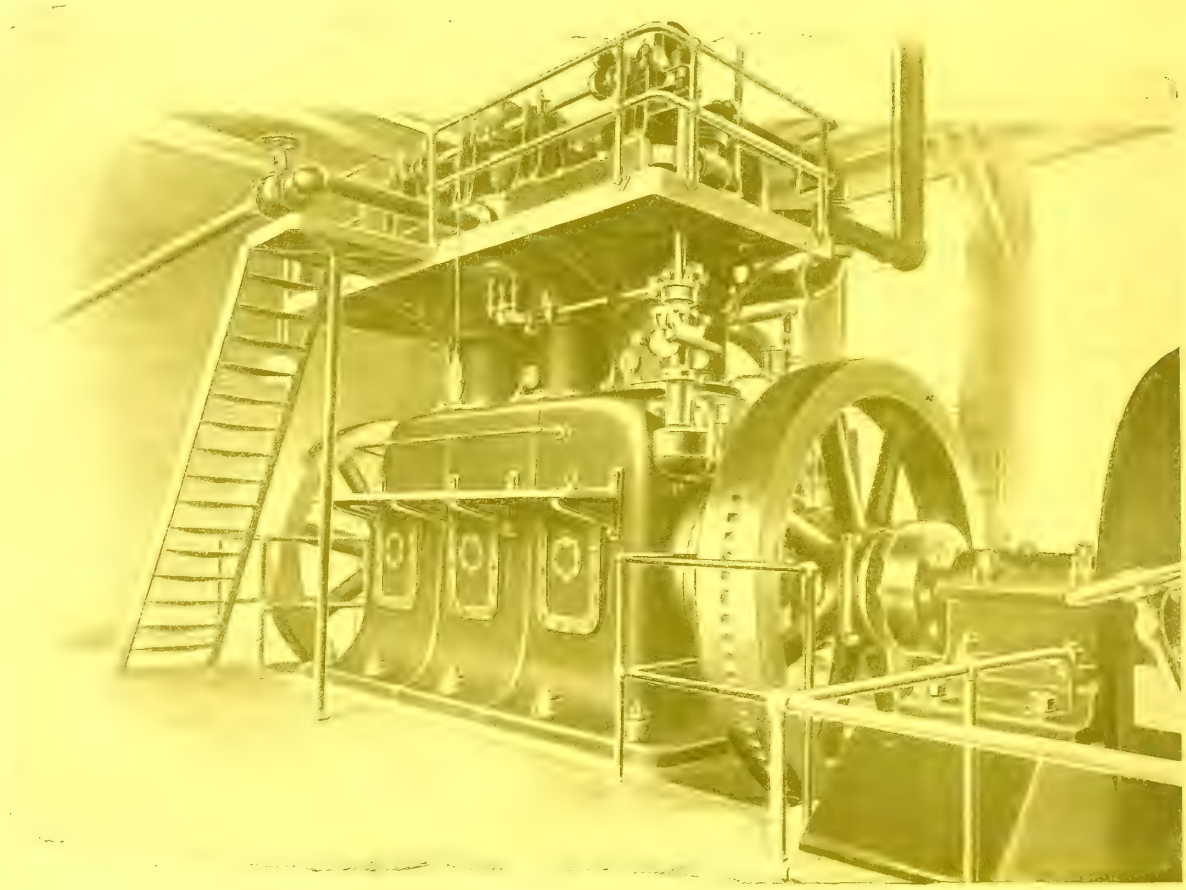
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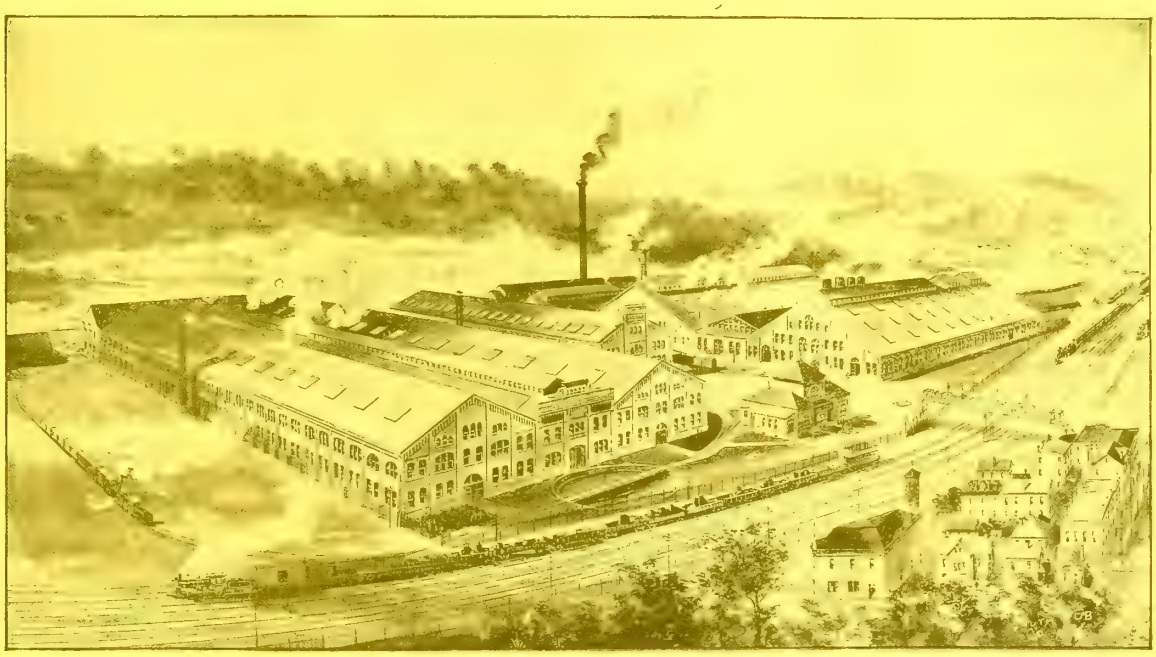
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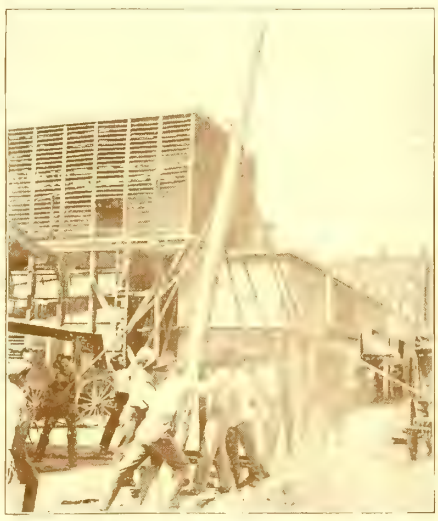
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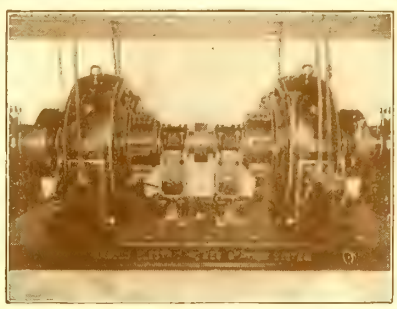


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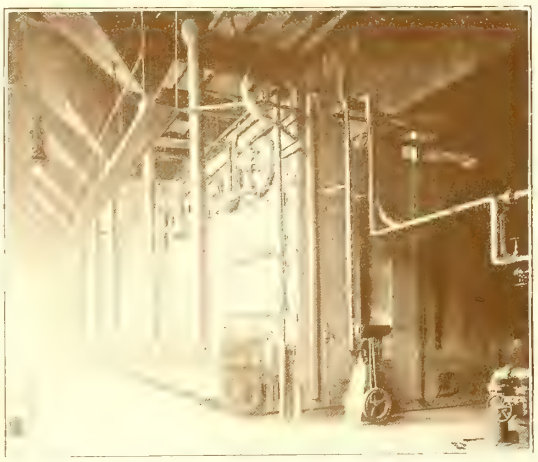
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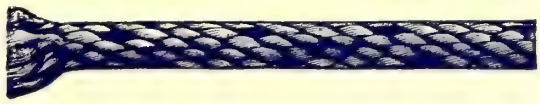
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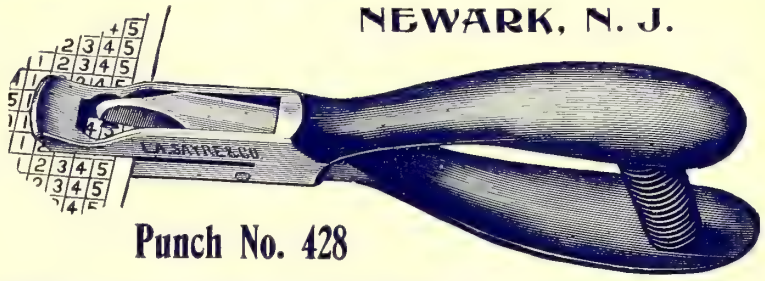
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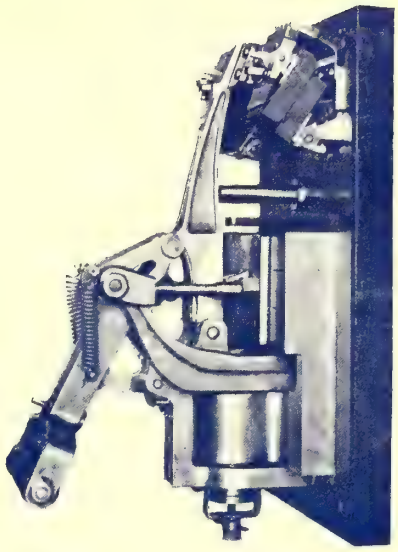
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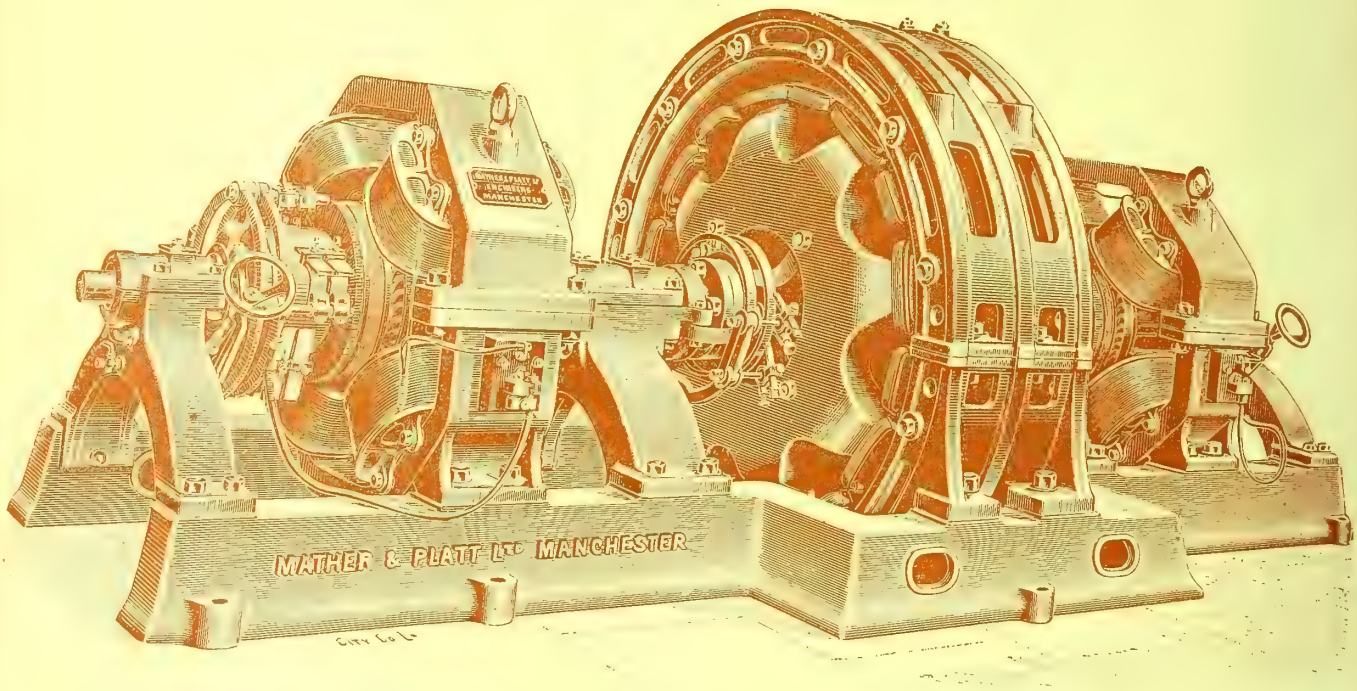
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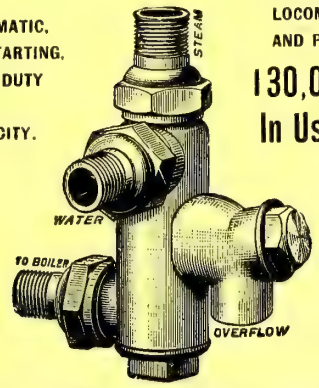
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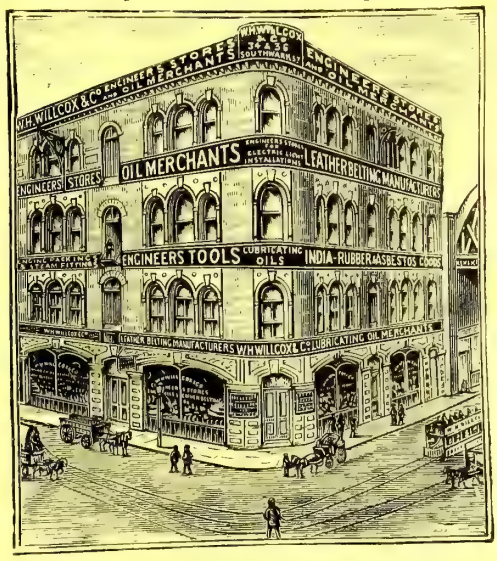
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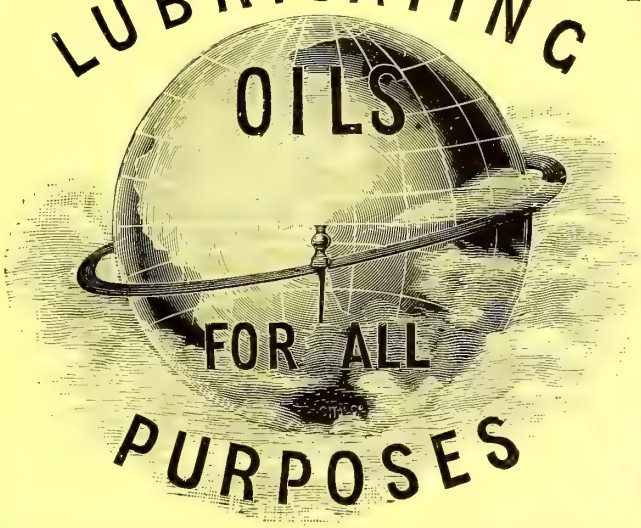
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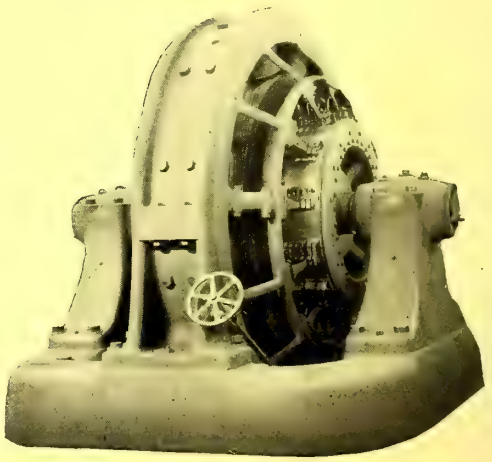
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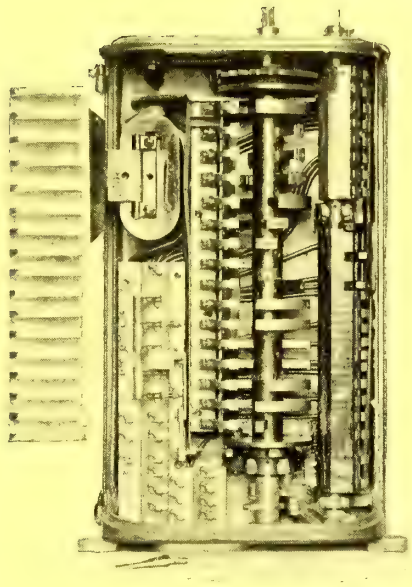
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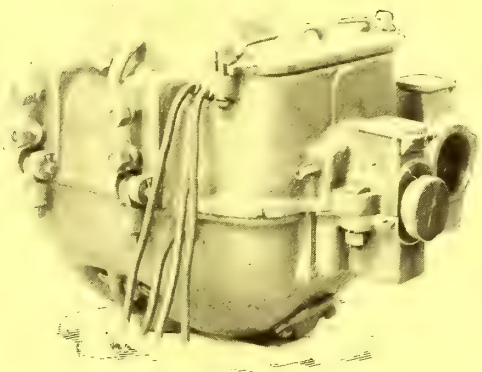
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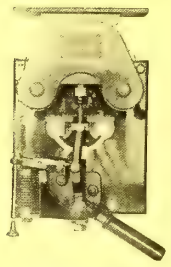
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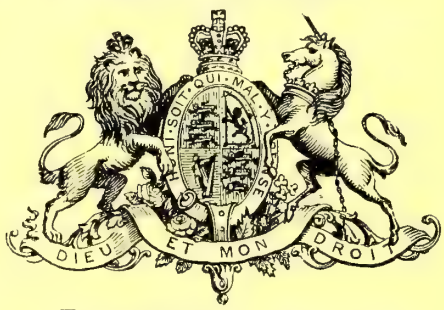
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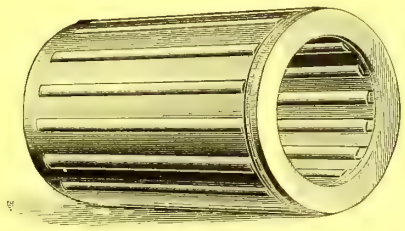
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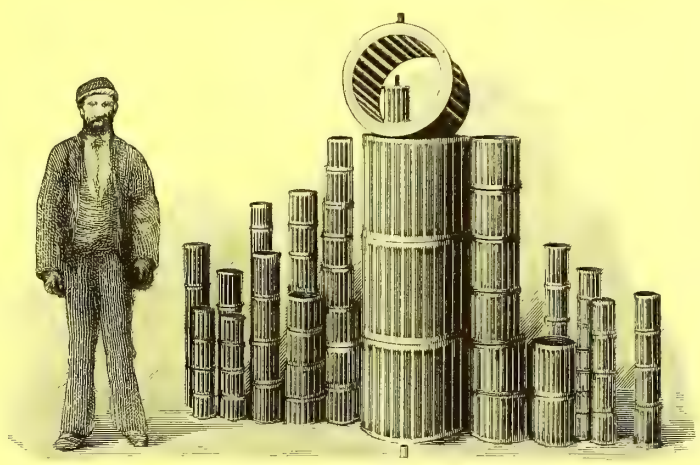
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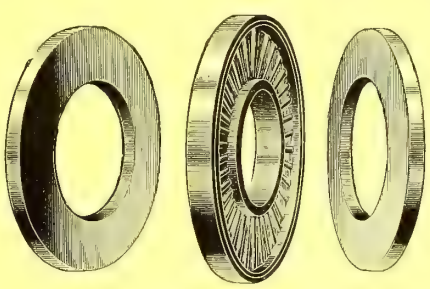
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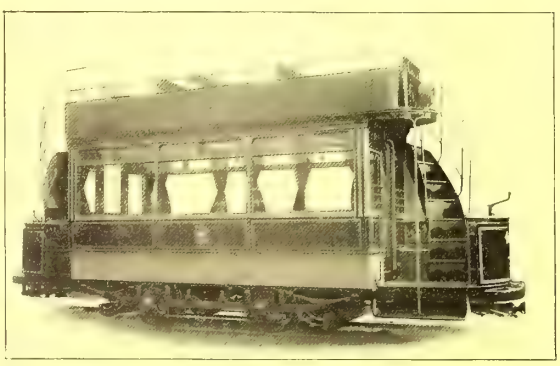
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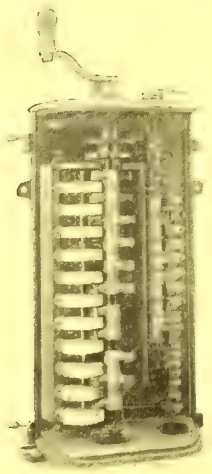
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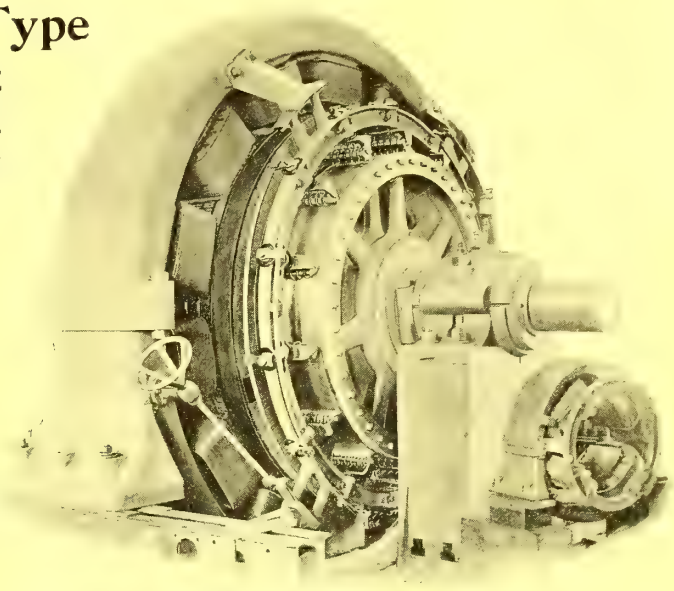


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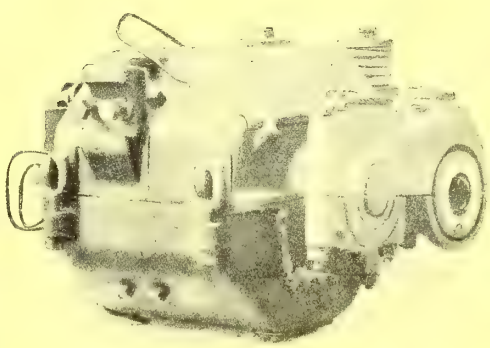
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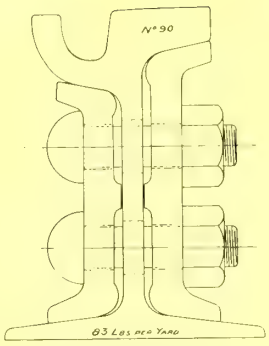


33 S. TRAMWAY MOTOR

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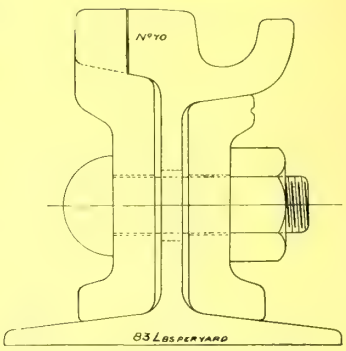
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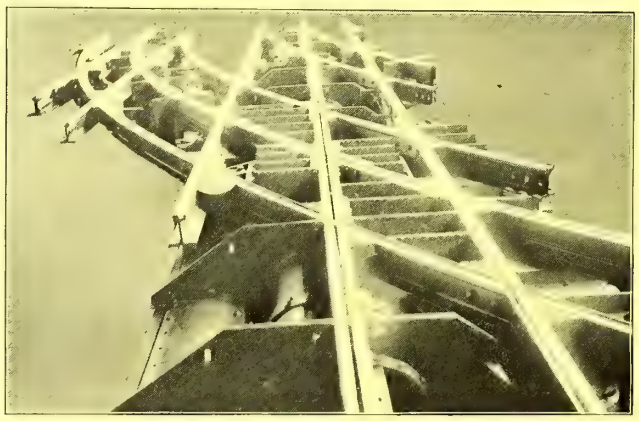
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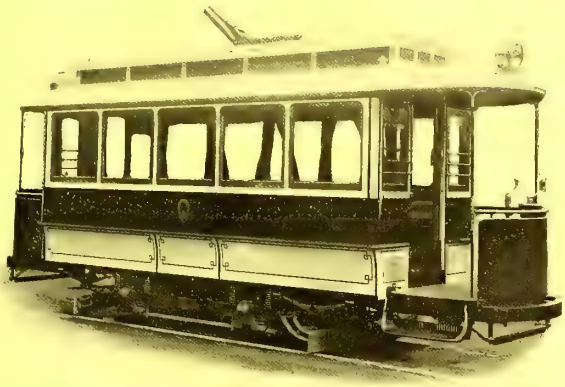
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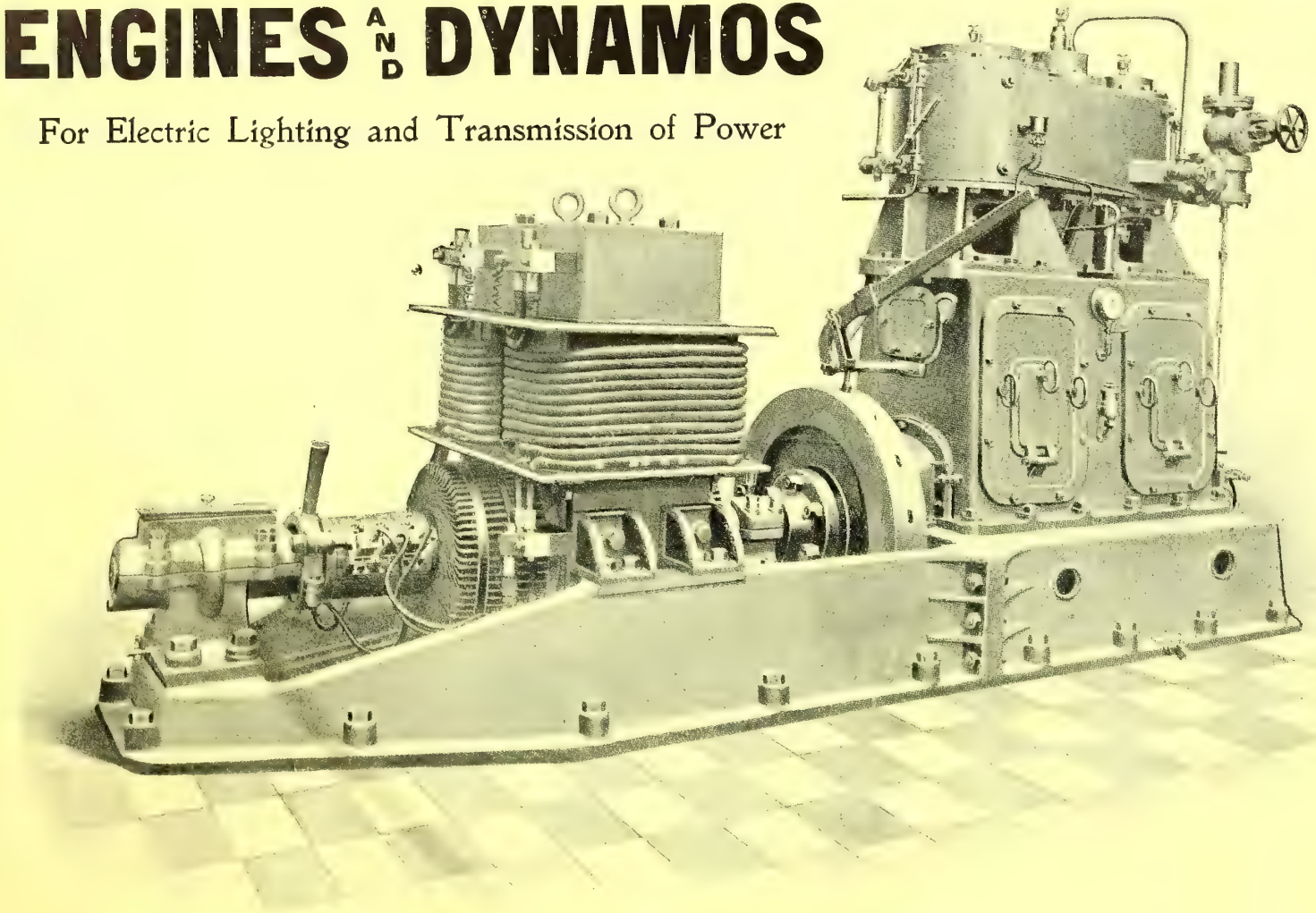
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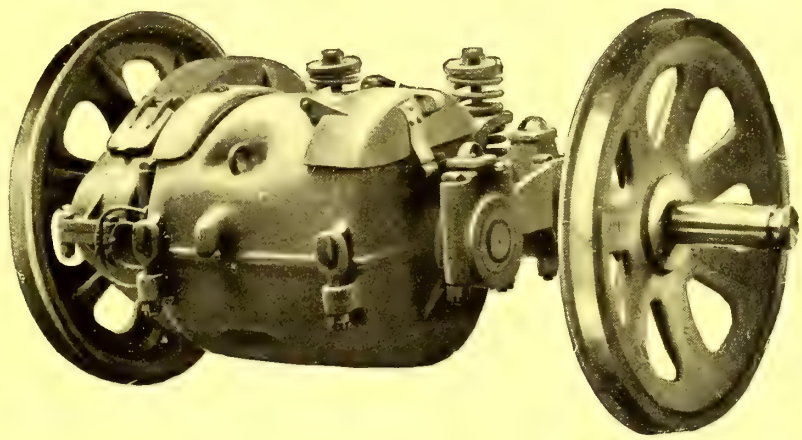
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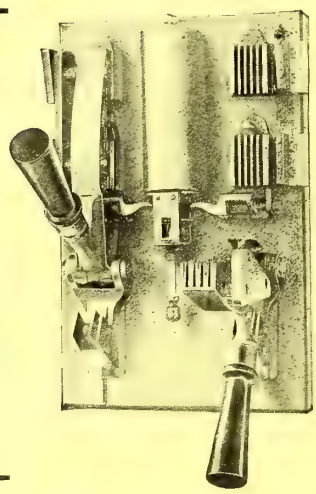
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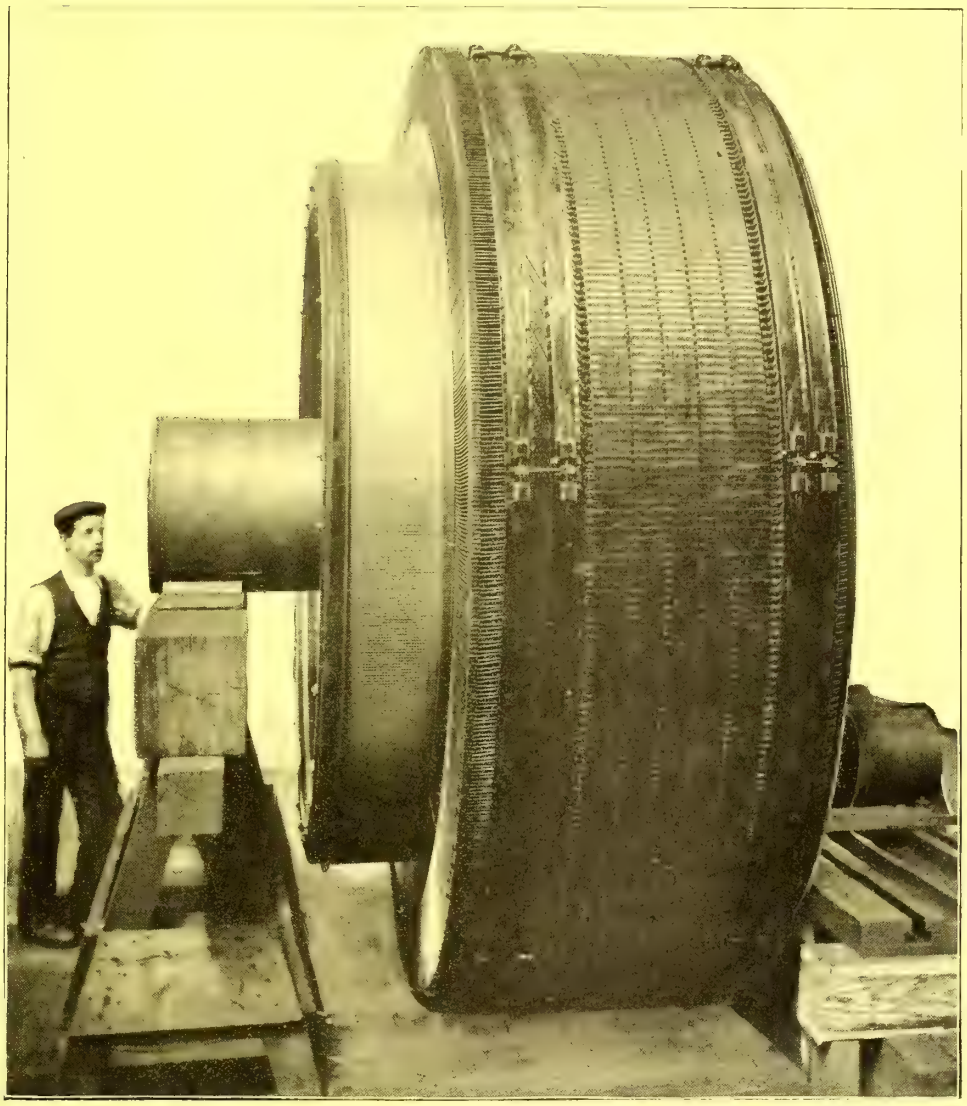
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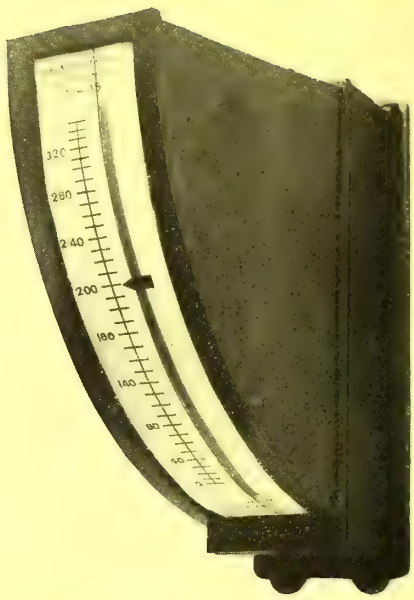
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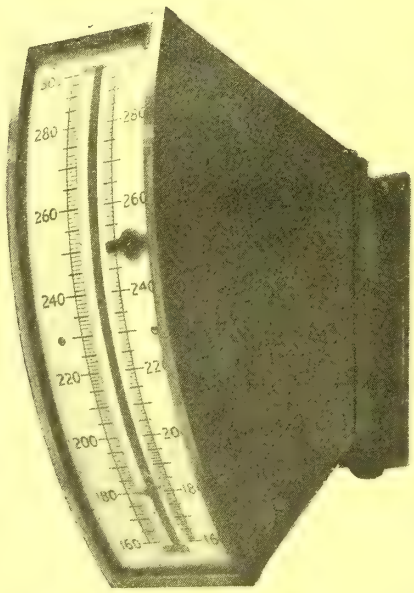
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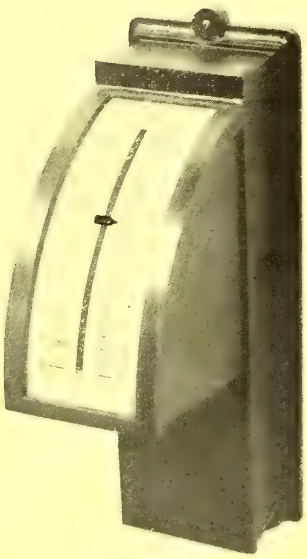
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Lord Kelvin's Patents.
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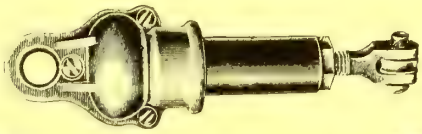
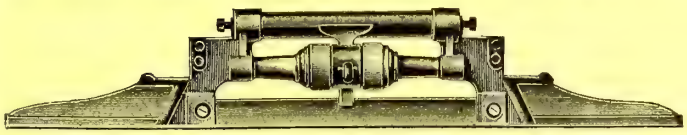
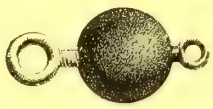
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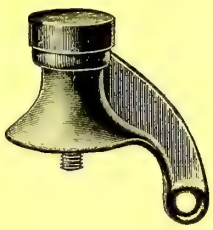
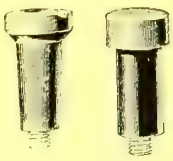
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CONTROLLER INSULATION

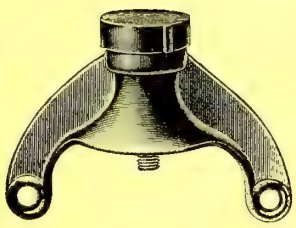
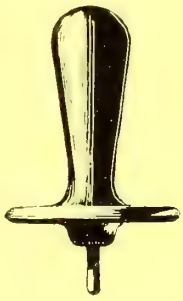



AMBROIN



Has been proved to be...

The Best Insulating Material

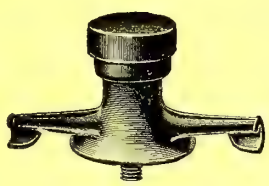
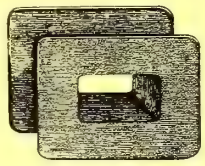
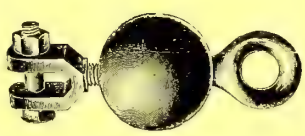



for

OVERHEAD LINE CONSTRUCTION

and for

All Insulating Parts of Dynamos, Motors, Switchboards, Etc.

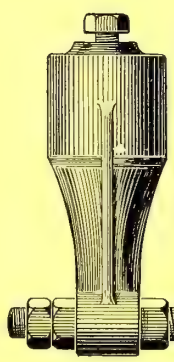






FOR PARTICULARS APPLY TO

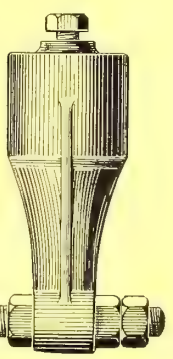
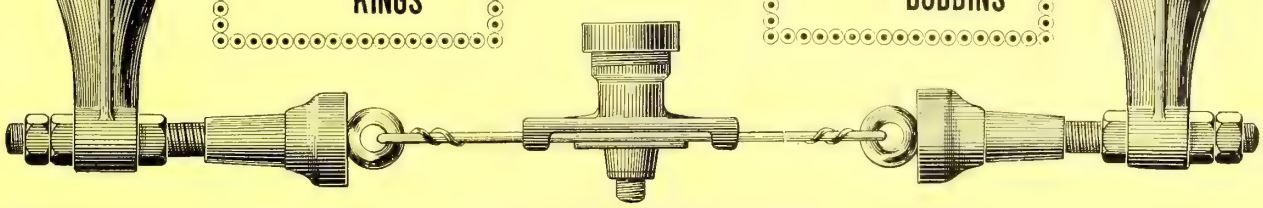
ESTLER BROTHERS

27 Leadenhall St. London, E. C.



MOTOR COMMUTATOR RINGS

MOTOR MAGNET BOBBINS

AMBROIN BRACKET ARM INSULATION

The British Insulated Wire Company

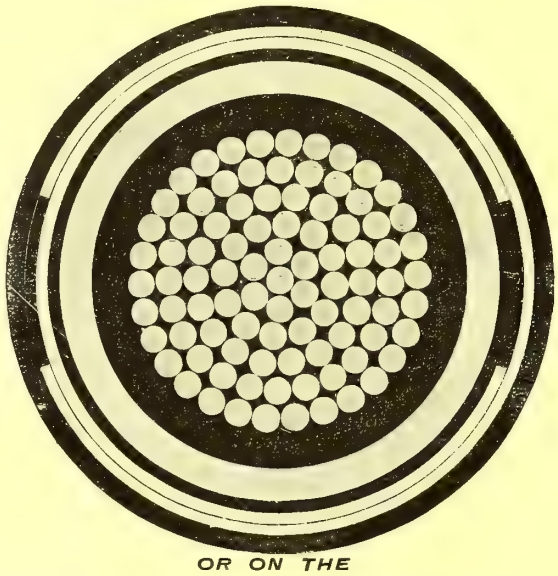
(LIMITED)

PRESCOT, LANCASHIRE

Underground Cables for Electric Tramways, laid either on the

ARMOURED SYSTEM

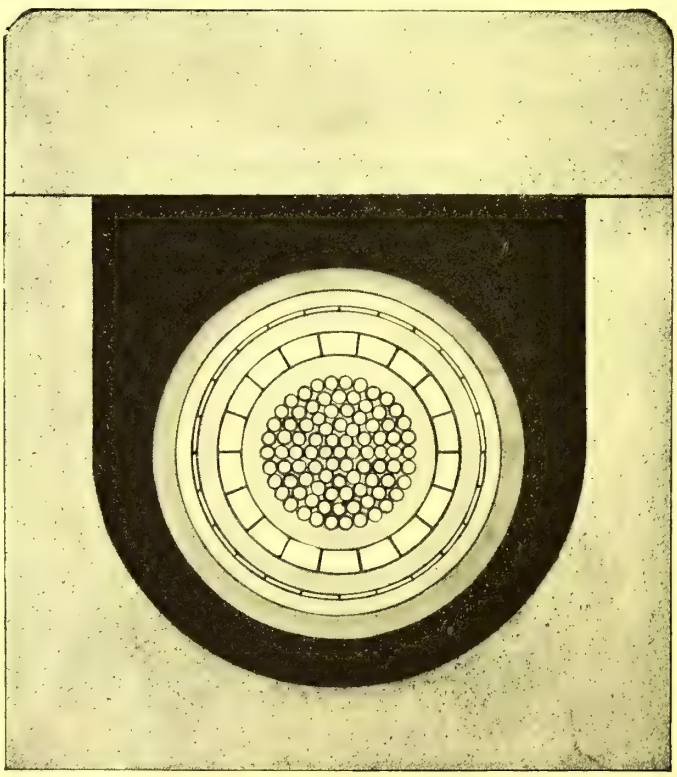
(direct in the ground)



OR ON THE

SOLID SYSTEM

(with earthenware troughing, filled in with compound)



Our cables are in use by over 100 of the Electric Lighting Works in Great Britain, and by the following tramways

BRISTOL.
CORK.
BLACKPOOL & FLEETWOOD.
ST. HELENS.

BRADFORD.
BUENOS AYRES & BELGRANO.
DUBLIN.
CITY & SOUTH LONDON.
COVENTRY.

BOLTON.
ABERDEEN.
CAPETOWN.
BLACKPOOL.
SHEFFIELD.

NORWICH.
ASHTON / HYDE.
PLYMOUTH.
COLOMBO, ETC.

CHLORIDE... ACCUMULATORS

For use in connection with...

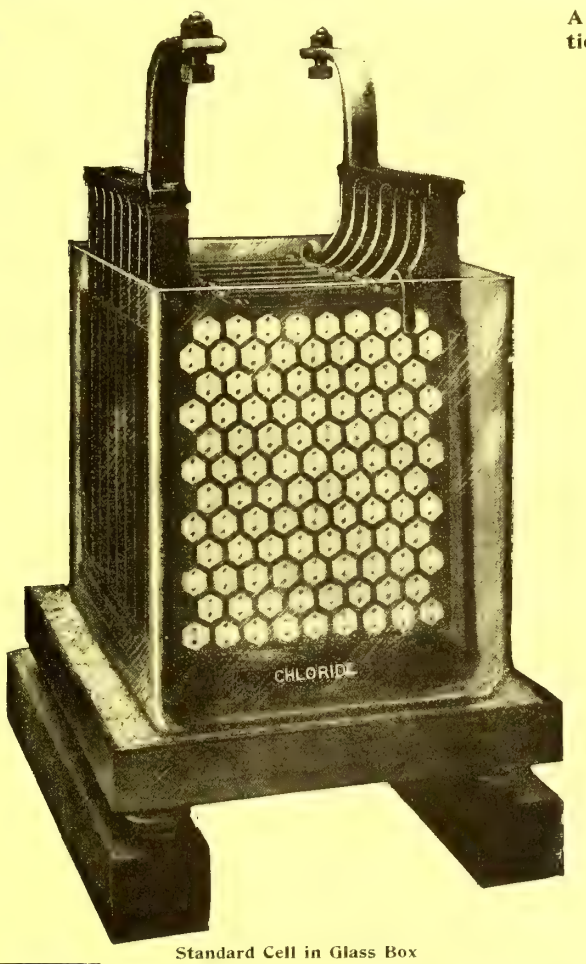
Central Lighting Stations
Trolley Line Regulation
House Lighting
Train Lighting
Yacht Lighting
Carriage Lighting
Electric Locomotives
Tram Car Traction
Auto Cars
Lorry Propulsion
Launch Propulsion
Bicycle Lighting
Telegraphs
Telephones
Phonographs
Mutoscopes
Dental
Medical
Surgical Work
Electric Fire Alarms
Electric Bells
Fan Motors

REPLATING OTHER TYPES OF CELLS

USED IN OVER 150 LIGHT AND POWER STATIONS

A Few of the Power Stations using Chloride Cells

HALIFAX
LIVERPOOL
ST. HELENS
LEEDS
DOUGLAS and LAXEY
SNAEFELL
RAMSEY
BOOTLE
BLACKPOOL
FLEETWOOD
CENTRAL LONDON RAILWAYS
NEW YORK MET. CO.
PHILADELPHIA
PITTSBURG
BALTIMORE
WOONSOCKET
EASTON
LAWRENCE
BARRE, VT.
WASHINGTON
FRAMINGHAM
ANACONDA
NORTH ABINGTON
NEW BRUNSWICK
BUFFALO
NEW HAVEN
BUENOS AYRES
ROCHESTER
CHICAGO
RIVER POINT
PAWTUCKET
CAMDEN



Standard Cell in Glass Box

A Few of the Lighting Stations using Chloride Cells

MANCHESTER
BOLTON
STAFFORD
NEWPORT
MORLEY
CANTERBURY
LINCOLN
STOCKPORT
CARLISLE
BRIG HOUSE
GALWAY
BATTERSEA
BARKING
NEWCASTLE
LEIGH
BEXHILL
PEMBROKE
CHICAGO
ST. LOUIS
HARTFORD
PHILADELPHIA
BOSTON
SAN FRANCISCO
LOWESTOFT
CHARING CROSS
BOOTLE
FLEETWOOD
CLEVELAND
WASHINGTON
RICHMOND, VA.
MAERDY
NORTHWICH
MILFORD

FOR LISTS &c. APPLY TO THE

CHLORIDE ELECTRICAL STORAGE SYNDICATE, LIMITED...

...London Office
39 Victoria Street, S. W.

Clifton Junction
MANCHESTER, ENG.



... THE ...

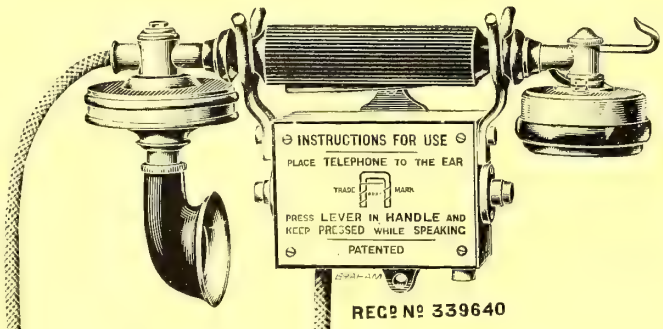
General Electric Co. LTD.

SPECIAL

TELEPHONES

.. FOR ..

Electric Traction Systems



REGD No 339640

K 201

Complete instrument comprising cast brass case containing induction coil and line terminals, combined with hand combination with switch in handle for fixing in section pillars or other positions at intervals along tram or railway routes, so that car conductors can communicate with the Central Station in case of accident.

No batteries are required in the pillars.

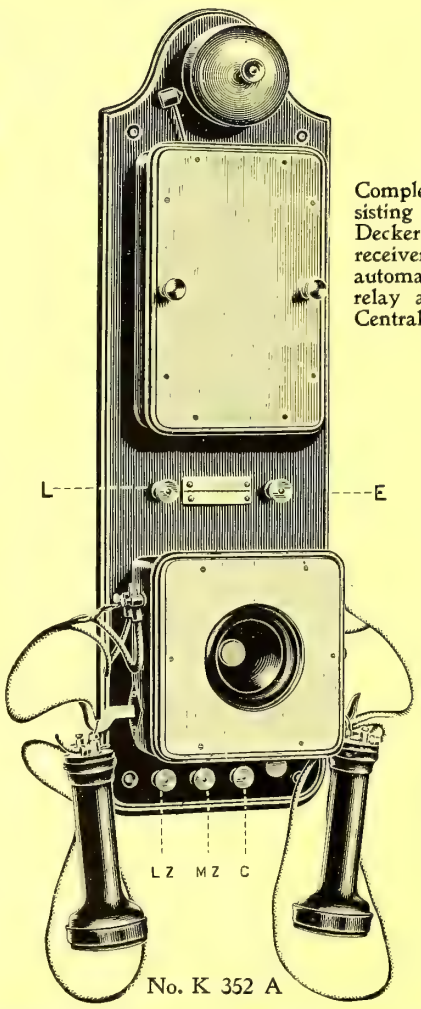


REGD

K 202

Plug box only for fitting into pillars or other convenient position.

In this case the Telephone is carried on the car and is fitted with a plug. To communicate with the Central Station, the conductors simply insert the plug in the holes provided for the purpose, shown in illustration.



No. K 352 A

K 352 A

Complete Telephone consisting of Hunningscone-Deckert Microphone, two receivers, induction coil, automatic switch hook, relay and call bell for Central Station.

NOTE.—One set of batteries in the Central Station is sufficient for any number of sub-stations.

WRITE FOR PAMPHLET GIVING FULL PARTICULARS, PRICES AND ILLUSTRATIONS OF THESE TELEPHONES

Head Offices, Warehouses and Showrooms

67, 69, 71, 88 and 92, Queen Victoria St., LONDON, ENG.

WORKS

Peel Works, Adelphi, Salford, MANCHESTER, ENGLAND

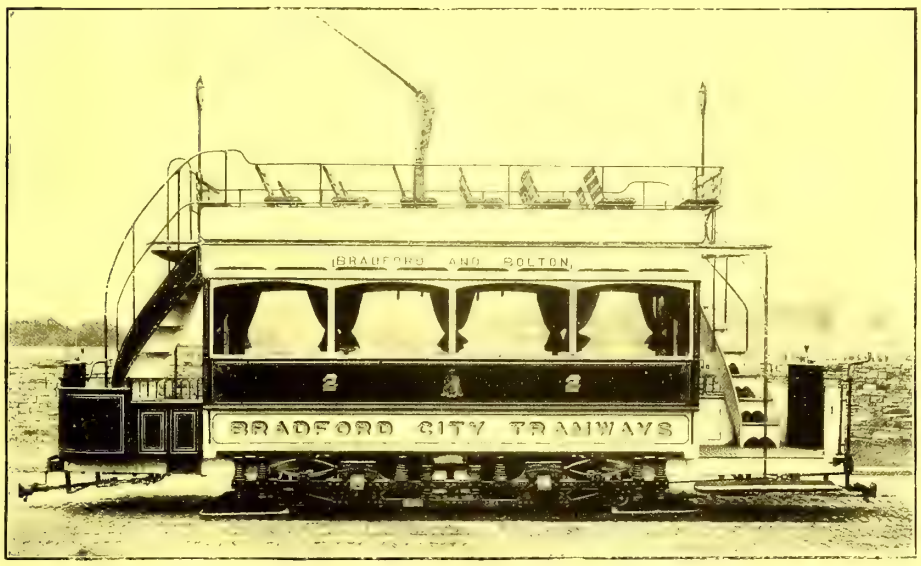
Ileene Works, Sherlock Street, BIRMINGHAM, ENGLAND

BRANCHES IN ALL CHIEF TOWNS

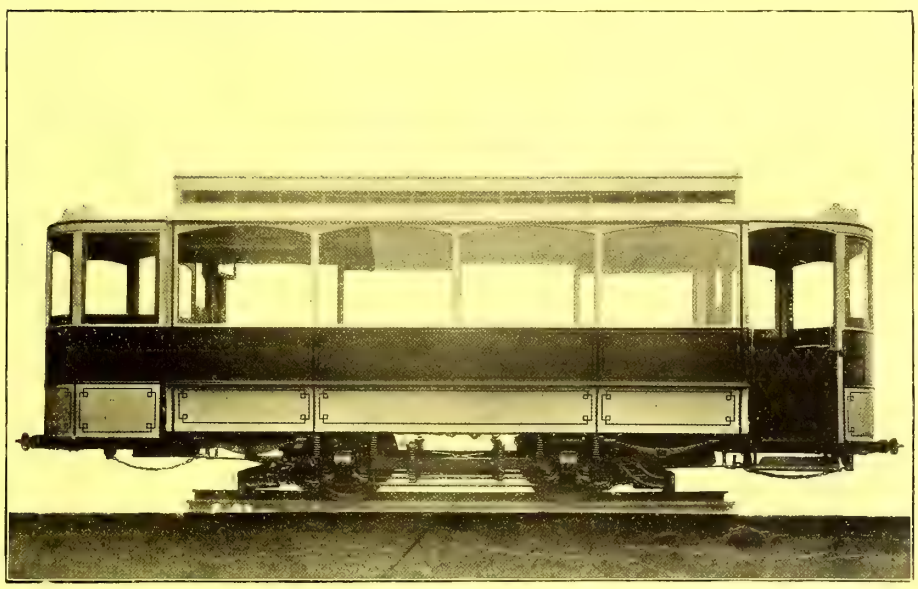




THE BRUSH
ELECTRICAL ENGINEERING COMPANY
LIMITED



TRAMWAY CARS for Electric, Steam, Cable or Horse Traction



Engines, Dynamos, Switchboards and Motors
FOR ELECTRIC TRACTION

HEAD OFFICES - - - 49 QUEEN VICTORIA STREET - - - LONDON, E. C.

FOR ELECTRIC TRACTION MATERIAL

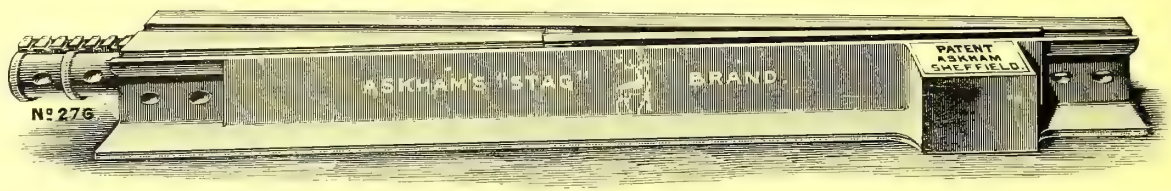
... Write or Cable to ...

Askham Bros. & Wilson

LIMITED

SOLE MAKERS OF THE PATENT

AUTOMATIC POINTS

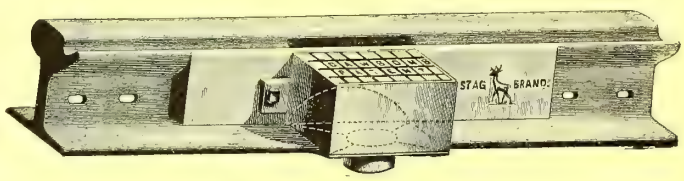


To Suit all Types of Rail

THE STANDARD POINT

In Best Crucible Cast Steel, as Laid on
ALL the English Electric Tramways . .

'DAWSON'S' Patent Drain Rail

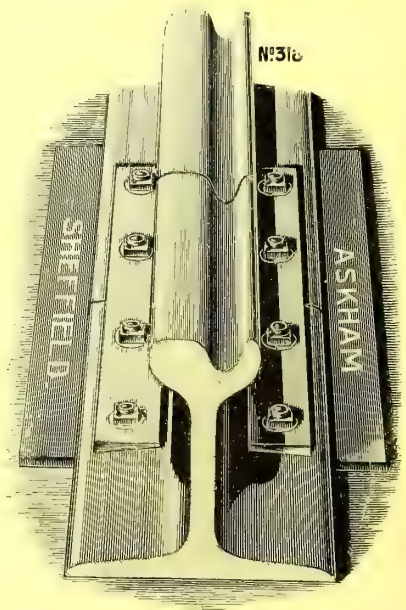


...FOR...
DRAINING TRAMWAYS
Will Save its Cost in Six Months



LEVEL X-OVER AS LAID IN HULL

THIS WORK IS OUR SPECIALTY



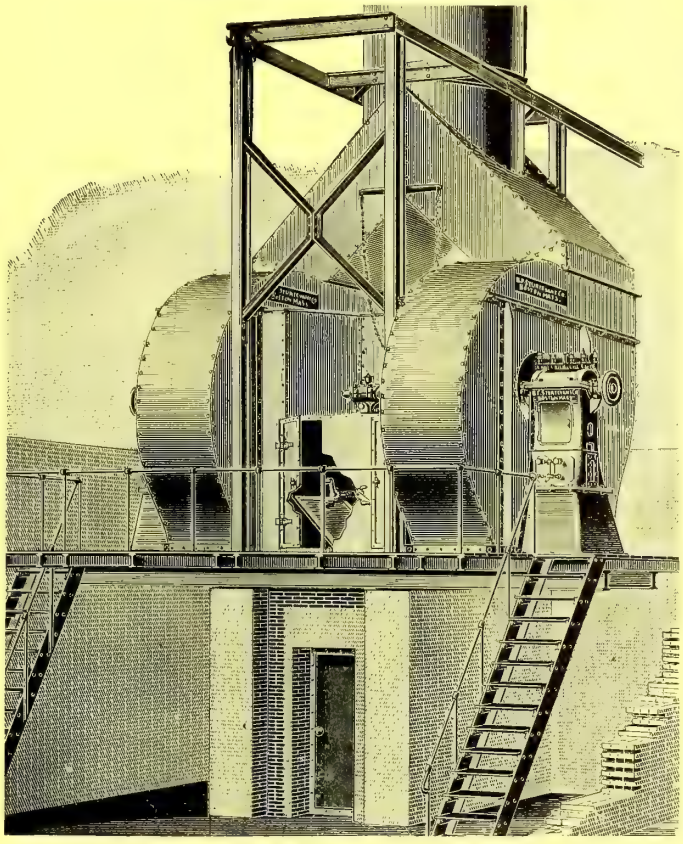
PATENT JOINT PLATES
AN ABSOLUTE NECESSITY

CABLE ADDRESS, "ASKHAM SHEFFIELD"

SHEFFIELD, ENGLAND

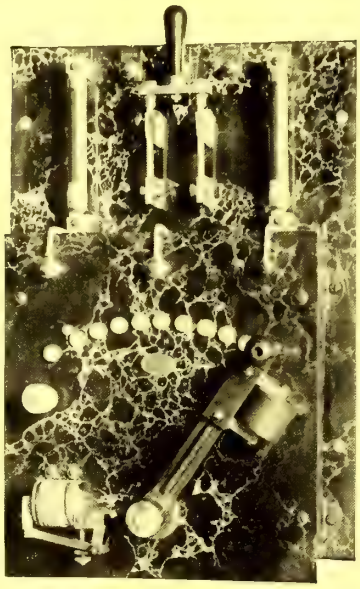
STURTEVANT FANS

FOR MECHANICAL DRAFT



Induced Draft Fan

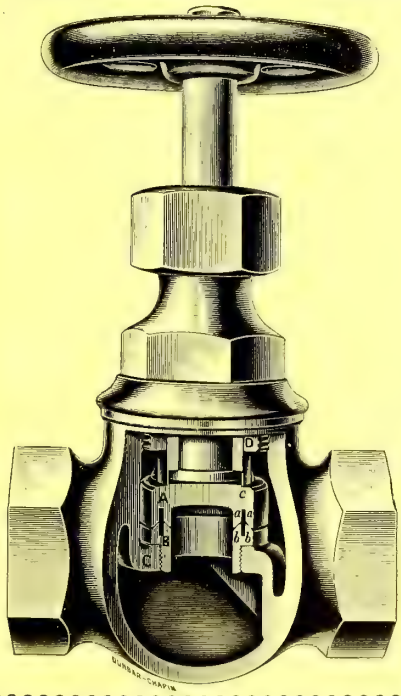
Cutler-Hammer
Motor Starting Switches
and
Speed Regulators



Universal Motor Starting Switch

STURTEVANT ENGINEERING CO., 75 Queen Victoria Street, London

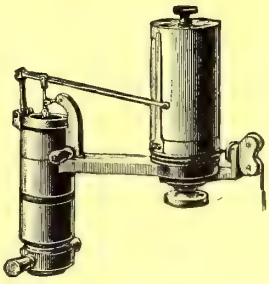
GLASGOW	BERLIN	STOCKHOLM	MILAN	AMSTERDAM
21, West Nile Street	4, Neue Promenade	2, Kungsholmstorg	4, Via Dante	745, Keizersgracht



CROSBY SPRING SEAT GLOBE AND ANGLE VALVES

For HIGH PRESSURE STEAM

With Renewable Seat and Disc



CROSBY STEAM ENGINE INDICATOR

Crosby Steam Gage and Valve Co.

75 Queen Victoria Street, London, E. C.

WORTHINGTON PUMPING ENGINE CO.

153, Queen Victoria Street, London, E.C.

TELEGRAMS:
"PUMPING, LONDON."
TELEPHONE:
614 BANK.

WORTHINGTON
TRADE MARK.

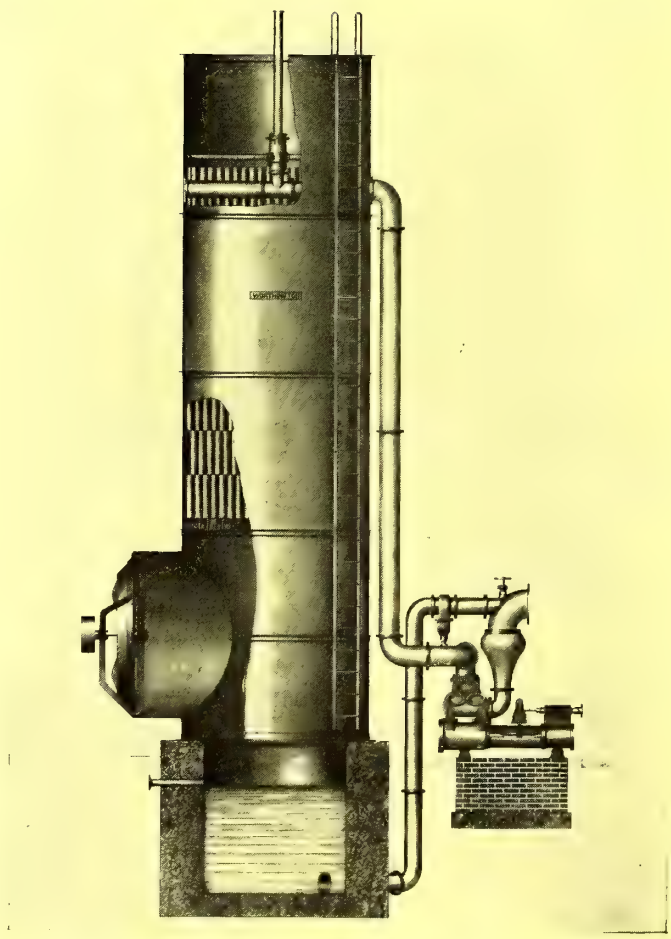
CODES USED:
"A I," "A B C,"
AND LIEBER'S.

COOLING TOWERS.

These Towers are made to work with either Natural or Fan Draught in connection with Condensers of Surface or Jet Type.

Are Suitable for any condition of Climate.

Are Reliable, Efficient, and Economical.



Small Space Required.

Can Stand on Ground or Roof.

All the Advantages of Condensing to be obtained in places where water is scarce.

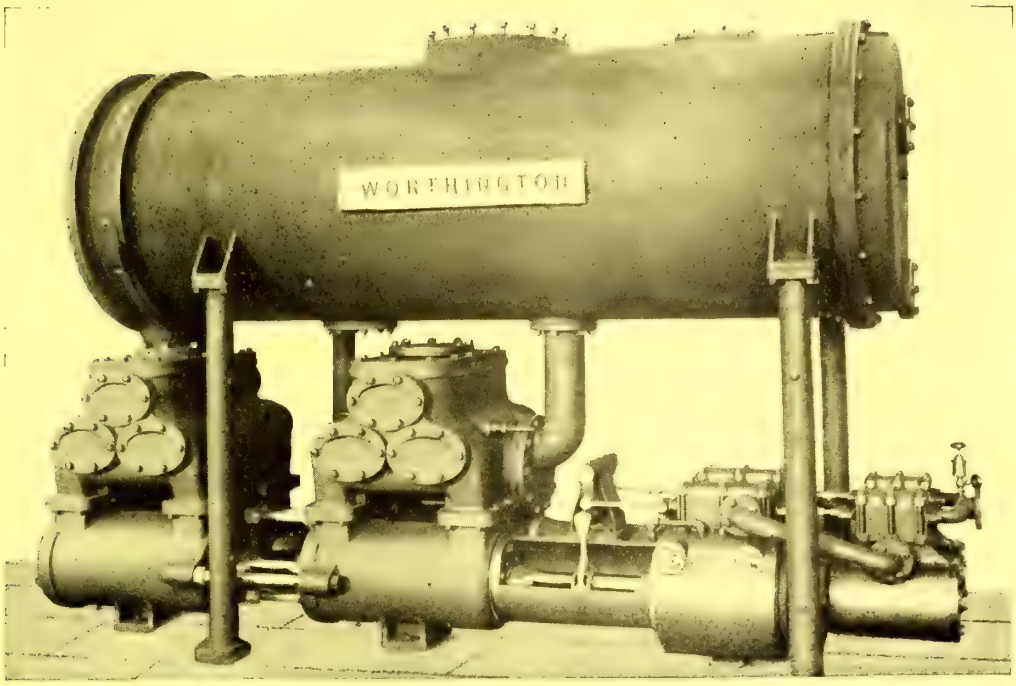
Water Required never exceeds amount necessary for Boiler Feeding Purposes.

Feed Heaters. Water Meters.

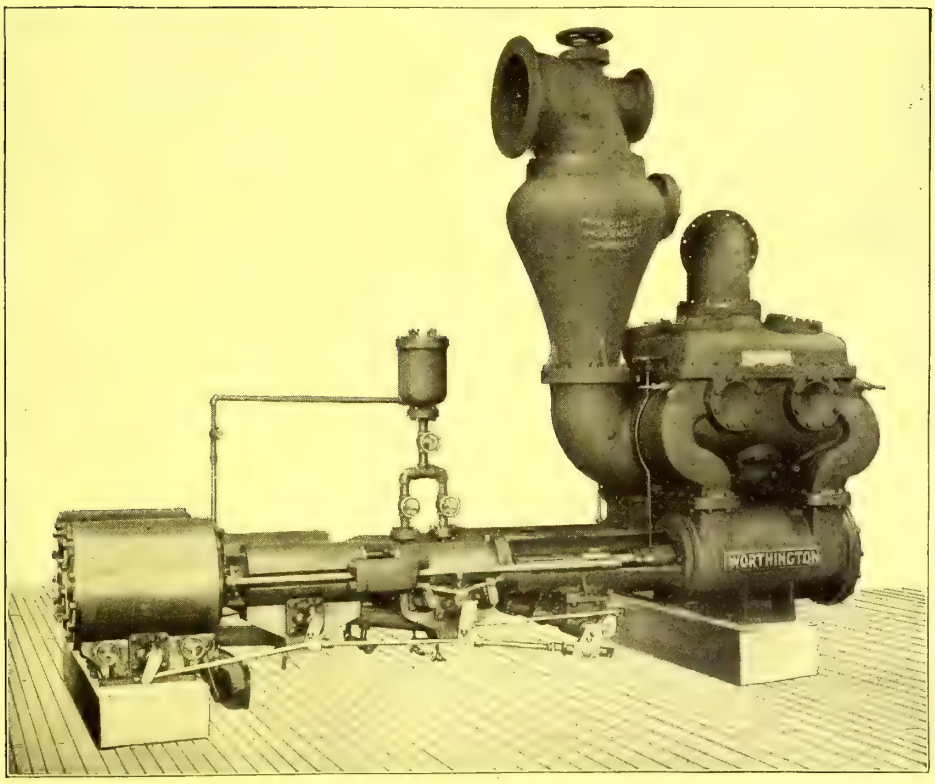
Water Motors.

ILLUSTRATED CATALOGUE ON APPLICATION.

WORTHINGTON CONDENSING PLANT



COMPOUND SURFACE CONDENSER WITH AIR AND CIRCULATING PUMPS.



TRIPLE EXPANSION INDEPENDENT JET CONDENSER.

WORTHINGTON

TRADE MARK.

Branch Offices:

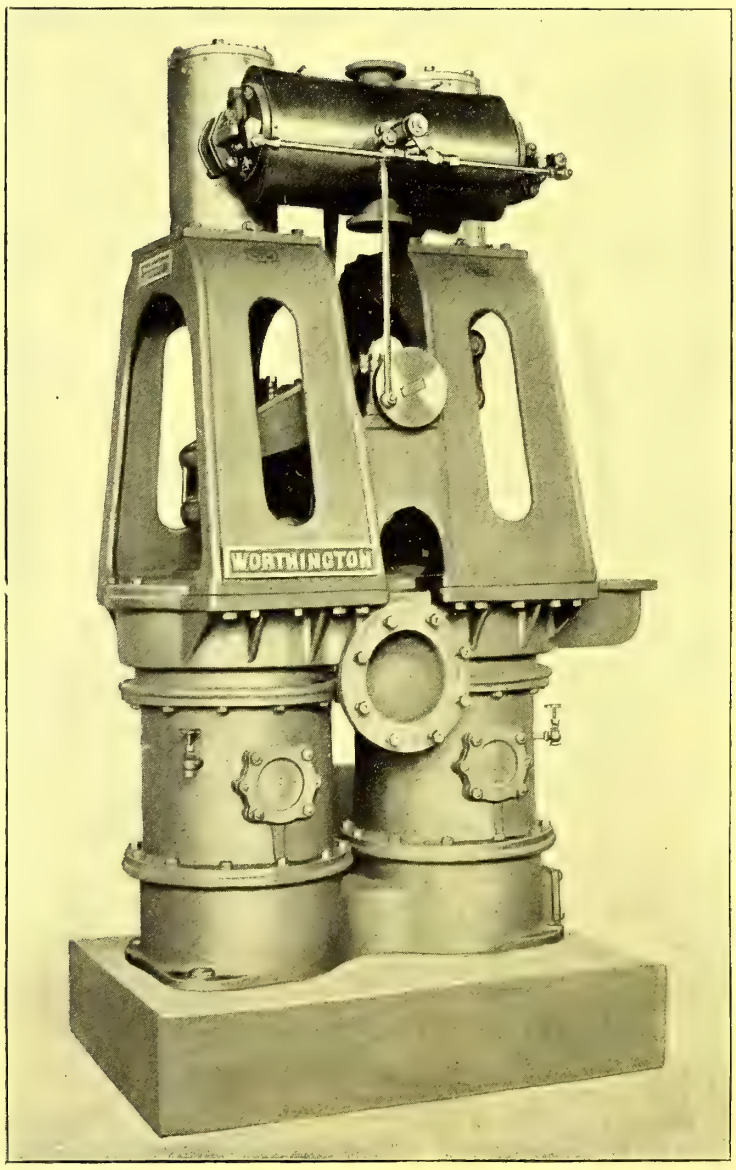
BIRMINGHAM: 13, Temple St.
NEWCASTLE-ON-TYNE: 50, Side.
COPENHAGEN: 28, Bredgade.
GLASGOW: 21, West Nile St.
CALCUTTA: 99, Clive Street.
MANCHESTER: 8 Exchange Street.
AMSTERDAM: Keizersgracht, 745.
JOHANNESBURG: Loveday Street.
ST. PETERSBURG: 27, Great Morskoy.
SYDNEY: 32, Clarence Street.

COMPAGNIE FRANÇAISE DES POMPES WORTHINGTON, Société Anonyme.
Paris: 43, Rue Lafayette. Brussels: 12, Boulevard du Nord.

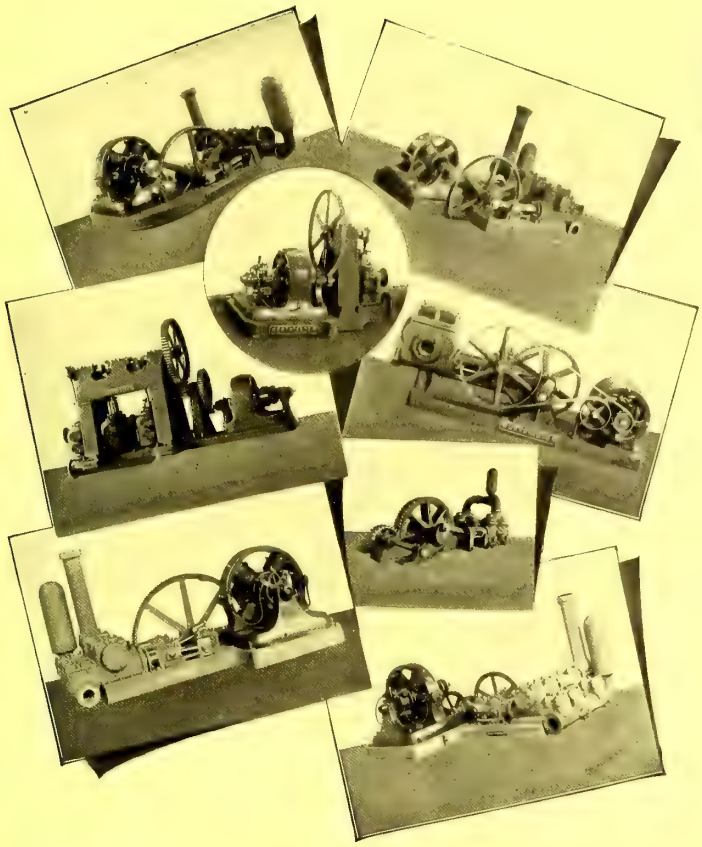
WORTHINGTON PUMPEN COMPAGNIE, Actien-Gesellschaft. Berlin, C.: 48, Kaiser Wilhelm Strasse.

ACTIEN-GESELLSCHAFT FÜR WORTHINGTON PUMPMASCHINEN.
Vienna: Reichsraths Strasse, 7. Budapest: VI Terez Körut, 37.

SOCIETÀ POMPE WORTHINGTON. Milan: Via Dante, 4. Naples: Corso Garibaldi, 353-357.



Vertical Beam Air Pump.



Electrically Driven Pumps in Great Variety.

WORTHINGTON

TRADE MARK.

Steam Pumps:

Horizontal or Vertical,

Positive in Stroke and

Certain in Action,

With Simple, Compound or

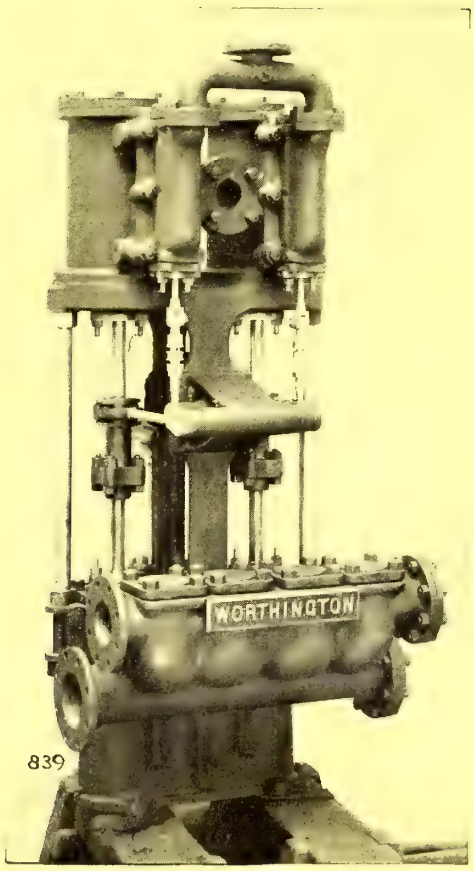
Triple Expansion

Steam Cylinders;

Any Capacity,

Any Pressure, and for

All Services.



THE

WILLANS Central Valve ENGINE

SPECIALLY ADAPTED FOR

ELECTRIC TRACTION.

Already 16,000 H.P. in use and on order for

Electric Traction in the United Kingdom,

AMONG WHICH ARE

8 Engines of 1,200 H.P. for Liverpool Trams.

OTHER USERS ARE

St. Helen's Corporation	= =	1,080 H.P.
Bradford "	= =	2,800 "
City and South London Railway	=	1,150 "

Etc., Etc.

Specialties.

DURABILITY, ECONOMY,
GOOD GOVERNING, STEADY RUNNING,
FREEDOM FROM REPAIRS,
SMALL SPACE OCCUPIED,
INTERCHANGEABILITY OF PARTS.

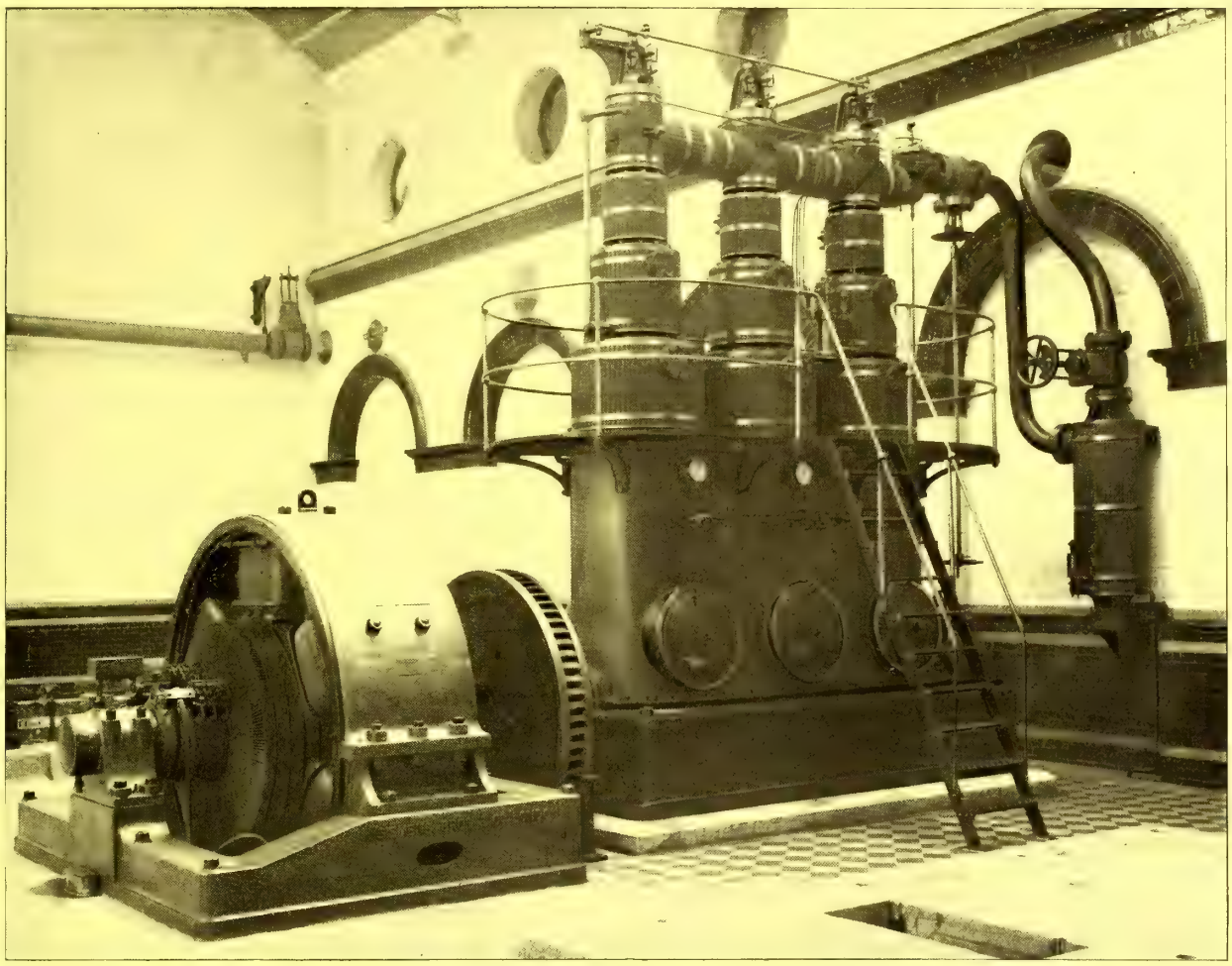
WILLANS & ROBINSON, LD., RUGBY, ENGLAND.

THE

WILLANS CENTRAL VALVE ENGINE

FOR

ELECTRIC TRACTION.



700 H. P. ENGINE and DYNAMO.

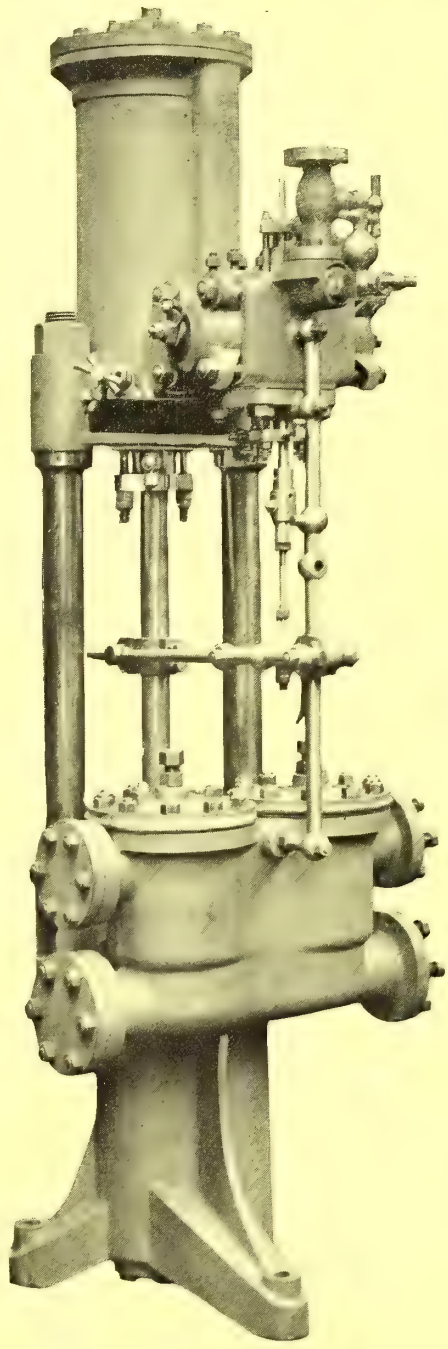
For

Bradford Corporation Electric Trams.

WILLANS & ROBINSON, Limited,

RUGBY, ENGLAND.

The WEIR Patent Direct Acting FEED PUMP



FOR

High Pressure Boiler-Feeding

IS THE

HIGHEST GRADE FEED PUMP
ON THE MARKET.

More Economical on Over-all Duty than Motor-Driven Pumps.

MORE RELIABLE, LESS EXPENSE,
SMALL SPACE, NOISELESS.

BOILERS OF OVER

Eleven Million I. H. P.

NOW BEING FED BY THIS PUMP.

ADOPTED BY

SEVENTEEN GOVERNMENTS

Universally used in the Mercantile Marine, and now being fitted in the latest Electric Light and Power Stations.

Boiler-Feeding IS OUR SPECIALTY.

LONDON OFFICE: 78 Billiter Buildings, E. C.

G. & J. WEIR, Ltd.,

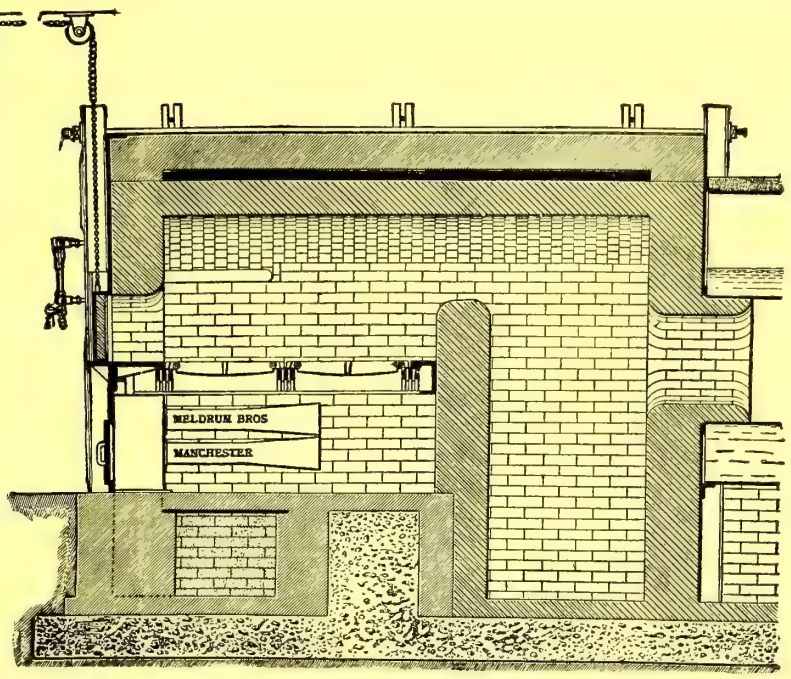
THE LARGEST FEED PUMP WORKS IN EUROPE.

CATHCART, GLASGOW.

The Meldrum Patent Simplex

DESTRUCTOR

FOR BURNING TOWN'S REFUSE



The Utilization of Towns' or Colliery Refuse for some practical purpose has been successfully solved, and there is, therefore, no reason why every township should not have its own Electric Light Installation, and obtain all the power from its dust bins.

At Hereford City the Sewage Farm is now worked entirely with power from refuse, 1¼ million gallons being pumped per day, besides Sludge Presses, Sludge Pump, and Lime Mixers, the saving in cost of coal (not now used) being about £300 per annum.

ORDERS IN HAND FOR DARWIN ELEC. WORKS, BURTON, SHIPLEY, HUNSTANTON, BLACKBURN, &c., &c.

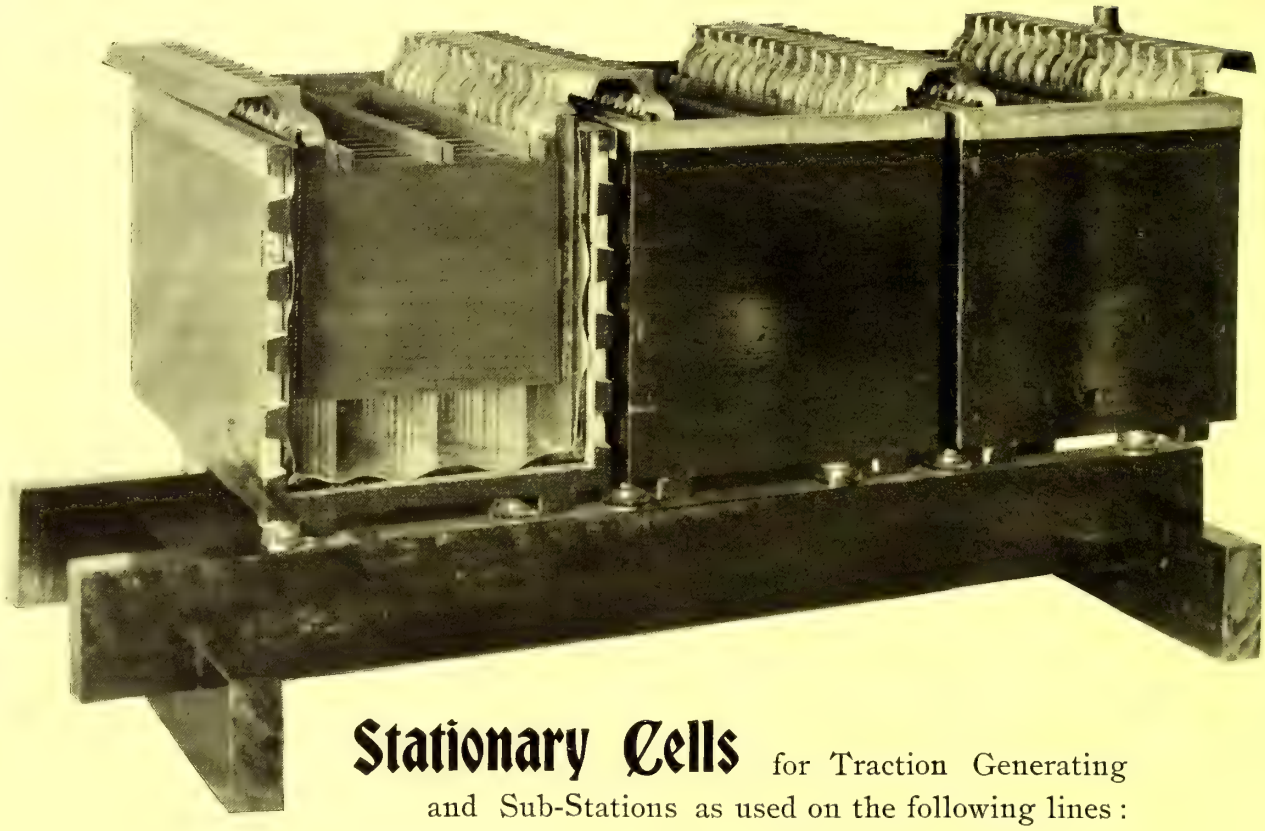
Write for full particulars, stating weight of refuse per annum, and for what purpose you would wish to use the power, when we shall be glad to submit a suitable scheme.

MELDRUM BROS.

Atlantic Works, Manchester, England

TUDOR ACCUMULATORS,

Specially Suited for Traction Work.



Stationary Cells for Traction Generating and Sub-Stations as used on the following lines:

Southampton Tramways.
Plymouth Tramways.
Middlesboro Tramways.
City and South London Ry.
Hill of Howth Electric Ry.
Brighton and Rottingdean Ry.

Special Portable Cells combining LIGHT WEIGHT with HIGH RATES of Charge and Discharge, as used at Paris, Berlin, Hanover, Dresden, etc., etc.

Catalogues, prices and full particulars on application to

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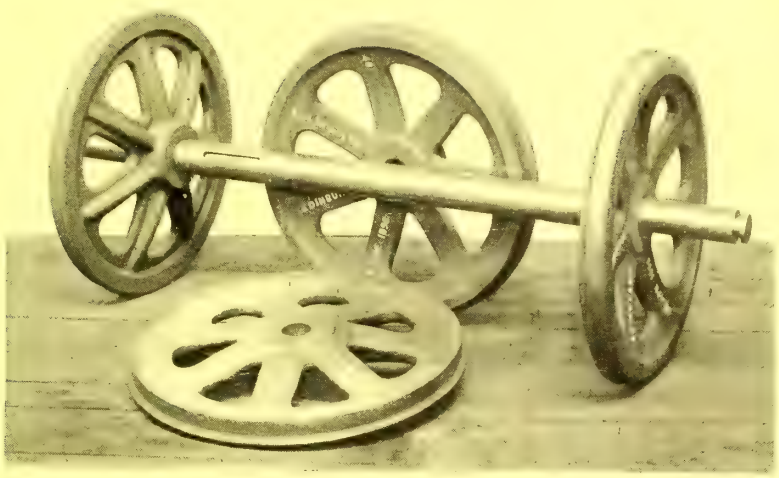
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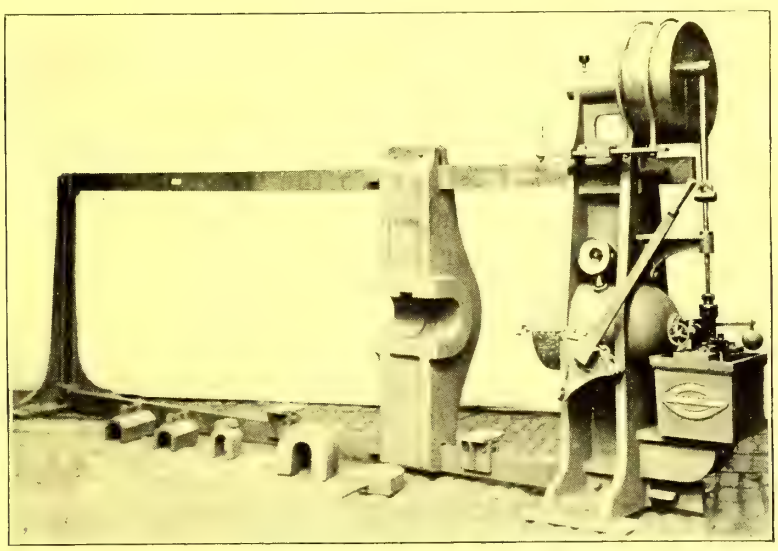
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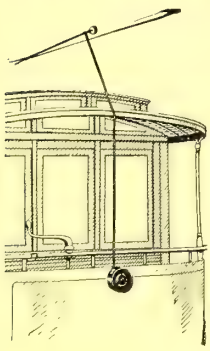
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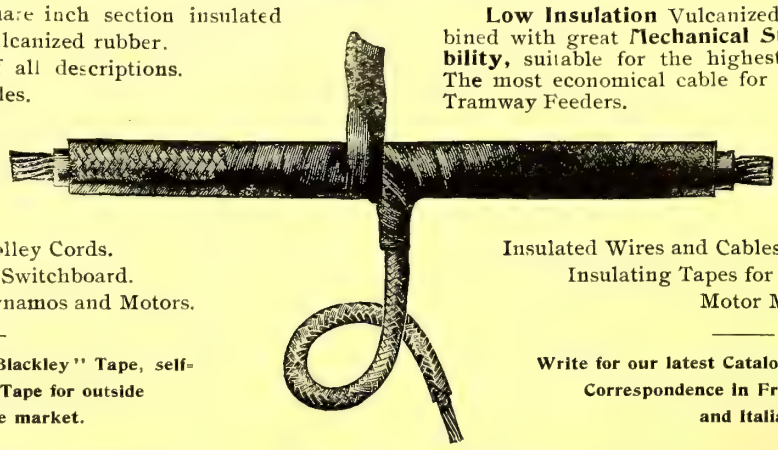
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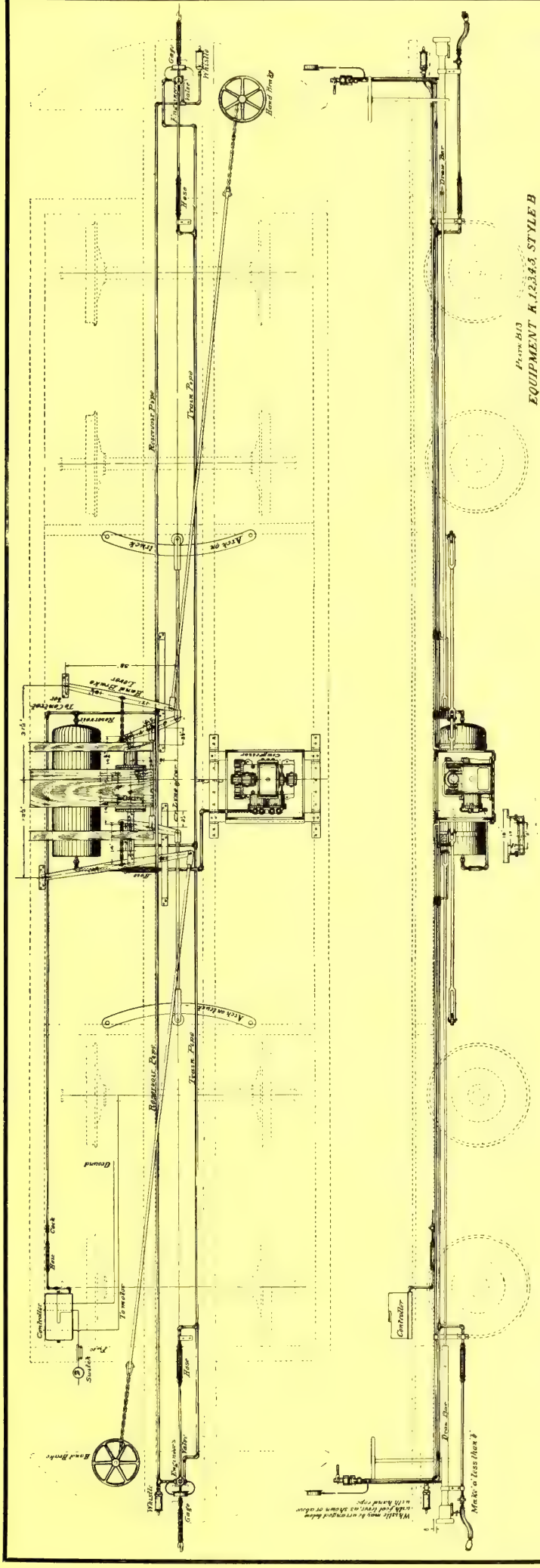


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Fox River Valley Electric Ry. Co.,	Appleton, Wis.
Detroit, Lake Shore & Mt. Clemens Ry. Co.,	Detroit, Mich.
Suburban Railway Co.,	Chicago, Ill.
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Cripple Creek District Ry. Co.,	Cripple Creek, Col.
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Lowell, Lawrence & Haverhill Ry. Co.,	Lowell, Mass.
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See also pages 204 and 205.

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THE STANDARD AIR BRAKE CO.

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Motor Driven Compound Compressors

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SEE ALSO ADVERTISING PAGES 206 AND 207

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VGL. S. 150 UND 151.

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VÉANSE PÁGINAS 150 Y 151

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VOIR AUX PAGES 150 ET 151

DEALERS in everything for electric railways, and a number of steam railroad specialties.

We solicit correspondence in relation to acting as purchasing agent for supplies for corporations or firms. By this method all your account will practically be with one concern, and you will thus save money, time and trouble.

Write us and send for our catalogue.

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Wir ersuchen Sie, sich mit uns in Verbindung zu setzen, da wir behufs Lieferungen für Korporationen oder Firmen als Kaufagent fungiren. Mit Hülfe dieses Verfahrens brauchen Sie thatsächlich nur mit einem Concern abzurechnen und sparen auf diese Weise Zeit und Mühe.

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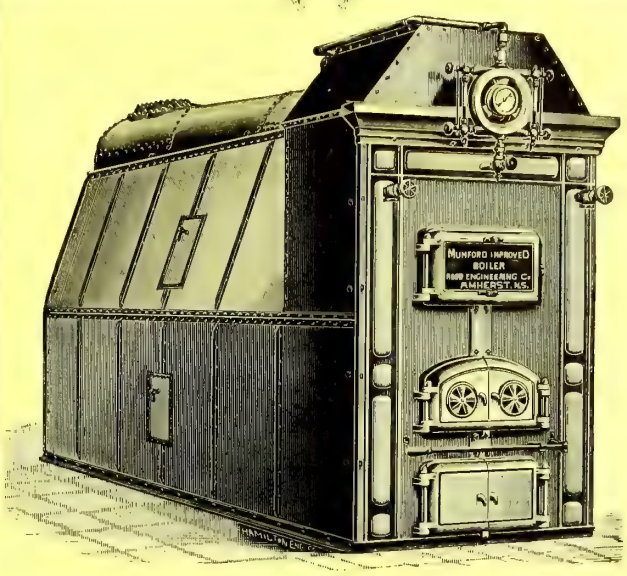
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See pages 233 and 261 of this issue.



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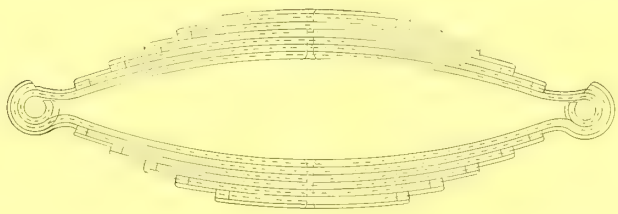
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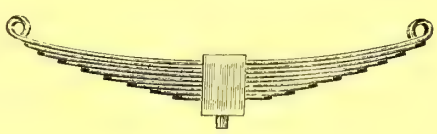
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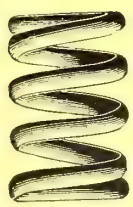


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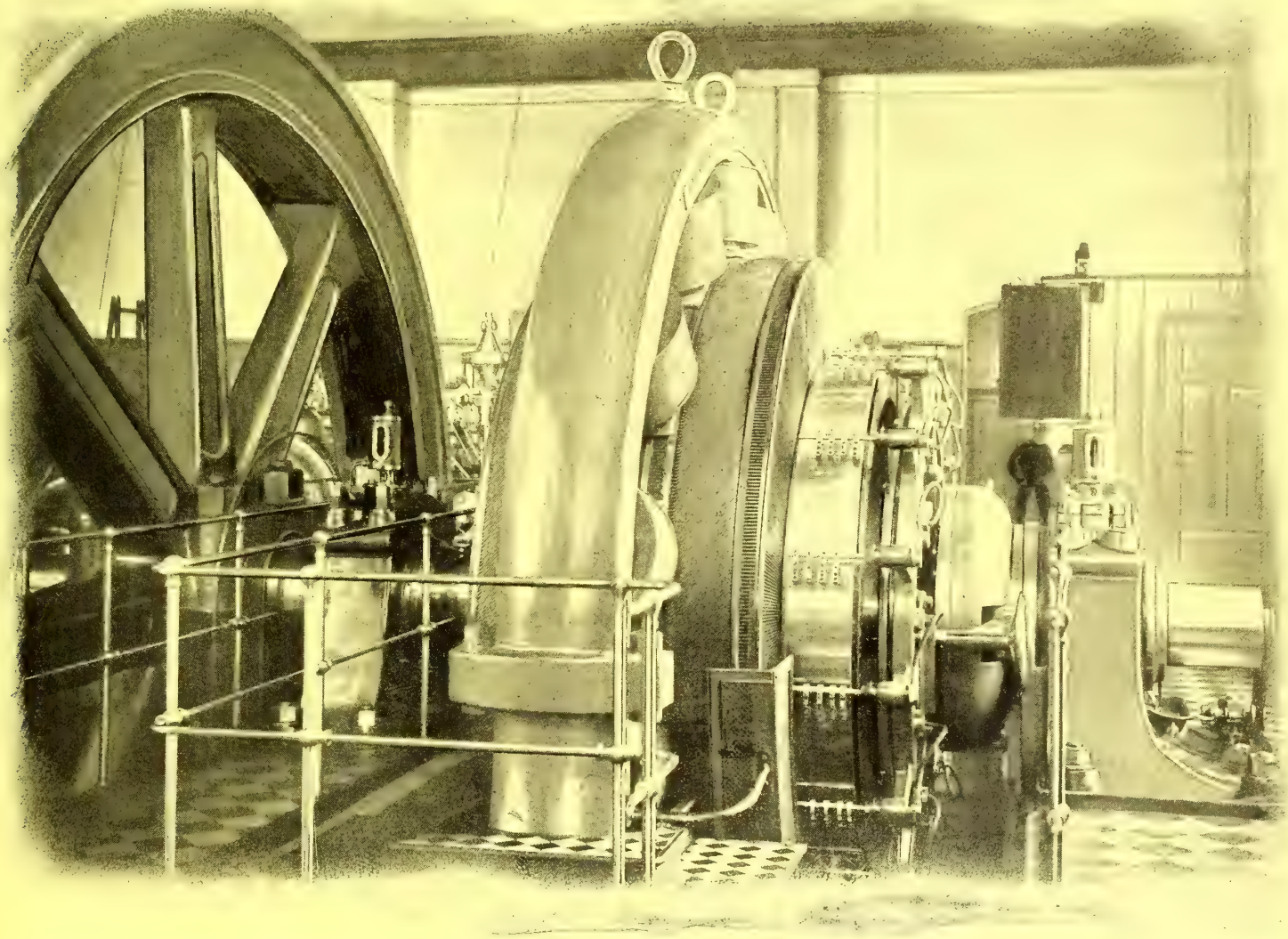
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Motive Power ...Systems...

Street Railway Journal
October, 1899

FOR ALPHABETICAL INDEX TO ADVERTISERS, SEE PAGES 23-25

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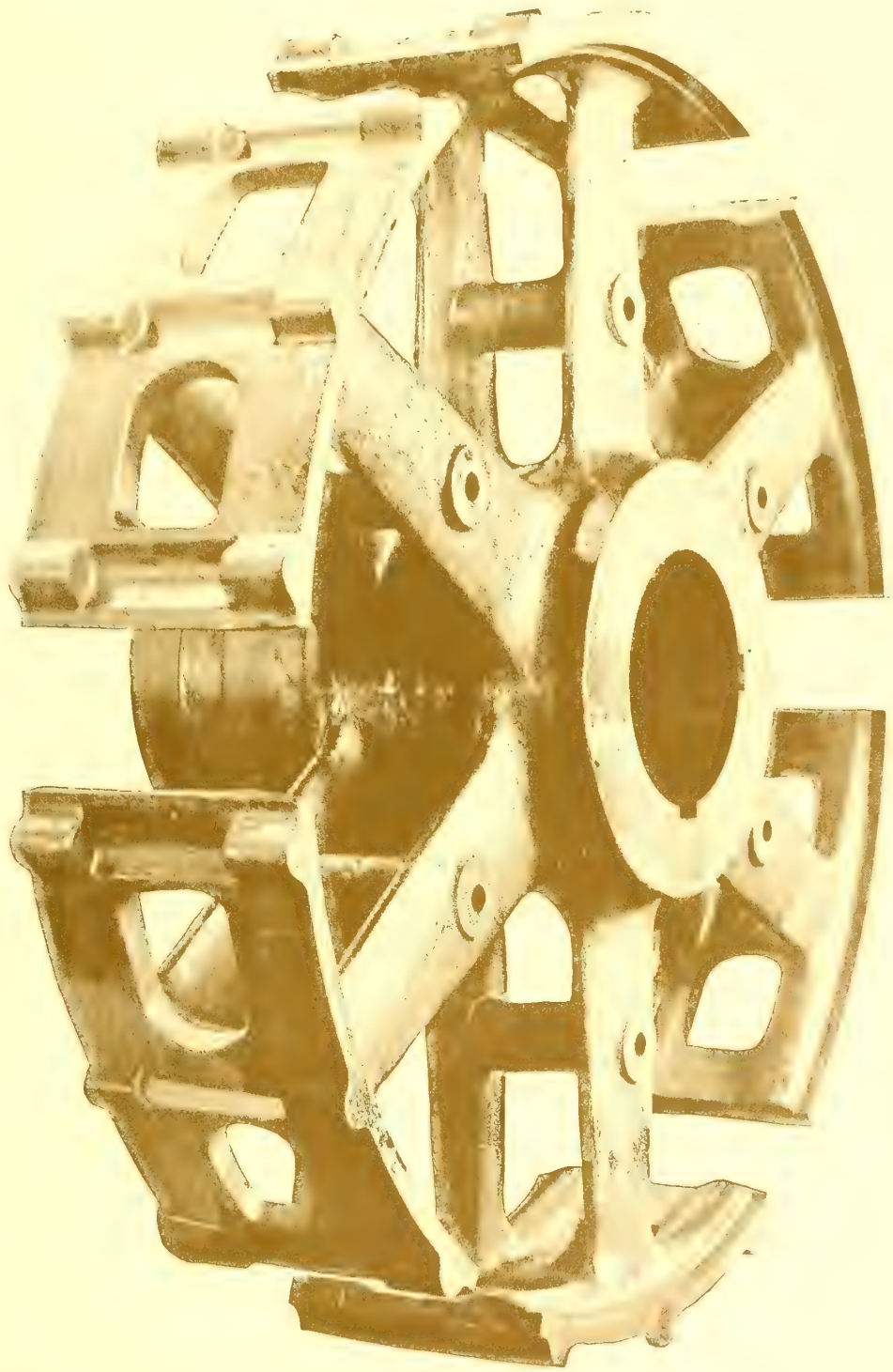
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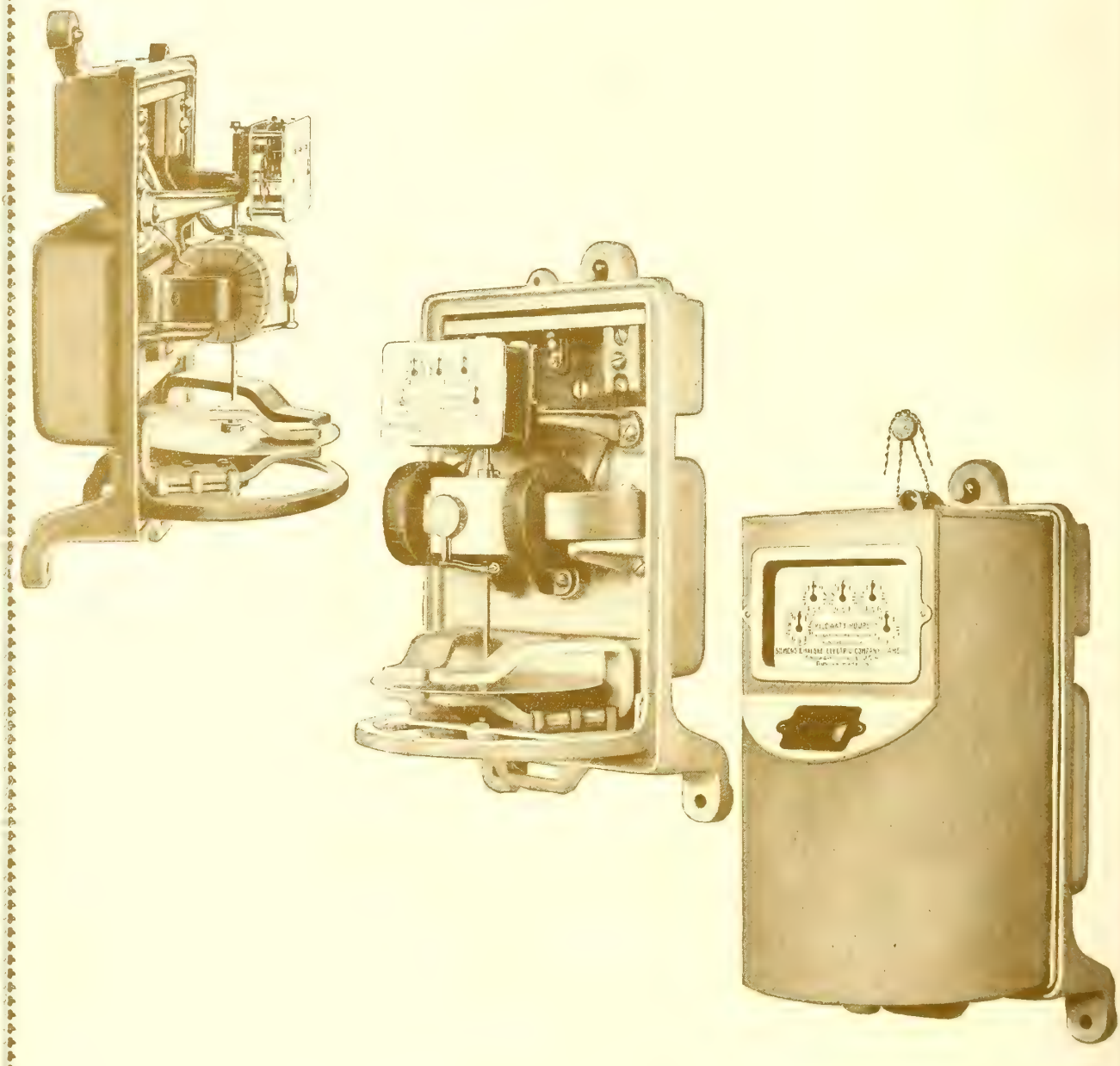
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THE UNION TRACTION CO., OF PHILADELPHIA

INSTALLED ITS FIRST BATTERY OF . . . . .

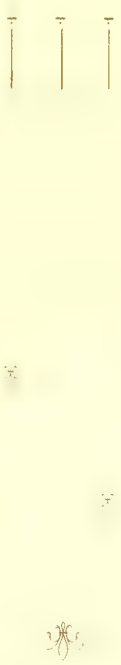
Chloride Accumulators

IN JULY, 1896

AND HAS RECENTLY CONTRACTED FOR FOUR ADDITIONAL BATTERY PLANTS

Among the other Street Railway Lines operating or being equipped with Chloride Accumulators, are:

Barre-Montpelier Traction & Power Company, Barre, Vt.
Bergen County Traction Company, Undercliff, N. J.
Black River Traction Company, Watertown, N. Y.
Buffalo Street Railway Company, Buffalo, N. Y.
Camden & Suburban Street Railway Company, Camden, N. J.
Camden & Suburban Street Railway Company, Haddonfield, N. J.
Central Railway Company, Baltimore, Md.
Chicago & Milwaukee Street Railway Company, North Chicago, Ill., Highwood, Ill., and Winnetka, Ill.
Consolidated Traction Company, Pittsburg: Oakland Street station, Duquesne Garden station, and East Liberty station.
Easton Edison Company, Easton, Pa.
Framingham Union Street Railway Company, Framingham, Mass.
Huntington Street Railway Company, Huntington, L. I.
Laconia Street Railway Company, Laconia, N. H.
La Capital Tramways Company, Buenos Ayres, Argentine.
La Capital Tramways Company, Buenos Ayres, Argentine. Second battery.
Long Island Railway Company, Hammel's Station, L. I.
Metropolitan Street Railway Company, New York: Twenty-third Street station, Thirty-second Street station, Fiftieth Street station, and 146th Street station.
Metropolitan Railroad Company, Washington, D. C.
Metropolitan Railroad Company, Washington, D. C. Second battery.
New Brunswick Traction Company, Metuchen, N. J.
New Brunswick Traction Company, Bound Brook, N. J.
Norfolk & Western Street Railway Company, Westwood, Mass.
North Abington Light & Power Company, North Abington, Mass.
Ottawa Electric Company, Ottawa, Ont.



Passaic Valley Electric Street Railway Company, Point, R. I.
Pawtucket Electric Company, Pawtucket, R. I.
Peekskill Traction Company, Peekskill, N. Y.
Philadelphia & West Chester Traction Company, Llanerch, Pa.
Potomac Electric Power Company, Washington, D. C.
Rochester Street Railway Company, Rochester, N. Y.
Sanford & Cape Porpoise Railway Company, Sanford, Maine
South Side Elevated Railway Company, Chicago: Twelfth Street station, Sixty-first Street station.
Standard Electric Company, San Francisco, Cal. First battery.
Standard Electric Company, San Francisco, Cal. Second battery.
Standard Electric Company, San Francisco, Cal. Third battery
Standard Electric Company, San Francisco, Cal. Fourth battery.
Union Railroad Company, Pawtucket, R. I.
United Traction Company, Pittsburg, Pa.
Union Electric Railway Company, Dover, N. H.
Union Traction Company, Philadelphia, Pa.: Chestnut Hill station, Thirty-second and Dauphin Streets station, Fifth and Lombard Streets station, Ninth and Dauphin Streets station, and Germantown and Erie Avenues station.
Waterloo & Cedar Falls Rapid Transit Company, Waterloo, Iowa.
Worcester & Suburban Street Railway Company, Leicester, Mass.
Worcester & Suburban Street Railway Company, Worcester, Mass.
Woonsocket Electric Machine & Power Company, Woonsocket, R. I.
Woronoco Street Railway Company, Westfield, Mass.

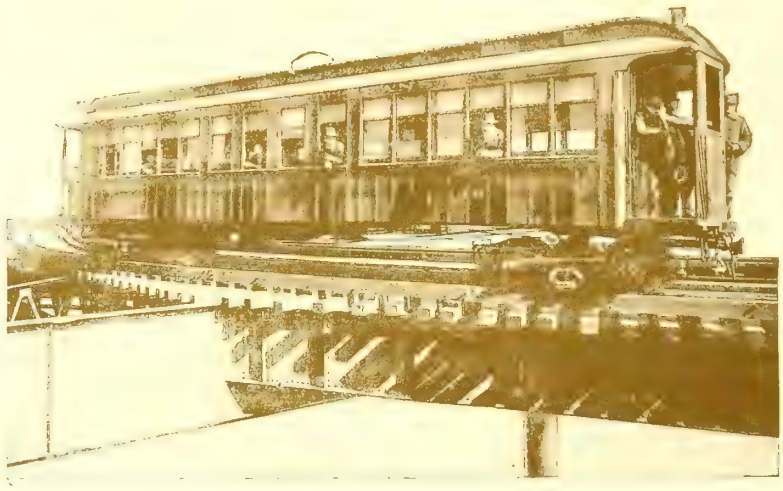
The Electric Storage Battery Company

19th STREET and ALLEGHENY AVENUE — PHILADELPHIA, PA.

... SALES OFFICES ...

NEW YORK: 100 Broadway
BOSTON: 60 State St.
BALTIMORE: Equitable Bldg.
CLEVELAND: New England Bldg.
CHICAGO: Marquette Bldg.
SAN FRANCISCO: The Parrott Bldg.

SPRAGUE



FIRST SPRAGUE CAR ON SOUTH SIDE ELEVATED RAILWAY,
CHICAGO, ILL.—APRIL, 1898

MULTIPLE UNIT



THREE CAR MULTIPLE UNIT TRAIN

SYSTEM

SPRAGUE



BROKEN MULTIPLE UNIT TRAIN—JULY, 1897

ELECTRIC COMPANY



TWO CAR MULTIPLE UNIT TRAIN ON BROOKLYN ELEVATED RAILROAD—1898

20 BROAD STREET
NEW YORK CITY

ANOTHER

VICTORY

for the

TRIUMPH CO.

over

Westinghouse Company

"United States Circuit Court of Appeals affirms decision of the lower court in favor of the TRIUMPH ELECTRIC COMPANY, in suit of Westinghouse Electric and Manufacturing Co. vs. The Triumph Electric Co."

NOTE { THAT WE FULLY PROTECT OUR GUARANTEES

We Manufacture Strictly High Grade

GENERATORS AND MOTORS

Either Belted or Direct Connected up to 500 K. W.

THE TRIUMPH ELECTRIC CO.

BRANCH OFFICES IN ALL LARGE CITIES

Main Office and Factory
CINCINNATI, OHIO

ASK US ABOUT OUR STREET RY. GENERATORS

The Lorain Steel Company

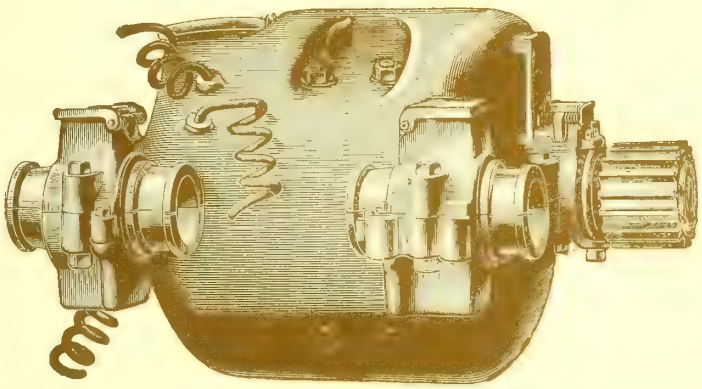
Johnstown, Pa.

Street and Elevated

RAILWAY MOTORS

30 H. P. Motor, 1200 Pounds.

RESULTS OBTAINED in SERVICE are always the MOST CONVINCING.

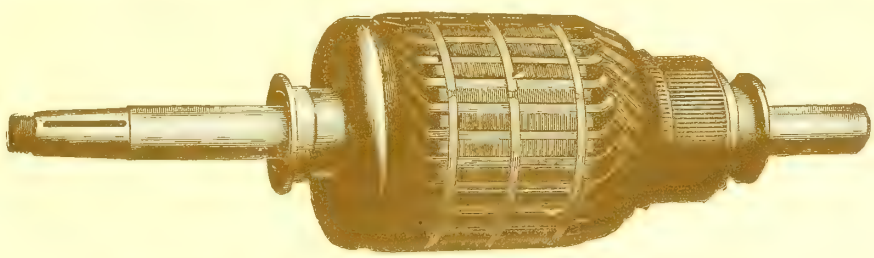


OUR MOTORS are performing the hardest service, therefore they are the best. . . . . .

Mechanical Strength. .
Interchangeable Parts.
Extra Large Bearings.

THE LORAIN STEEL CO. is the ONLY COMPANY

Which has in Successful Operation on the Same Road, Double, Triple and Quadruple Equipments.



ARMATURE, 30 H. P. MOTOR. WEIGHT OF MOTOR, 1200 POUNDS.

Our Motors will Earn Money for the Purchasers, and Represent the Highest Attainment in Motor Construction.

SALES OFFICES:

NEW YORK, Empire Building. PITTSBURGH, Penn Building. CHICAGO, Monadnock Building.
ST. LOUIS, Bank of Commerce Building. ATLANTA, Equitable Building. CINCINNATI, Mitchell Building.

WORKS: Johnstown, Pennsylvania.

REASONS

why the HYDROCARBON MOTOR car is superior to all other methods for the propulsion of street and suburban cars:

FIRST—It can run on any track with any other system, and requires no trolleys or cables, no subterranean or overhead construction.

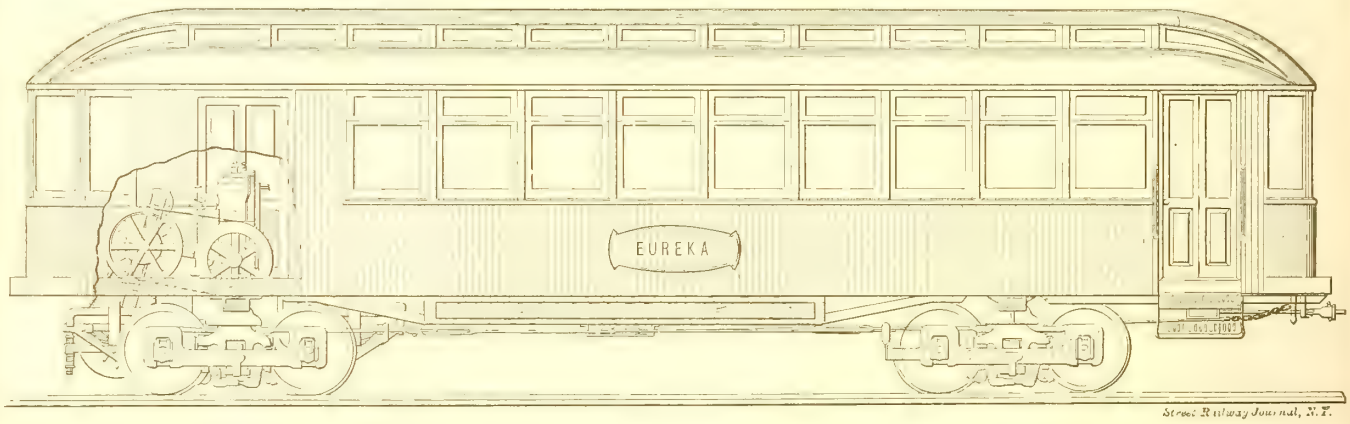
SECOND—It is the cheapest of all systems in cost of equipment and operation.

THIRD—Any accident to one car does not affect any other. The cars can run at any rate of speed and are started or stopped without jars or jerks. There is no noise or unpleasant sensation.

EIGHTH—They cannot be stalled on a railroad crossing in front of an approaching train by loss of power, as frequently happens with electric lines.

NINTH—There are no "deadly line wires," no breaking of cables, no failure of storage battery, no delays; each and every car runs independent and is always ready for use.

TENTH—They avoid all possibilities of accidents and deaths from "live" wires and standard cables.



PLAN OF CAR NOW IN SUCCESSFUL OPERATION.

FOURTH—In operation it only requires a track and car barn.

FIFTH—The motors are all independent, so that no derangement of machinery at a central station can affect any car or cars on the line.

SIXTH—There are no dynamos or motors to be burned out or disabled during electric storms.

SEVENTH—Street blockades, or detention from any cause, cannot reduce the capacity for propulsion. The power remains intact until used, however long the period of suspension.

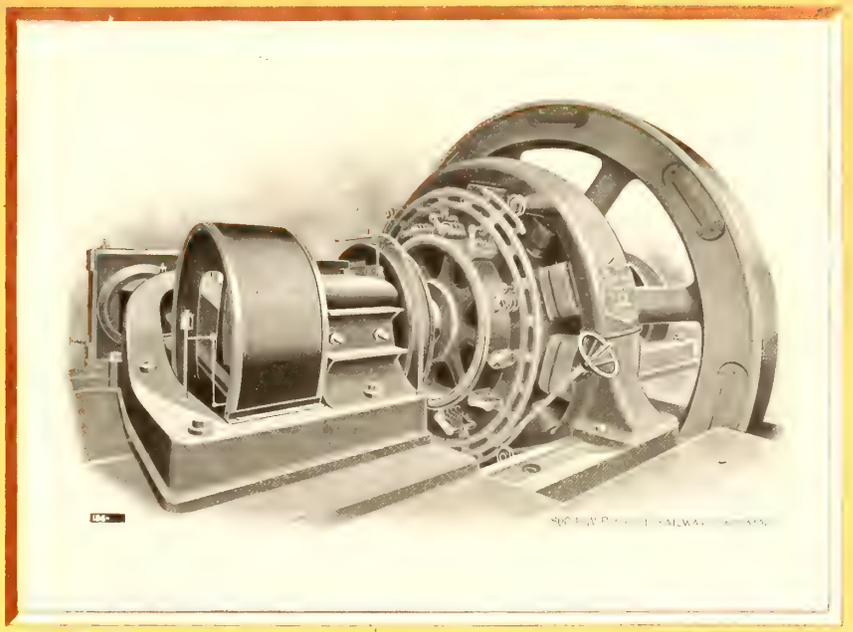
ELEVENTH—The motors are independent and not affected, as in other systems, by the derangement of feed wire or cable lines, broken station machinery, or by electric storms. In times of riot or other disorder, mischievous persons cannot obstruct the running of cars by tampering with the source or the conductors of power.

TWELFTH—That for the operation of city and suburban roads, whether surface or elevated, no other motive power can compare favorably with it, either in first cost, economy of operation, freedom from all objections, or the possession of incidental advantages.

VIMOTUM HYDROCARBON CAR CO.

Great Northern Building, CHICAGO, ILL.

BULLOCK ELECTRIC GENERATORS



BULLOCK ELECTRIC MANUFACTURING CO. CINCINNATI, OHIO, U.S.A.

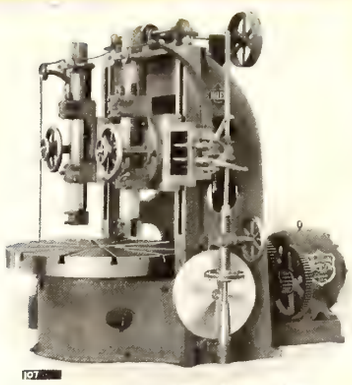
OUR RAILWAY GENERATORS POSSESS THE SAME CHARACTERISTICS THAT HAVE MADE OUR LIGHT AND POWER APPARATUS FAMOUS



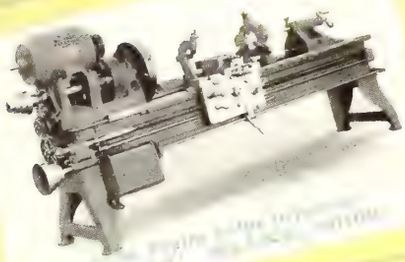
Works of Bullock Electric Mfg. Co.

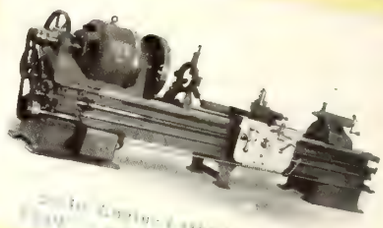
SEND FOR BULLETIN NO. 2734

WE WERE THE PIONEERS IN APPLYING THE MOTOR DIRECTLY TO THE MACHINE TO BE DRIVEN



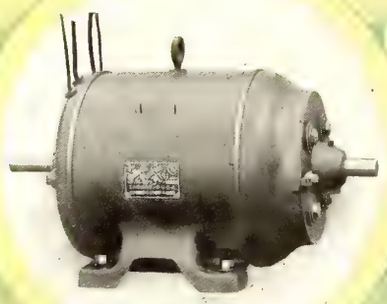
OUR WORKS ARE THE MOST MODERN OF THEIR KIND IN THE WORLD





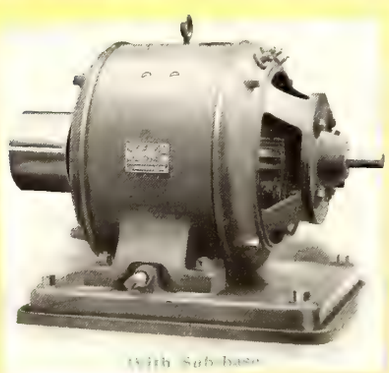
TYPE BULLOCK "N" MOTOR





FULLY DESCRIBED IN BULLETIN No. 2735

THESE MOTORS ARE ADAPTED TO ALL CLASSES OF WORK, MAY BE PLACED UPON CEILING OR WALL, AND EITHER DIRECT-CONNECTED, GEARED OR BELTED TO THE WORK.



THE BULLOCK SYSTEMS OF MOTOR CONTROL PROVIDE FOR EVERY CONTINGENCY AND ARE THE MOST ECONOMICAL TO OPERATE. ALL LOSSES ARE MINIMIZED AND THE SPEED OF MOTORS MAY BE VARIED AT WILL.

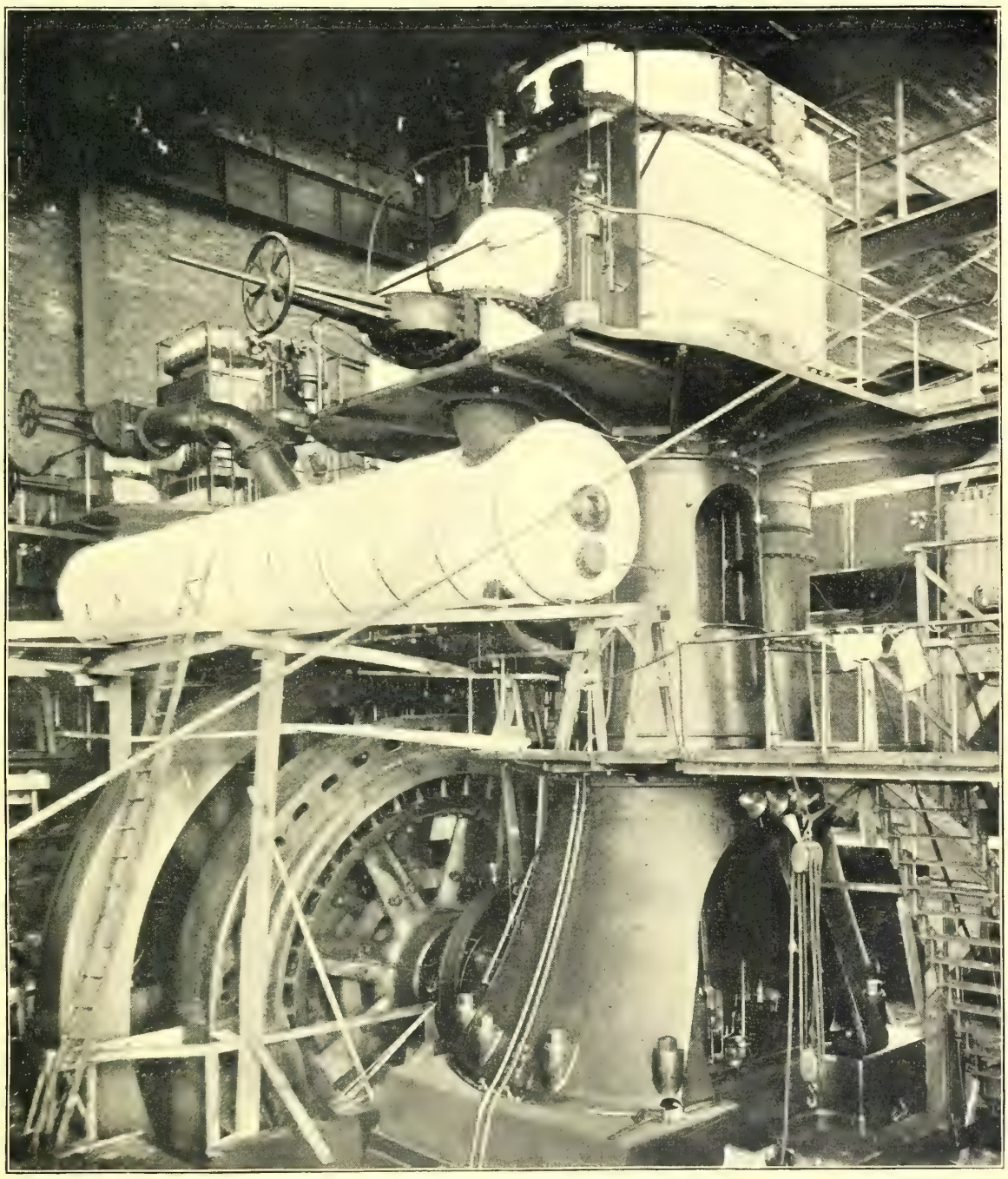
BULLOCK ELECTRIC MANUFACTURING CO.
CINCINNATI, OHIO, U.S.A.

World's Electric Railway Practice

... OF THE ...

GENERAL ELECTRIC COMPANY

I



3500 KILOWATT THREE-PHASE GENERATOR

Metropolitan Street Railway Co.
New York City

Main Office: SCHENECTADY, N. Y.

World's Electric Railway Practice

... OF THE ...

GENERAL ELECTRIC COMPANY

II



250 KILOWATT TRANSFORMER

Buffalo Street Railway

Buffalo, N. Y.

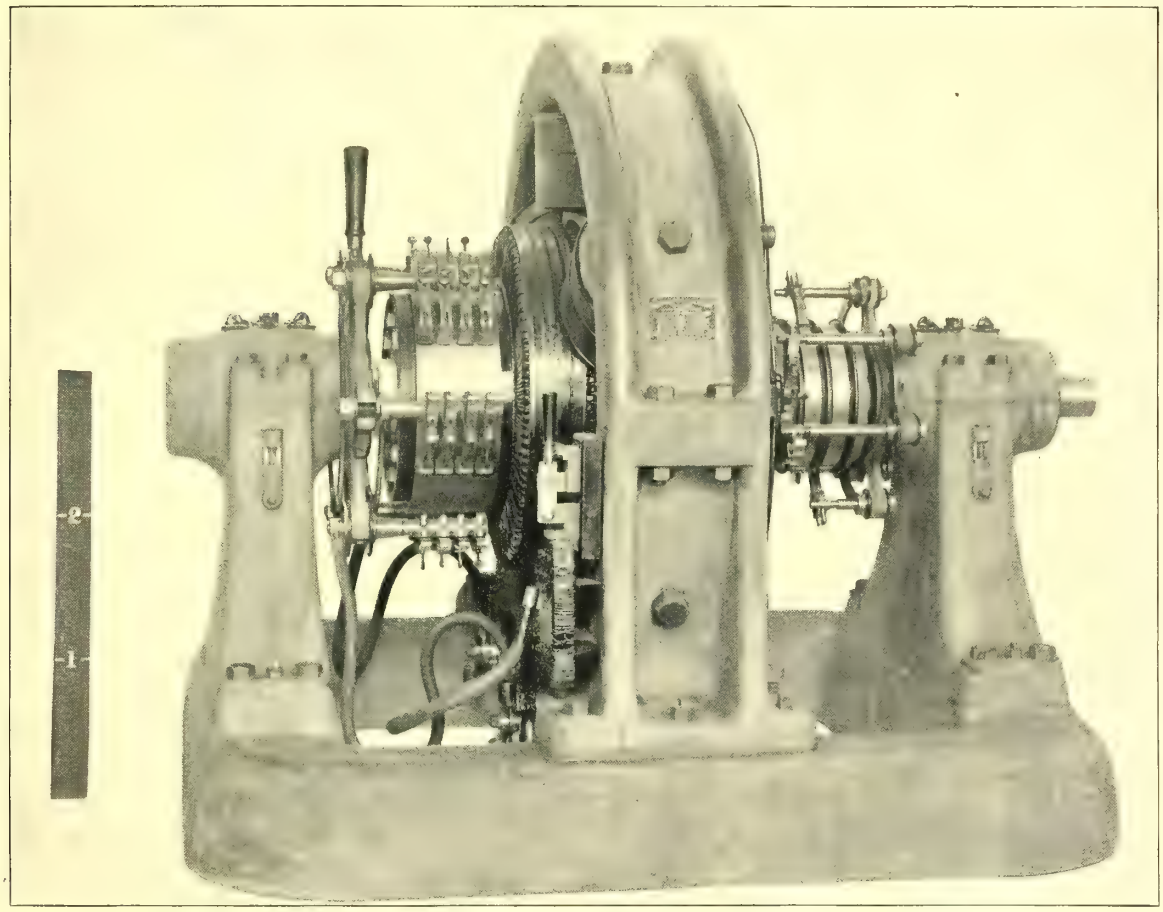
Main Office: SCHENECTADY, N. Y.

World's Electric Railway Practice

... OF THE ...

GENERAL ELECTRIC COMPANY

III



200 KILOWATT THREE-PHASE ROTARY CONVERTER

Dublin United Tramways
Ireland

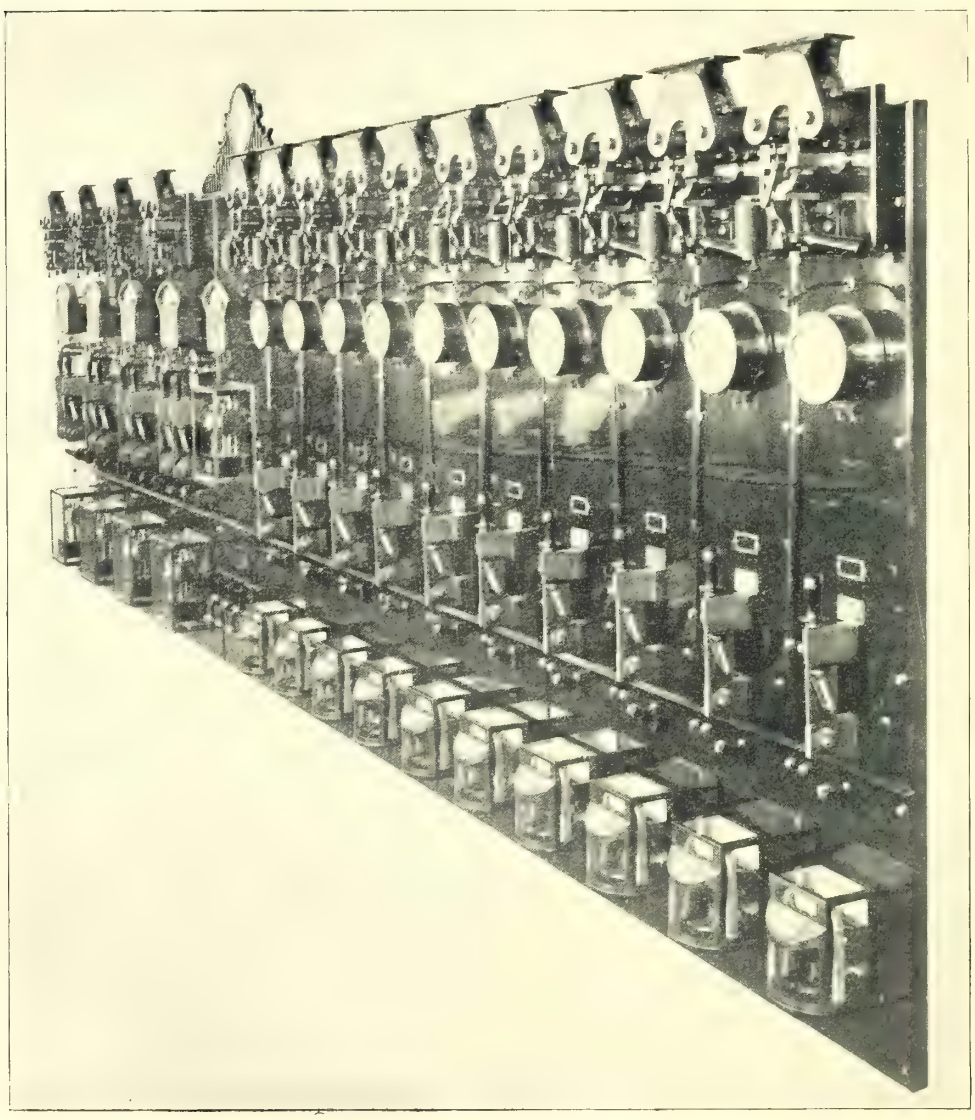
Main Office: SCHENECTADY, N. Y.

World's Electric Railway Practice

... OF THE ...

GENERAL ELECTRIC COMPANY

IV



RAILWAY SWITCHBOARD

Government Tramways
Sydney, N. S. W.

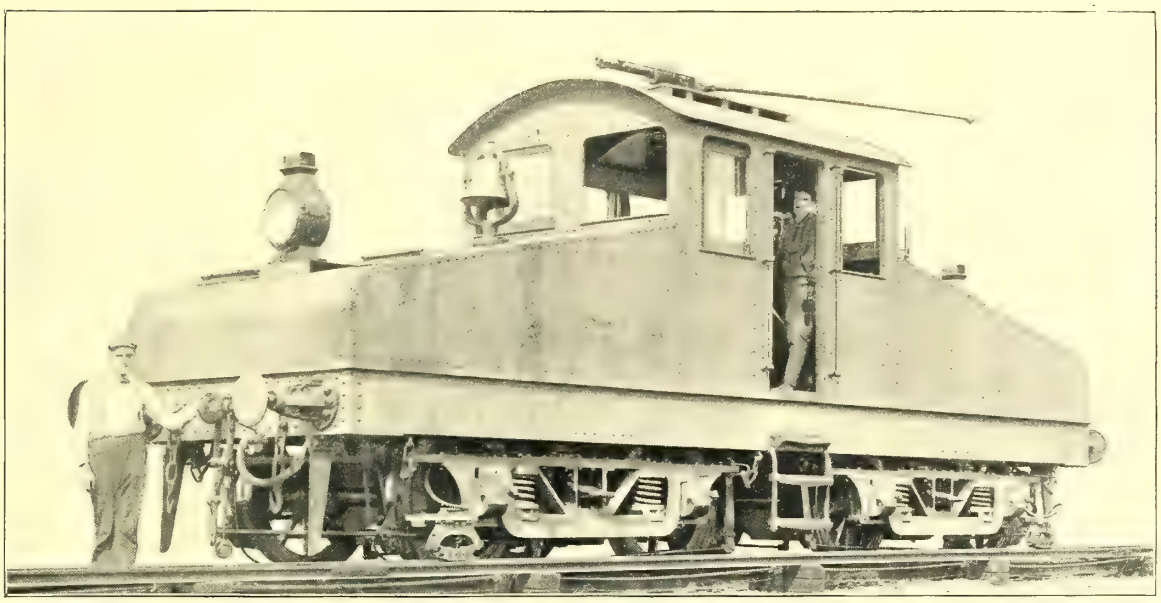
Main Office: SCHENECTADY, N. Y.

World's Electric Railway Practice

... OF THE ...

GENERAL ELECTRIC COMPANY

V



37 TON ELECTRIC LOCOMOTIVE

Built for the Compagnie Francaise
Thomson-Houston
Paris, France

Main Office: SCHENECTADY, N. Y.

World's Electric Railway Practice

... OF THE ...

GENERAL ELECTRIC COMPANY

VI



G E 55 MOTORS

Metropolitan West Side Elevated
Chicago

Main Office: SCHENECTADY, N. Y.

World's Electric Railway Practice

... OF THE ...

GENERAL ELECTRIC COMPANY

VII



G E 800 MOTORS

Cape Town Tramways
South Africa

Main Office: SCHENECTADY, N. Y.

World's Electric Railway Practice

... OF THE ...

GENERAL ELECTRIC COMPANY

VIII



G E 1000 MOTORS

Kioto Tramways
Japan

Main Office: SCHENECTADY, N. Y.

FINANCIAL NOTES

INDIANA

The property and franchises of the Fort Wayne Consolidated Railway Company were sold at receiver's sale Sept. 28, to George A. Garretson, of Cleveland, for $1,092,000. Mr. Garretson represents the bondholders, and his offer was in excess of the appraised value, $564,000. The company will be reorganized and take in Frank de Haas Robinson, former owner of a majority of the stock.

The Indianapolis & Greenfield Rapid Transit Company has increased its capital stock from $1,000,000 to $3,000,000.

IOWA

The Sioux City Traction Company has filed with the Secretary of State an amendment to its articles of incorporation increasing the capital stock of the company from $1,000,000 to $1,200,000.

KENTUCKY

Middendorf, Oliver & Company, of Baltimore, offer for subscription an issue of $737,000 first mortgage, 5 per cent gold bonds of the Lexington Railway Company. The Continental Trust Company is trustee of the mortgage. The Lexington Railway Company is a consolidation of the Passenger & Belt Railway, Belt Line Electric Company, Central Electric Company and the Hercules Ice Company.

LOUISIANA

The New Orleans City Railroad Company reports earnings for

August	1898	1899
Gross receipts	$107,381	$113,410
Operating expenses	76,115	73,669
Earnings from operation	$31,266	$39,741

MINNESOTA

The St. Paul & Suburban Railway Company, of St. Paul, has filed a mortgage for $500,000 in favor of the Central Trust Company, of New York, to secure an issue of bonds.

NEW JERSEY

The New Jersey Transportation & Elevator Company, which is building a monster elevator running from the Hackensack Plank Road, Weehawken, to the top of the bluff at Mountain Road, West Hoboken, at a cost of $100,000, has transferred its stock, placed at that amount, to the People's Elevator Company, controlled by the Shanley syndicate, which also controls the principal trolley roads in New Jersey. The elevator will be used for hoisting trolley cars, wagons and pedestrians to the top of the bluff, and it is rumored that the circuitous elevated trolley structure running from West Hoboken to Hoboken, is to be abandoned and a more direct line to the heights put in operation by running the cars to this elevator at Weehawken and there connecting with a new crosstown line to be built in West Hoboken.

NEW YORK

The property and franchises of the Middletown-Goshen Traction Company, of Middletown, have been sold at receiver's sale to Russell House, representing the bondholders, for $1 over the existing indebtedness of about $310,000. The property consists of 13 miles of electric road, operated through Middletown, Wallkill and Goshen, together with all buildings, cars, machinery and other appurtenances. Also the pleasure resort known as Midway Park, subject to leases, and a farm, of some 94 acres, adjoining. W. B. Royer, who has been acting as receiver of the company, will be made resident manager and treasurer of the company.

The Port Chester Street Railway Company has filed with the Secretary of State a certificate of the increase of its capital stock from $100,000 to $300,000.

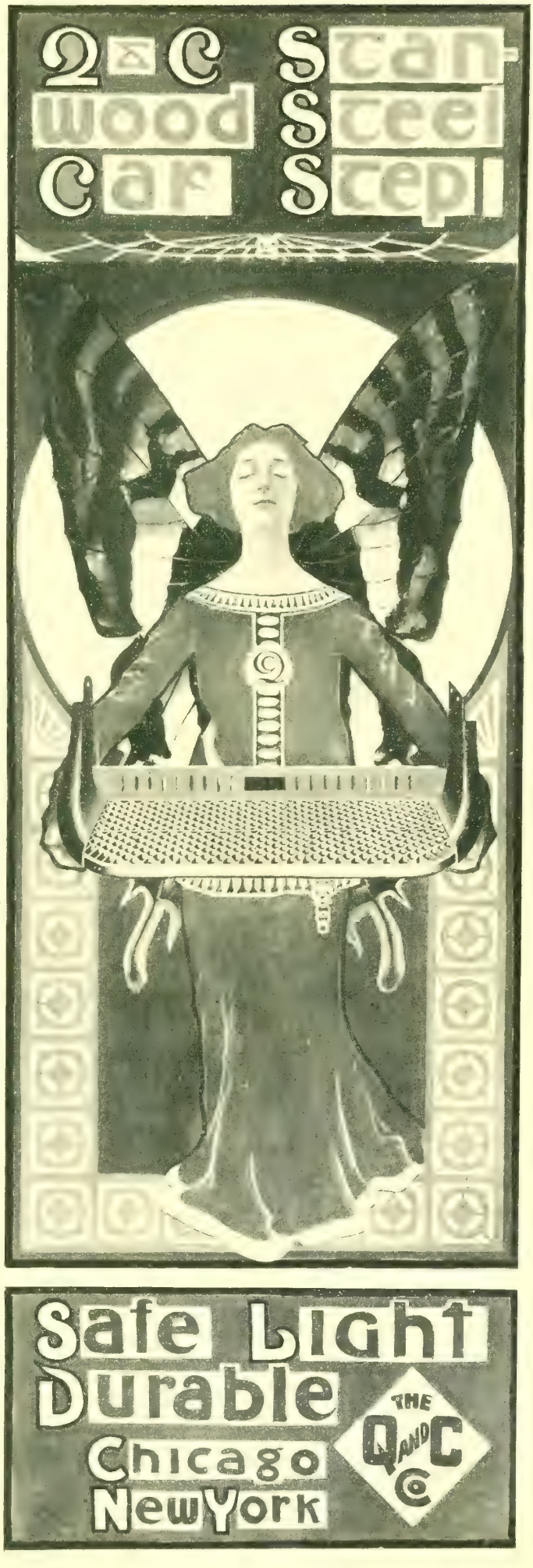
The Metropolitan Street Railway Company, of New York, has declared a dividend of 1¾ per cent, payable Oct. 16.

The Brooklyn Rapid Transit Company has issued the following statement of its earnings for September:

Receipts from passengers.	1898	1899
Brooklyn Heights system	$535,330	$556,891
Nassau system	206,159	193,740
Elevated system	144,532	182,681
Receipts from other sources	26,670	28,912
Receipts total	$912,691	$962,224

Three months ending Sept. 30.

Receipts from passengers.	1898	1899
Brooklyn Heights system	$1,659,956	$1,651,470
Nassau system	684,871	570,595
Elevated system	420,974	534,872
Receipts from other sources	67,016	103,839
Receipts total	$2,832,817	$2,860,776



OHIO

S. M. Bullock, of New York, representing an Eastern syndicate, is said to have purchased the People's Electric Railway, of Sandusky, and the Sandusky, Milan & Norwalk Electric Railway, of Sandusky, for $140,000. The new company is known as the Sandusky, Milan & Norwalk Traction Company, and has filed a mortgage in favor of the State Trust Company, of New York, to secure an issue of $600,000 gold bonds, the proceeds of which will be used in betterments.

The Columbus Street Railway Company reports earnings for the week ending Sept. 28, as $15,108, against $13,272 for the same period of 1898, showing an increase of $1,836. The total increase in earnings since Sept. 1, 1899, over the same period of 1898, was $12,167.

The motion to set aside the sale of the Newark & Granville Electric Street Railway has been overruled. Notice has been given that the case will be appealed to the Circuit Court.

The Cincinnati, Newport & Covington Street Railway Company, of Cincinnati, reports the following excellent statement of its operation for the eight months ending Aug. 30.

	1898.	1899.
Gross receipts	$433,138	$464,410
Operating expenses	209,606	190,191
Gross earnings	223,532	274,219
Tolls, damages, taxes, etc.	107,596	99,239
Net earnings	$115,936	$174,980

The statement is especially worthy of note because of the marked decrease in the operating expenses for 1899 over those of 1898.

PENNSYLVANIA

The Schuylkill Valley Traction Company, of Norristown, has filed an equipment mortgage to the West End Title & Safe Deposit Company as trustee, to secure the issue of $100,000 fifty-year 5 per cent bonds.

The directors of the Harrisburg Traction Company have declared an extra dividend of 1 per cent. This increases the annual dividend to 5 per cent and demonstrates the growing value of the stock.

The United Traction Company, of Pittsburgh, reports gross earnings for August of $150,980; operating expenses, $64,910; net earnings, $86,070; fixed charges, $52,986; surplus, $33,084.

TENNESSEE

J. B. Harrison, of Knoxville, has opened negotiations with the owners of the Chattanooga Street Railway properties for their purchase by the Baltimore syndicate which has secured control of the street railway and the electric light properties of Nashville and Knoxville. The Chattanooga deal, it is understood, is to include the Chattanooga Electric Railway, the Chattanooga Rapid Transit Company, the Signal Mountain Electric Railway, and the Chattanooga Electric Light & Power Company. It is possible that the incline railways up Lookout Mountain may also be included. J. B. Scott, of Baltimore, is interested with Mr. Harrison. He was instrumental in making the deals in the other cities mentioned.

DESIGNERS ELECTROTYPERS
High Grade Machinery Our Specialty
Commercial Engraving Co.
WOOD PHOTO HALF TONE
BENNETT BUILDING
Nassau, Fulton and Ann Sts.
NEW YORK

THE GRAF AUTOMATIC LIFE-SAVING FENDER.
For Street Cars and Motor Vehicles.
Fender Cannot be Damaged through Collisions. Received Highest Award at AMERICAN INSTITUTE.
FENDERS, MANUFACTURING RIGHTS, OR PATENTS FOR SALE.
For Full Particulars Address, FREDERICK J. GRAF, Fender Expert,
47 ST. MARKS PLACE, NEW YORK, U. S. A. AGENTS WANTED
N. B. Expert Testimony given in Damage Suits.


KOSMIC OIL FILTER
No Waste or Felt Used in Our Filters.
Nothing to Renew. The First Cost is All.
WE GUARANTEE OUR FILTER FOR FIVE YEARS
KOSMIC OIL FILTER CO., - EASTON, PA.

IF YOU ARE NOT USING....
DREHER JOURNAL and MOTOR GREASE
WILL SEND TO YOU SUFFICIENT TO GIVE IT A GOOD TRIAL FREE
Absolutely Neutral
No Wear to Brasses
THE STANDARD LUBRICANT FOR ELECTRIC RAILROADS
One pound of our Motor Grease is guaranteed to run no less than 500 miles with perfect lubrication.
DREHER GREASE AND OIL COMPANY
80 Cortlandt Street, New York

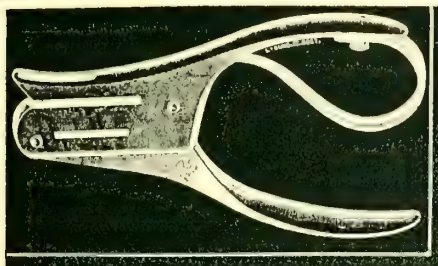
A NECESSITY!


The only article that will prevent sparking. Will keep the Commutator in good condition and prevent cutting.
50 cents per Stick. $5.00 per Doz.
Absolutely Will Not Gum the Brushes.
It will put that HIGH GLOSS ON THE COMMUTATOR you have so long sought after.
For sale by all supply houses, or....
Sample furnished free upon receipt of coupon.
Name.....
Address.....
S. R. J.
K. McLENNAN & CO.,
SOLE MANUFACTURERS,
100 Washington Street, Chicago.

DIXON'S
Graphited Wood Grease
FOR TROLLEY CAR GEARS.
Absolutely prevents noise and does not ooze out of gear case.
"Lasts three times as long as any other lubricant."
JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

Drummond's Detective Agency,
A. L. DRUMMOND, EX-CHIEF U. S. SECRET SERVICE, GEN. MGR.
RAILWAY WORK A SPECIALTY.
PARK ROW AND ANN STREET, NEW YORK.

DANIEL M. BRADY, President.
BRADY BRASS COMPANY,
ADOLPH ONSLOW, General Supt.
MANUFACTURERS OF
STREET AND ELECTRIC CAR BRASS CASTINGS,
MOTOR BEARINGS OF EVERY DESCRIPTION, TROLLEY WHEELS, BABBITT METALS, &c.
The quality and finish of every pound of metal sold by us is fully guaranteed. We respectfully solicit your inquiries.
Telephone, 186 Jersey City.
General Office and Works: 202 to 208 Tenth Street, JERSEY CITY, N. J.



Uniform Buttons

Special Designs.
With Monograms on same, made to order.

Cap and Coat Badges

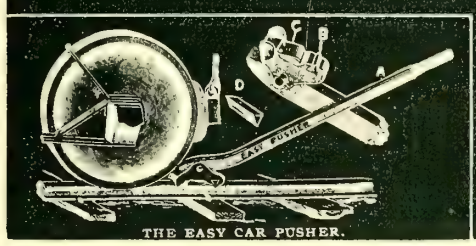
of every description.
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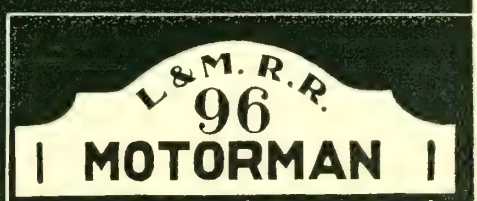


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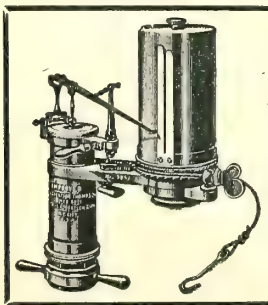
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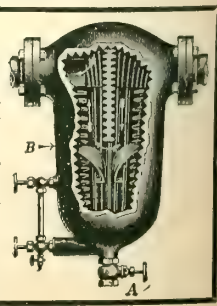
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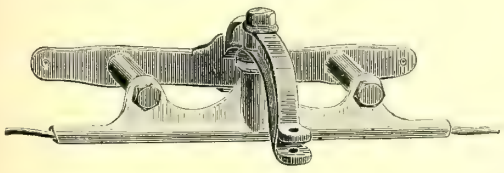
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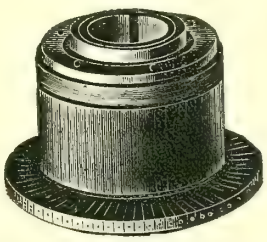
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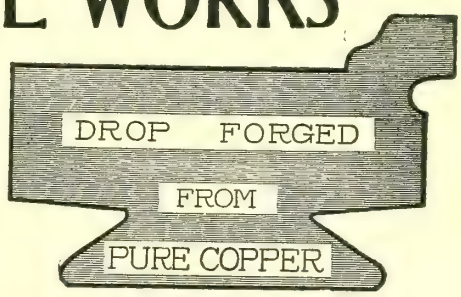
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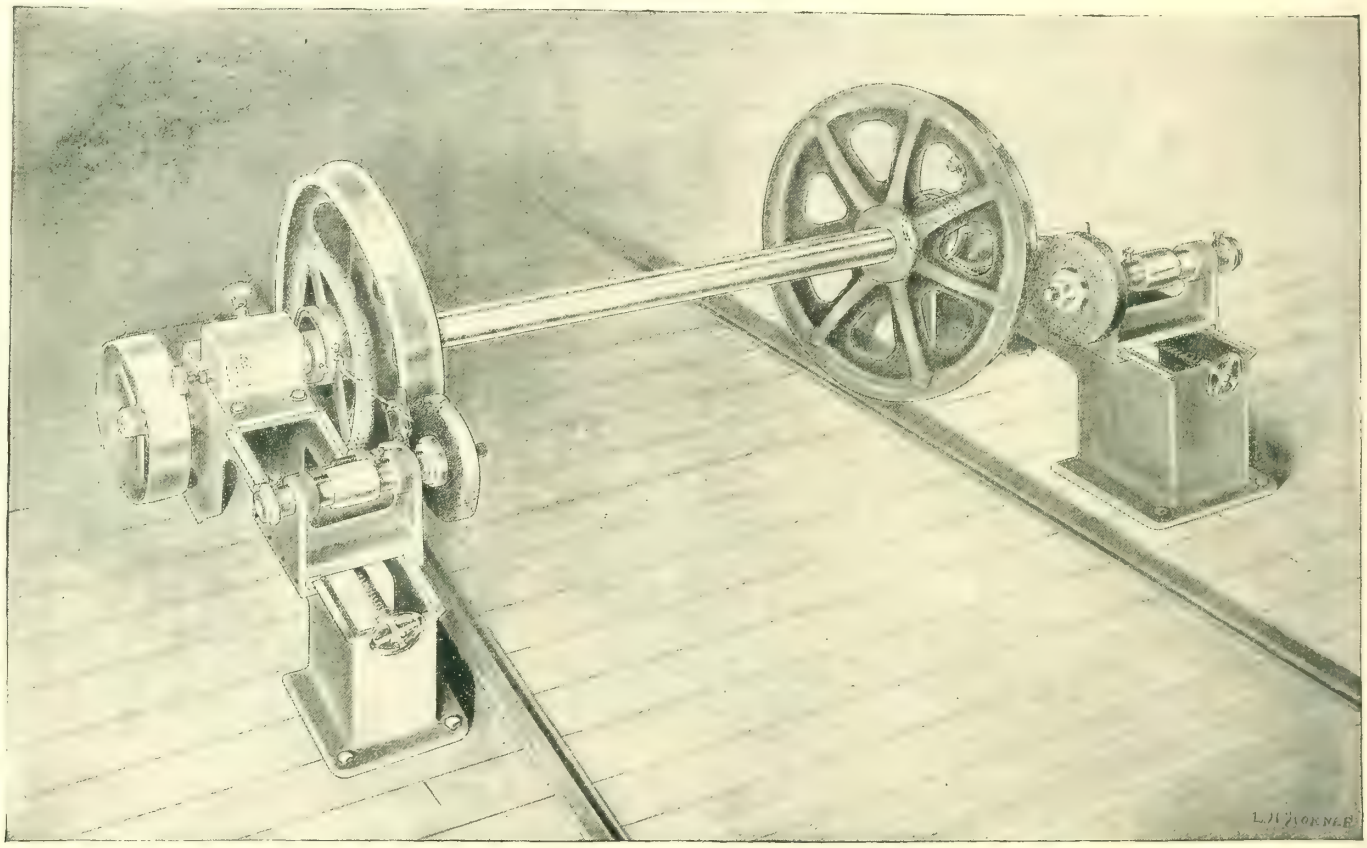
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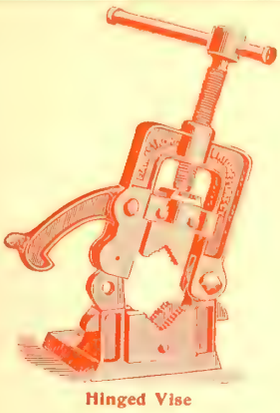
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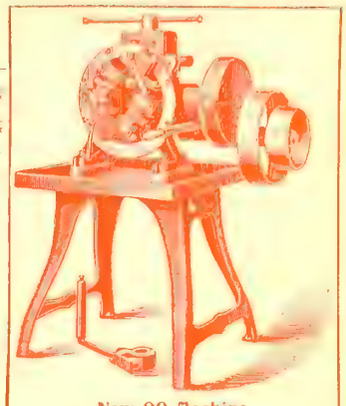
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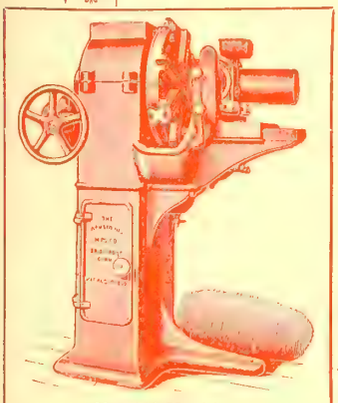
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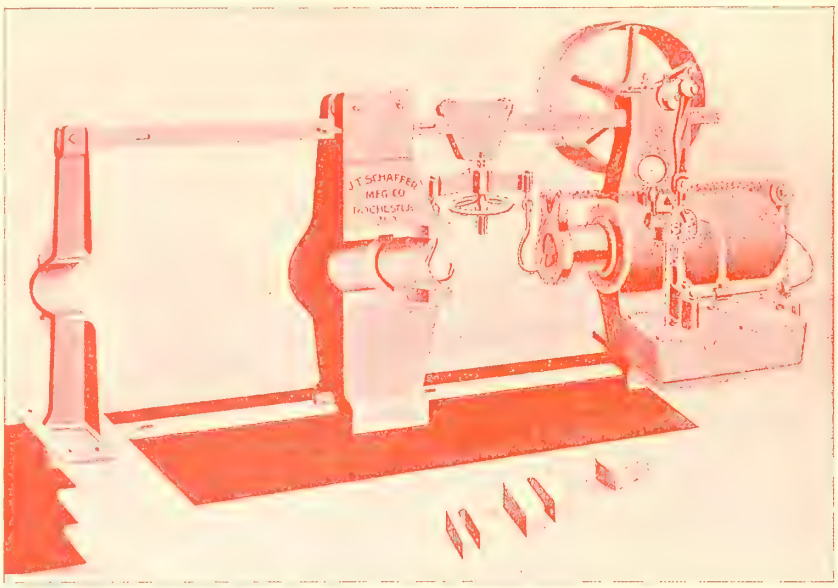
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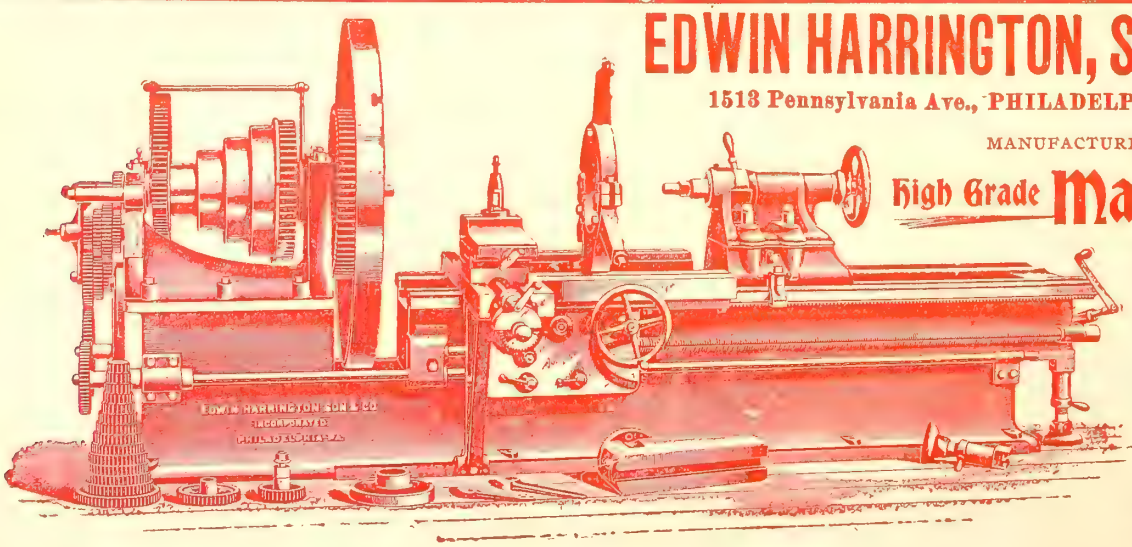
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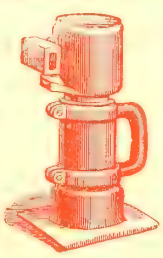
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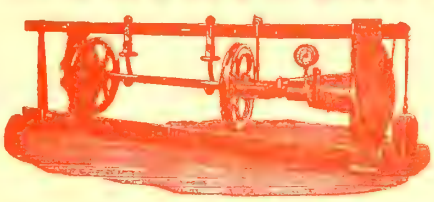
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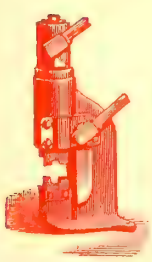




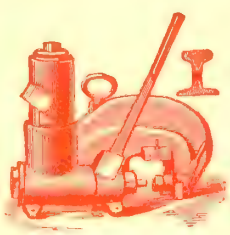
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"PICTURESQUE TRUNK LINE OF AMERICA"

D. I. ROBERTS, General Passenger Agent, . . NEW YORK

Special Train to Chicago Convention

A Special Train for the accommodation of delegates and others attending the Convention of the American Street Railway Association will be run via the

New York Central & Hudson River Railroad

.. AND ..

Lake Shore & Michigan Southern Railroad

The train will consist of Wagner Vestibuled Drawing Room Sleeping Cars, and Dining car serving meals through to Chicago.

Time Table of Special Train

Lv. Boston	B. & A.	10:30 A. M.	Sunday	Oct. 15.
" Worcester	"	11:42 A. M.	"	"
" Springfield	"	1:14 P. M.	"	"
Ar. Albany	"	4:15 P. M.	"	"
Lv. New York	N. Y. C.	1:00 P. M.	"	"
Ar. Albany	"	4:15 P. M.	"	"
Lv. Albany	"	4:35 P. M.	"	"
" Utica	"	6:52 P. M.	"	"
" Syracuse	"	8:15 P. M.	"	"
" Rochester	"	10:05 P. M.	"	"
Ar. Buffalo	"	11:55 P. M.	"	"
Lv. Buffalo	L. S. Ry.	12:00 Midnight,	"	"
Ar. Chicago	"	2:30 P. M.	Monday	Oct. 16.

Rates of Fare

Special rate of one and one-third fare on the certificate plan has been made, and delegates, when purchasing tickets, should ask Ticket Agent for certificate, which, on presentation at Chicago, will secure one-third fare for the return trip. Sleeping car fares at regular rates.

The Committee in charge would respectfully urge all who take the special train at New York, or Stations on the New York Central & Hudson River Railroad to communicate with Milton C. Roach, General Eastern Passenger Agent, New York Central & Hudson River Railroad, 413 Broadway, New York, stating exact accommodations required and from what point.

Those who will take the train at Boston and Stations on the Boston & Albany Railroad should communicate with Mr. J. L. White, Passenger Agent, Boston & Albany Railroad, 266 Washington St., Boston.

Reservations will be made in order as received, and prompt notification of assignment made to applicant.

The Committee would respectfully suggest that delegates and their friends should make early arrangements. Applicants should address or call on Ticket Agent, L. S. & M. S. R. R., 180 Clark St., Chicago, Ill., for the return trip.

CONVENTION AT CHICAGO.

The WABASH RAILROAD, with its various lines running into CHICAGO from different sections of the country offers the best possible train service to members of the AMERICAN STREET RAILWAY ASSOCIATION who are going to attend their ANNUAL CONVENTION, October 17–20.

Direct connections made at ST. LOUIS and KANSAS CITY with all lines from the SOUTH and WEST, and through Sleeping Car Service from these cities to CHICAGO.

Direct connections at BUFFALO with all lines from the EAST, and through Sleeping Car Service from that city to CHICAGO.

Through Palace Sleeping Cars from BOSTON and NEW YORK to CHICAGO.

Special Round Trip rate of a fare and a third, on the certificate plan, has been granted by the various Railroad Committees for this event.

For information in regard to rates, train service, reservation of sleeping car space, etc., apply to your local ticket agent, or

C. S. CRANE,
General Pass. and Ticket Agent, St. Louis, Mo.

F. A. PALMER,
Assistant Gen'l Pass. Agent, Chicago, Ill.

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Wagner Sleeping Cars, Elegant Day Coaches.
Private Compartment Sleeping Cars,
Dining Cars, Buffet Parlor Cars,
Elegant Equipment. Superior Service.

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TOLEDO and DETROIT.

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One night to Denver—at 10 every morning

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Duluth-Superior Limited
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THROUGH Car Line between Chicago, Milwaukee, Ashland, Duluth, St. Paul, Minneapolis, Des Moines, Sioux City, Omaha, Denver Cheyenne, Ogden, Salt Lake, Portland, San Francisco, Los Angeles. Ticket Offices: 193 Clark Street and Wells Street Station, Chicago.

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SHIZUO KONDO, President.

HEAD OFFICES:

Tokyo, Japan. Singer Building, Broadway and Liberty St, New York.

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The water flows into the Cooler through holes an inch above the bottom of Receptacle.

Any Cooler in which the Receptacle is placed will not sweat. The Cooler and the water on the outside of the Receptacle are kept from getting *extremely and unnecessarily* cold, and the ice therefore melts half as fast.

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It is suited to every line of business and to every class of product. The principles are unvarying, but their application differs from time to time. Adaptations are always intelligently made to meet requirements.

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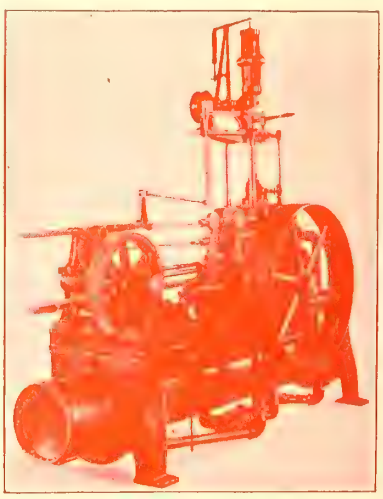
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Steam Plant Equipment

Street Railway Journal
October, 1899

FOR ALPHABETICAL INDEX TO ADVERTISERS, SEE PAGES 23-25

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IN ACTUAL PRACTICE HAS PROVEN TO BE A MOST REMARKABLE

Smoke Preventing and Fuel Economizing Device.

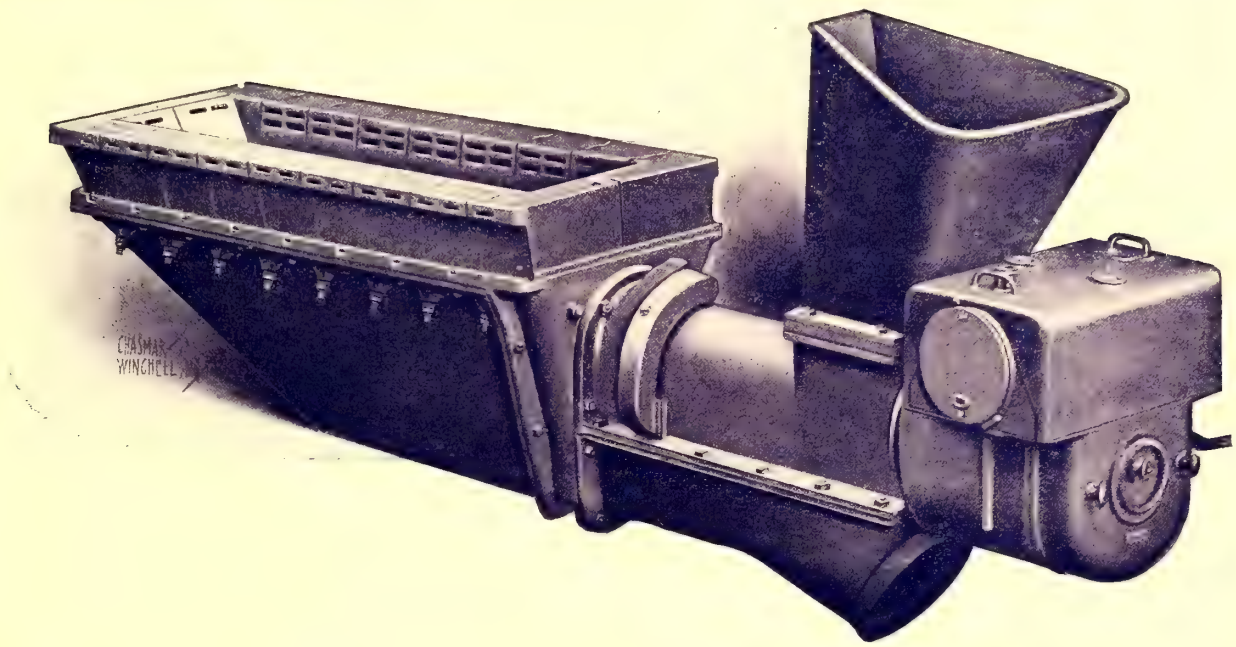
Maximum Efficiency and Economy.

The Union Station of the Edison Electric Light Co. of Brooklyn, have an installation of **fifteen** under "Cahall B. & W. Type Boilers" and have ordered **twenty-one** more.

The Hunt Power Station of the Cincinnati Street Railway Co. have installed **twelve** under "Abendroth & Root Boilers."

The Carnegie Steel Co. have at present in operation **fifty-eight** of these Stokers under "Two Flue Boilers," we having just completed an installation of **twenty-eight**.

The Kings County Electric Heat and Power Co. of Brooklyn, N. Y., have an installation of **eighteen** under "Stirling Boilers."



The Schoenberger Steel Co. gave us several orders, aggregating **eighteen** Stokers prior to January 1, 1899. This was followed by an order for **twenty** more. Since then, **thirteen** more have been installed, and we have an order now for **twelve** additional for them.

The Akron Street Railway & Illuminating Co. write as follows: "We have had in use four of your Stokers for about a year and one-half. We think there is nothing that we have had in service in the stoker line that comes anywhere near being as economical and reliable as they are. We are now about to install twelve more, which fact alone speaks for itself; eight of these are taking the place of other automatic stokers."

THE "AMERICAN" WORKS WITH ANY TYPE OF BOILER.
NO MECHANICAL PARTS IN CONTACT WITH THE FIRE.

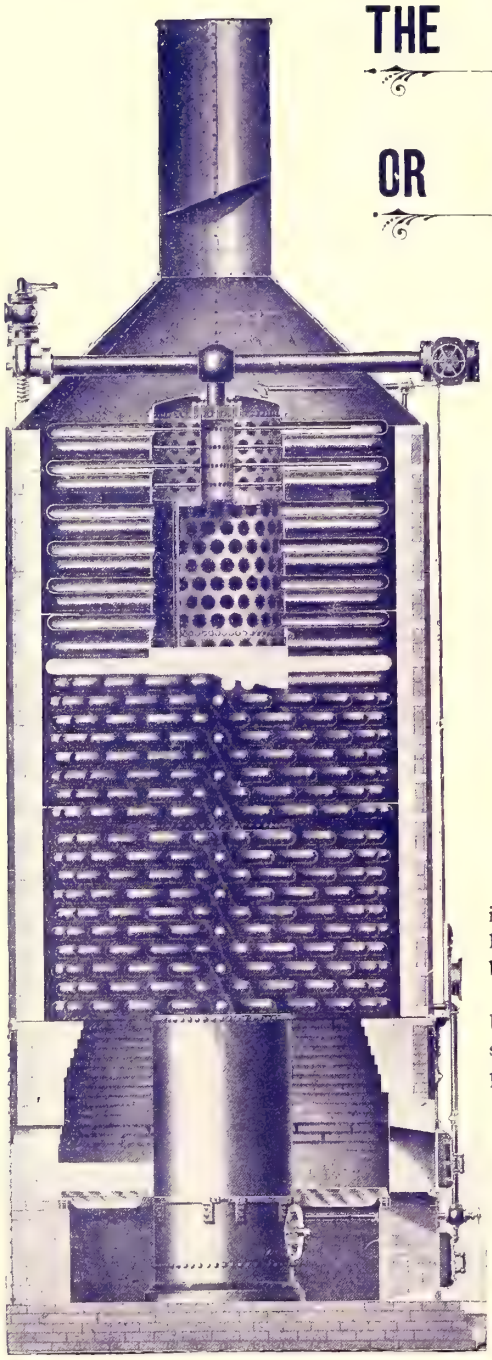
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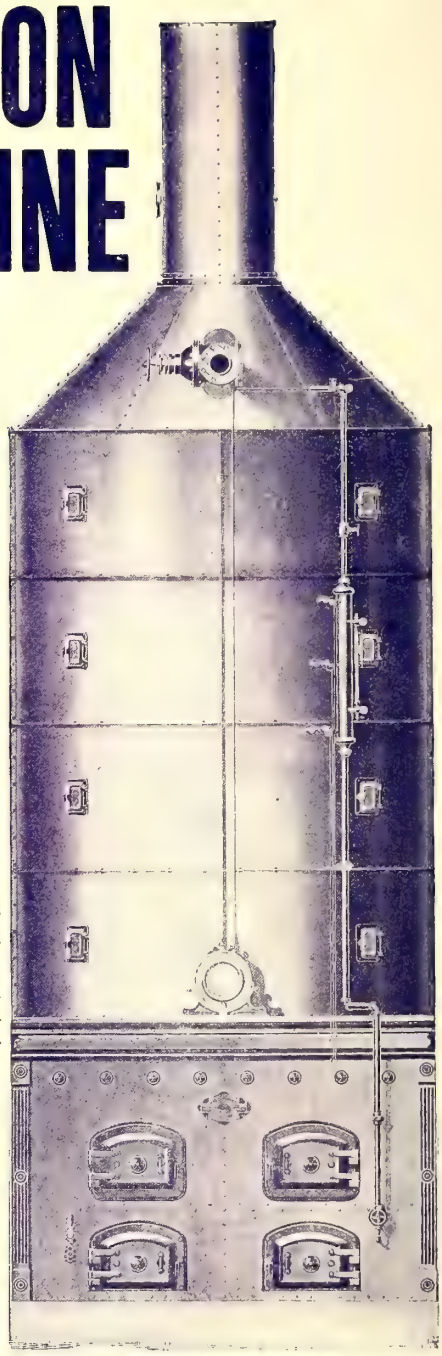


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STEEL-CLAD
SQUARE FURNACE
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STEEL JACKET

is not only the best boiler WE have ever made, but is the best boiler ANYBODY has ever made.

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Metropolitan St. Ry. Co., New York	10 orders,	'94-'98	23,000
Union Traction Co., Philadelphia, Pa	9 orders,	'93-'95	21,675
Boston Elevated R. R. Co, Boston, Mass	11 orders,	'89-'98	19,000
Brooklyn Heights R.R. Co., Brooklyn, N. Y.	6 orders,	'91-'93	16,500
Metropolitan St. Ry. Co., Kansas City, Mo.	6 orders,	'86-'96	4,696
South Side Elevated R. R. Co., Chicago, Ill	2 orders,	'97-'98	4,800
Metropolitan West Side Elevated Railroad Co., Chicago, Ill		'91-'98	6,000
Consolidated Traction Co., Pittsburgh, Pa	1 order,	'97	4,500
Union Elevated R.R. Co., Chicago, Ill.	1 order,	'96	6,400
Northwestern Elevated R. R. Co., Chicago, Ill	1 order,	'96	6,400
Nassau Electric R. R. Co., Brooklyn, N. Y.	5 orders,	'91-'98	7,500
Buffalo St. Ry. Co., Buffalo, N. Y.	3 orders,	'90-'93	4,500
Cincinnati St. Ry. Co., Cincinnati, O	5 orders,	'90-'93	3,300
Cleveland Elec. Ry. Co., Cleveland, O		'98	2,378
Market St. Cable Ry. Co., San Francisco, Cal	3 orders,		2,208
Denver City Cable Ry. Co., Denver, Col	3 orders,	'89'-91	2,686
Detroit Citizens' St. Ry. Co., Detroit, Mich	3 orders,	'95	3,500
Louisville Railway Co., Louisville, Ky	2 orders,	'96-'99	2,562
North Jersey R. R. Co., Jersey City, N. J	5 orders,	'93-'98	5,500
Union Railroad Co., Providence, R. I	2 orders,	'92-'93	2,000
Lynn & Boston R. R. Co., Boston, Mass	3 orders,	'91-'92	4,000
Albany Railway Co., Albany, N. Y	4 orders,	'89-'96	1,500
Union Railroad Co., New York	2 orders,	'91-'92	1,500
New York & Brooklyn Bridge, Brooklyn, N. Y.	5 orders,	'92-'96	1,786
Springfield St. Ry. Co., Springfield, Mass	3 orders,	'94 '97	1,500
Montreal St. Ry. Co., Montreal, Canada		'96	1,500
Newton & Boston St. Ry. Co., Newtonville, Mass	3 orders,	'93-'97	1,027
Pittsburgh & Birmingham Traction Co., Pittsburgh, Pa.		'90	1,000
Columbus St. Ry. Co., Columbus, O	4 orders,	'90-'93	1,807
Rochester Ry. Co., Rochester, N. Y	3 orders,	'91-'94	1,143
Cleveland City Cable Co., Cleveland, O		'90	1,086
Duluth St. Ry. Co., Duluth, Minn	4 orders,	'90-'93	1,312
Portland St. Ry. Co., Portland, Me		'95	1,000
Detroit, Ypsilanti & Ann Arbor St. Ry. Co., Ypsilanti, Mich	2 orders,	'98	1,380
Florence & Cripple Creek Ry. Co., Goldfield, Col		'98	1,584
New Orleans & Carrollton R.R. Co., New Orleans, La		'92-'94	1,040
Dallas Consolidated St. Ry. Co., Dallas, Tex		'96	1,000
St John's St. Ry. Co., St. John, N. B		'96	1,250
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High Class
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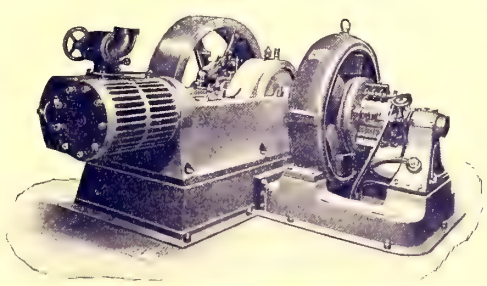


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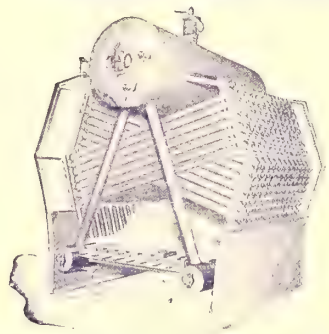
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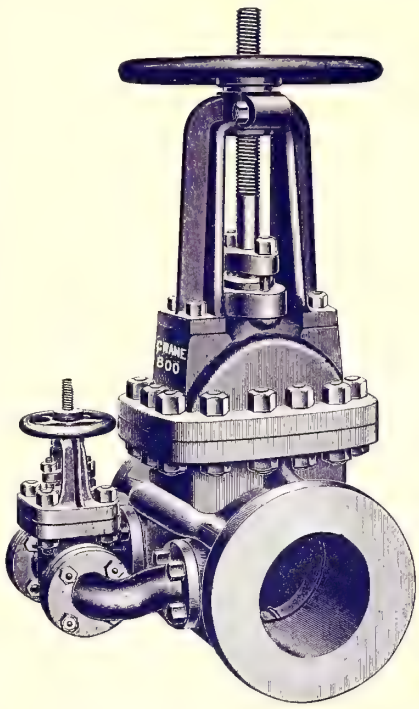
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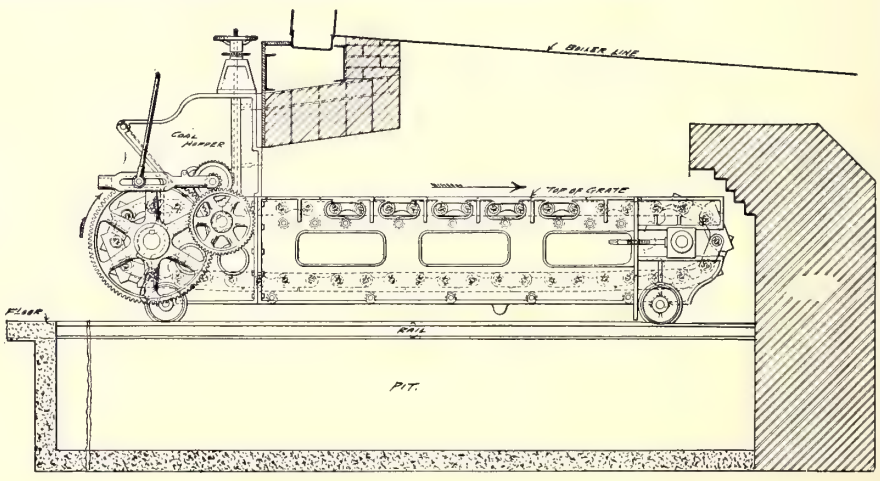
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U. S. Glue Co., Milwaukea,
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Edge Moor Boilers, 5 grates, 4000 H. P.
Armour Packing Co., Kansas City
Edge Moor Boilers, 1 grate, 500 H. P.
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Stirling Boilers, 3 grates, 2d order, 1000 H. P.
West Chicago St. Ry. Co., Chicago,
Stirling Boilers, 1 grate, 600 H. P.
West Chicago St. Ry. Co., Chicago,
Stirling Boilers, 19 grates, 2d order, 11400 H. P.
Swift & Co., Chicago,
B. & W. Boilers, 2 grates, 1100 H. P.
Metropolitan St. Ry. Co., Kansas City,
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Luhrig Coal Co., Daleton, Ohio,
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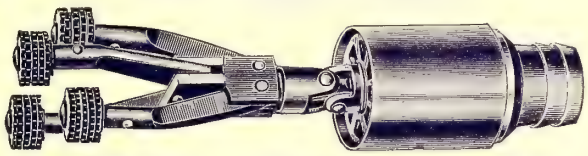
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Not an "Impulse" Cleaner.



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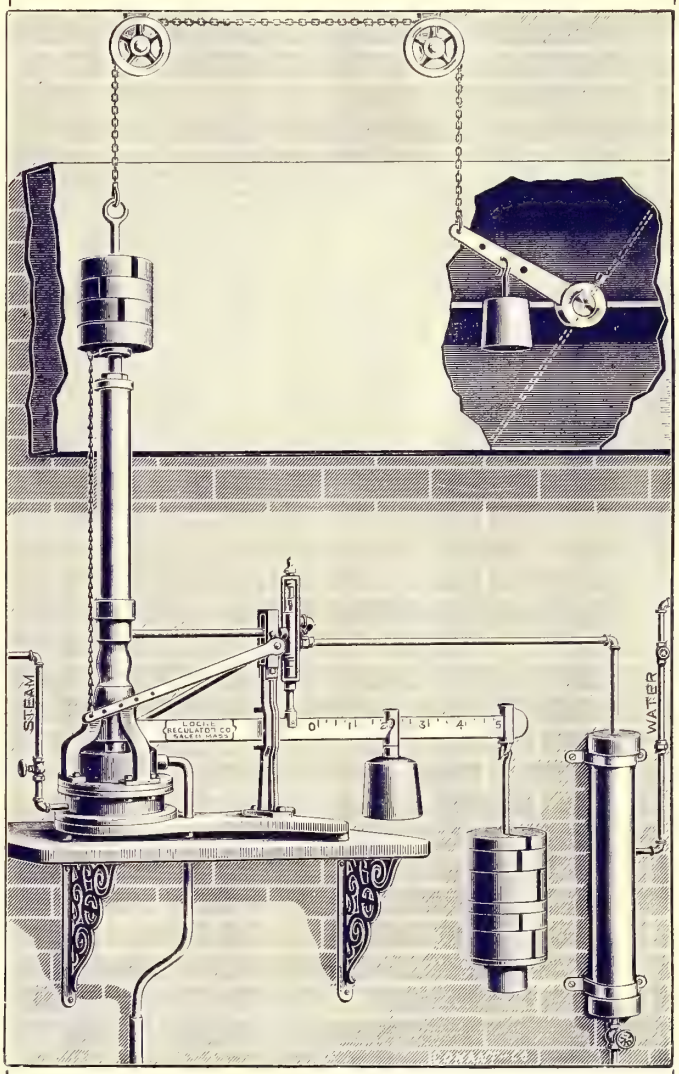
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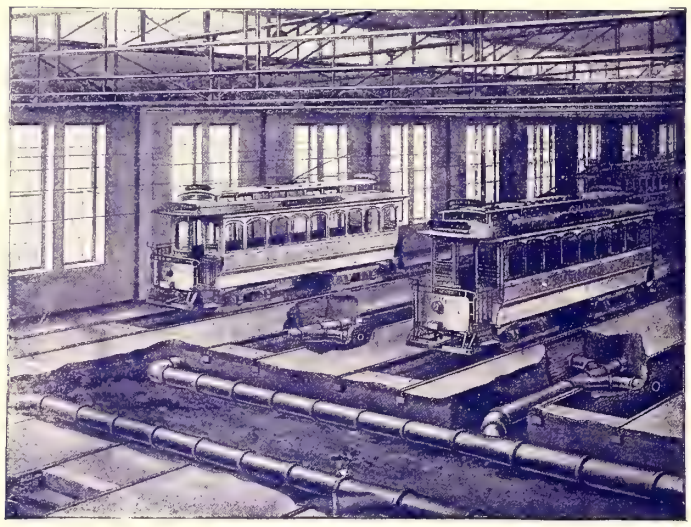
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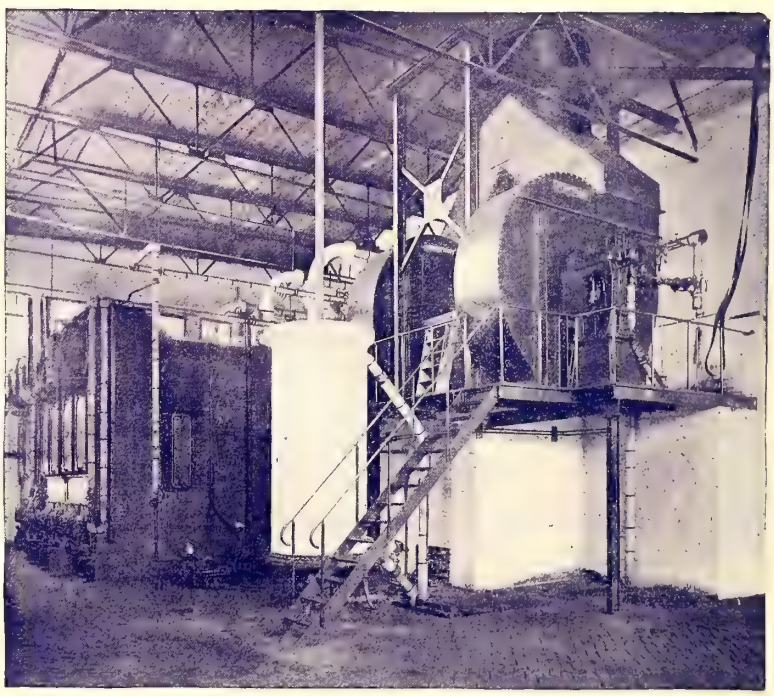
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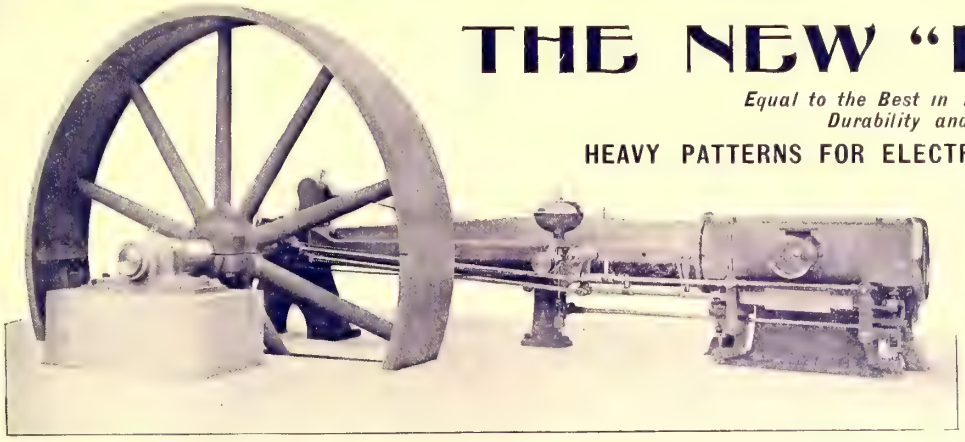
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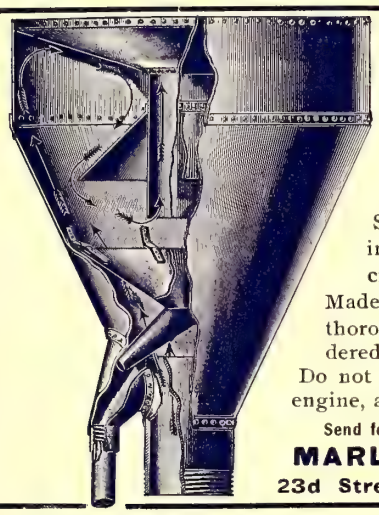
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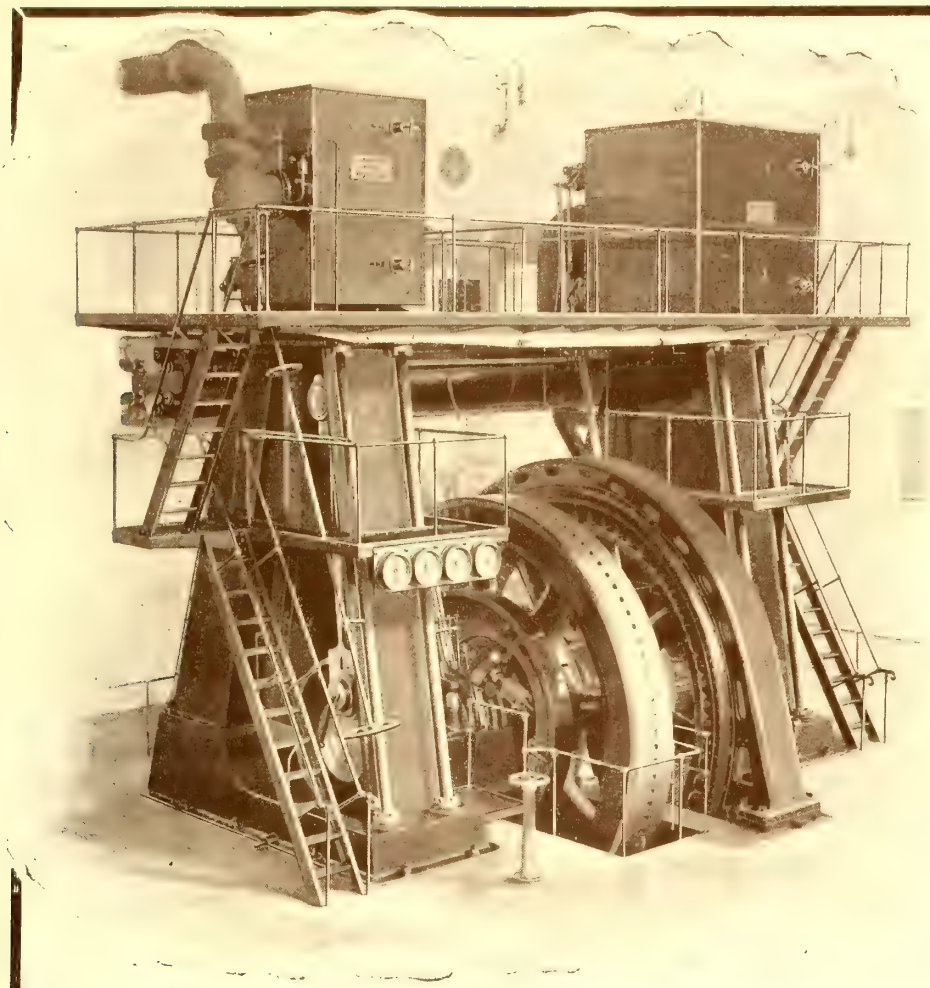
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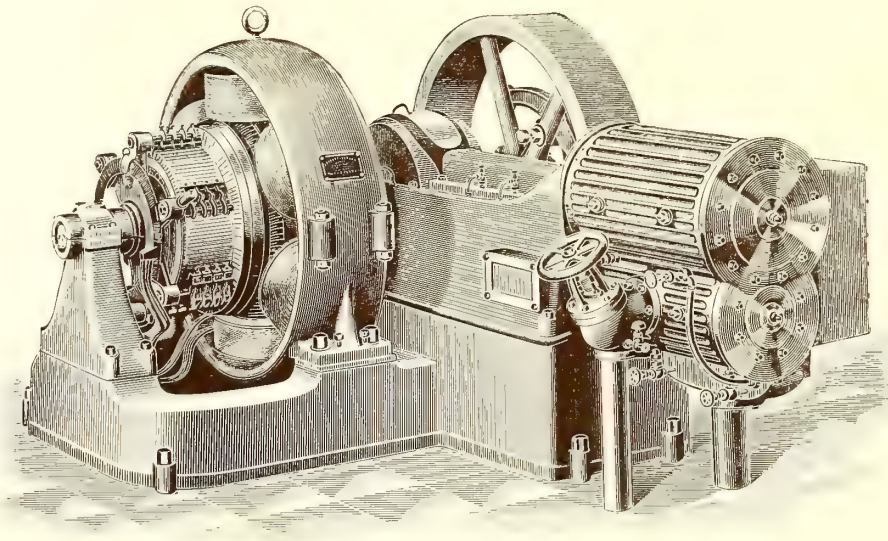
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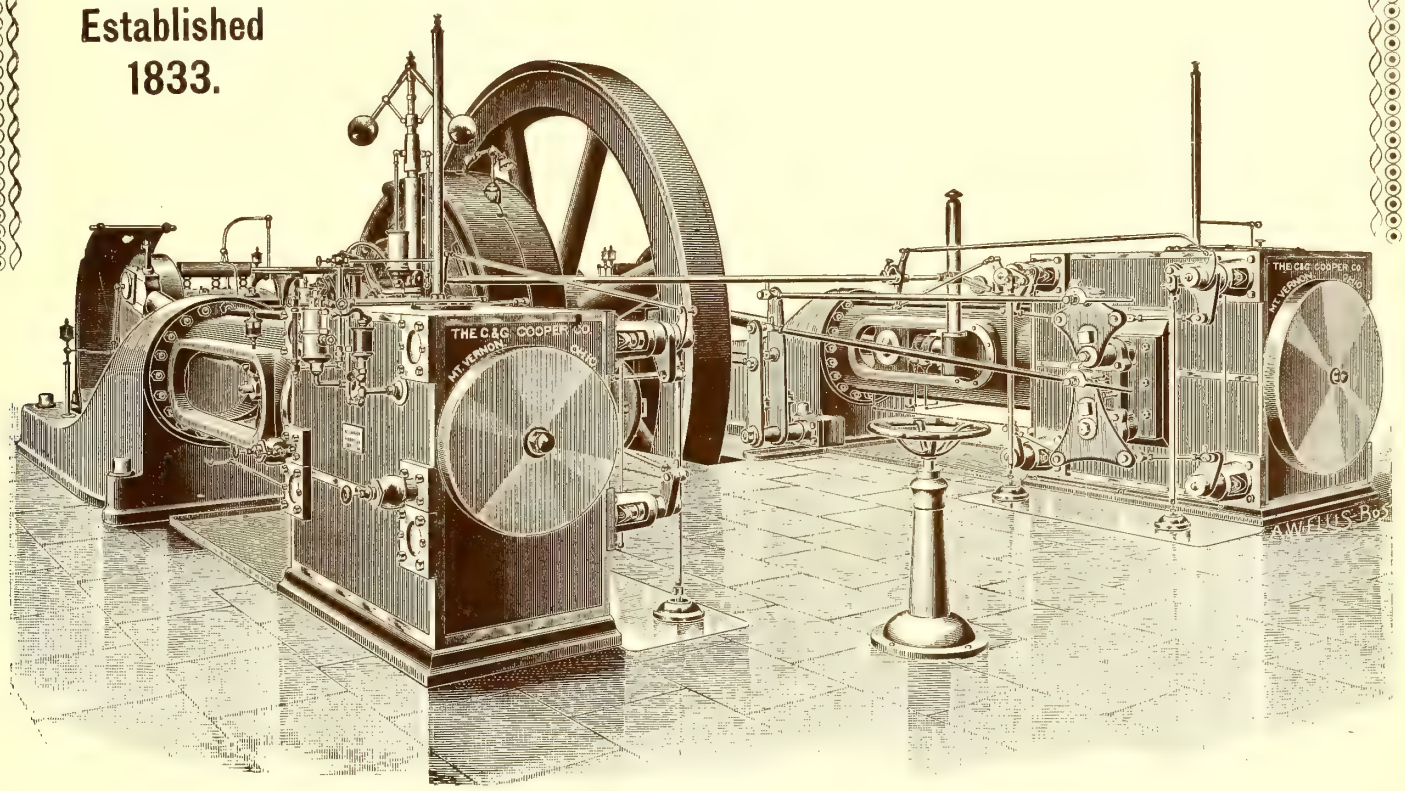
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WE make a specialty of Direct Coupled Work and of equipping the largest Power Plants. Engines of 150 to 2500 H. P. for direct-connected Generators. Simple or Compound. Particular attention given to the Export Trade. Write for specifications and estimates.

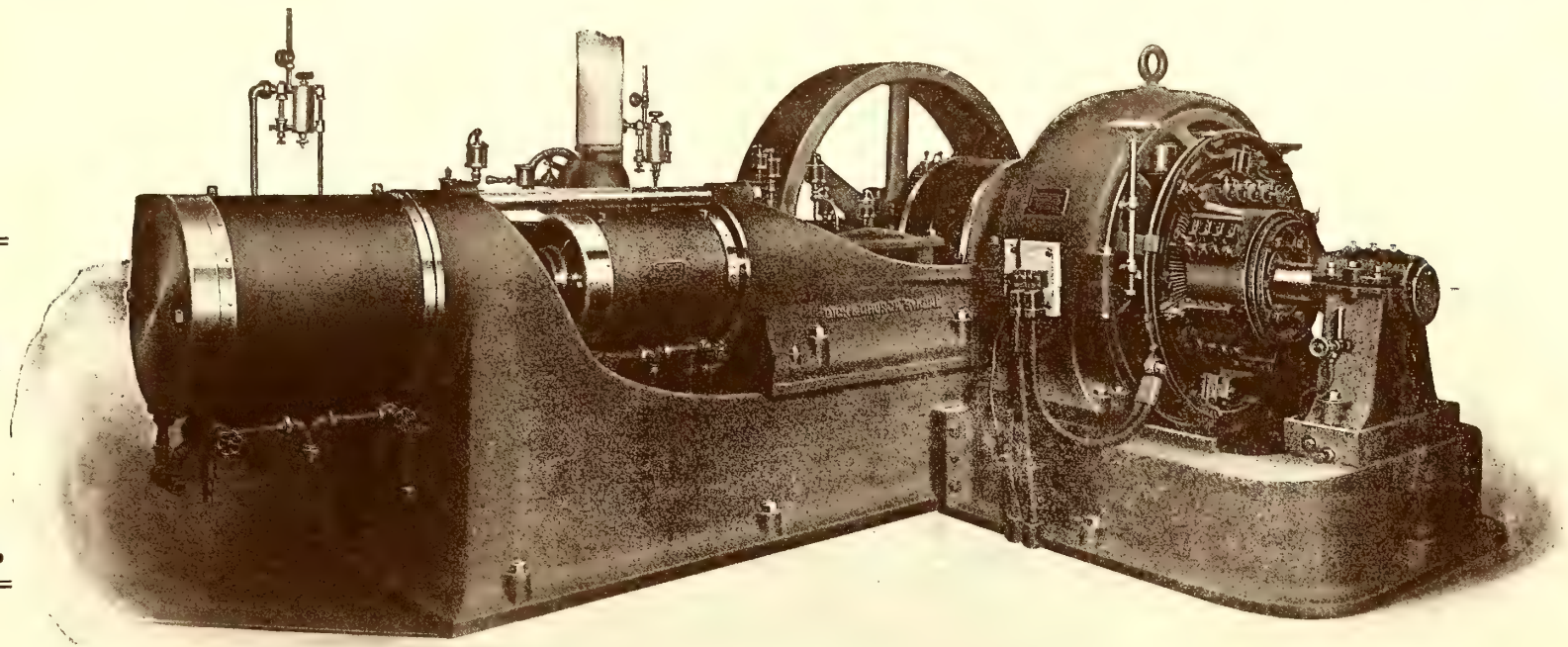
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Simple, Compound and Triple Expansion.



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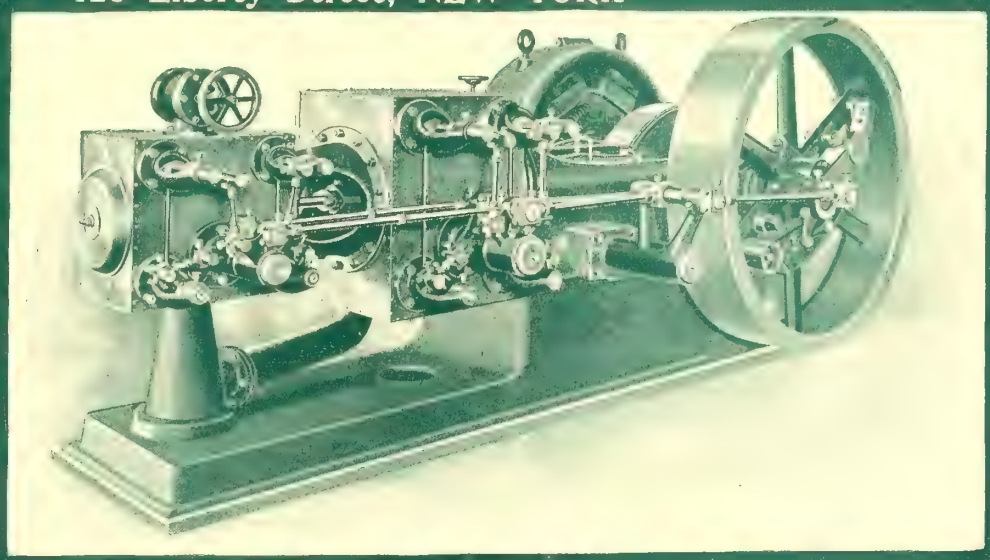
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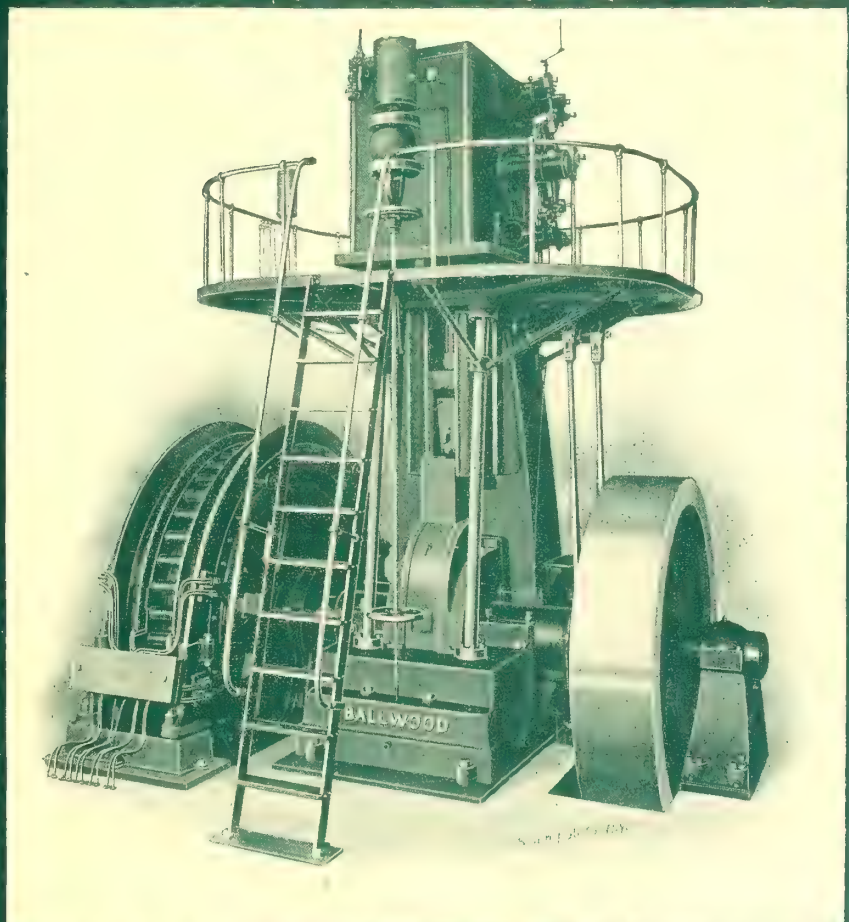


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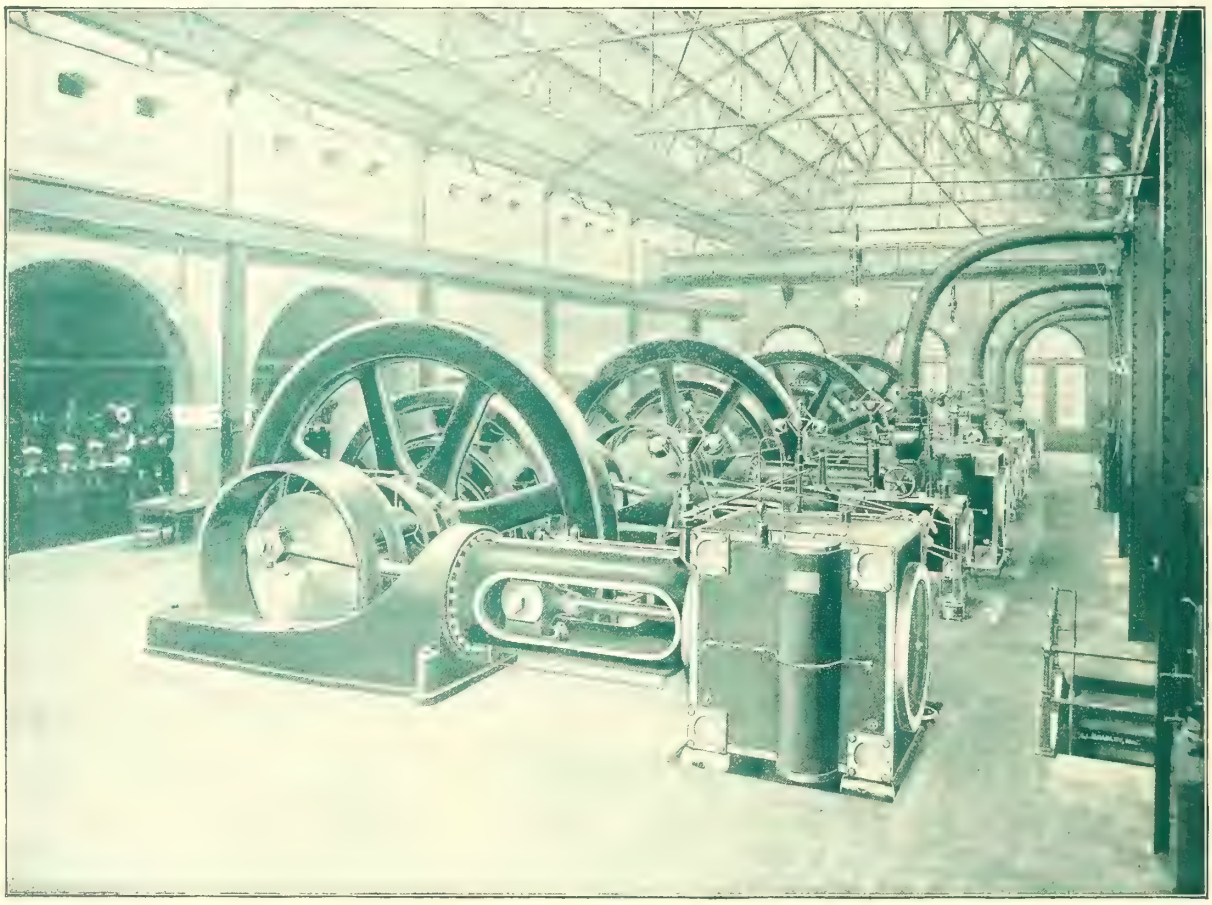
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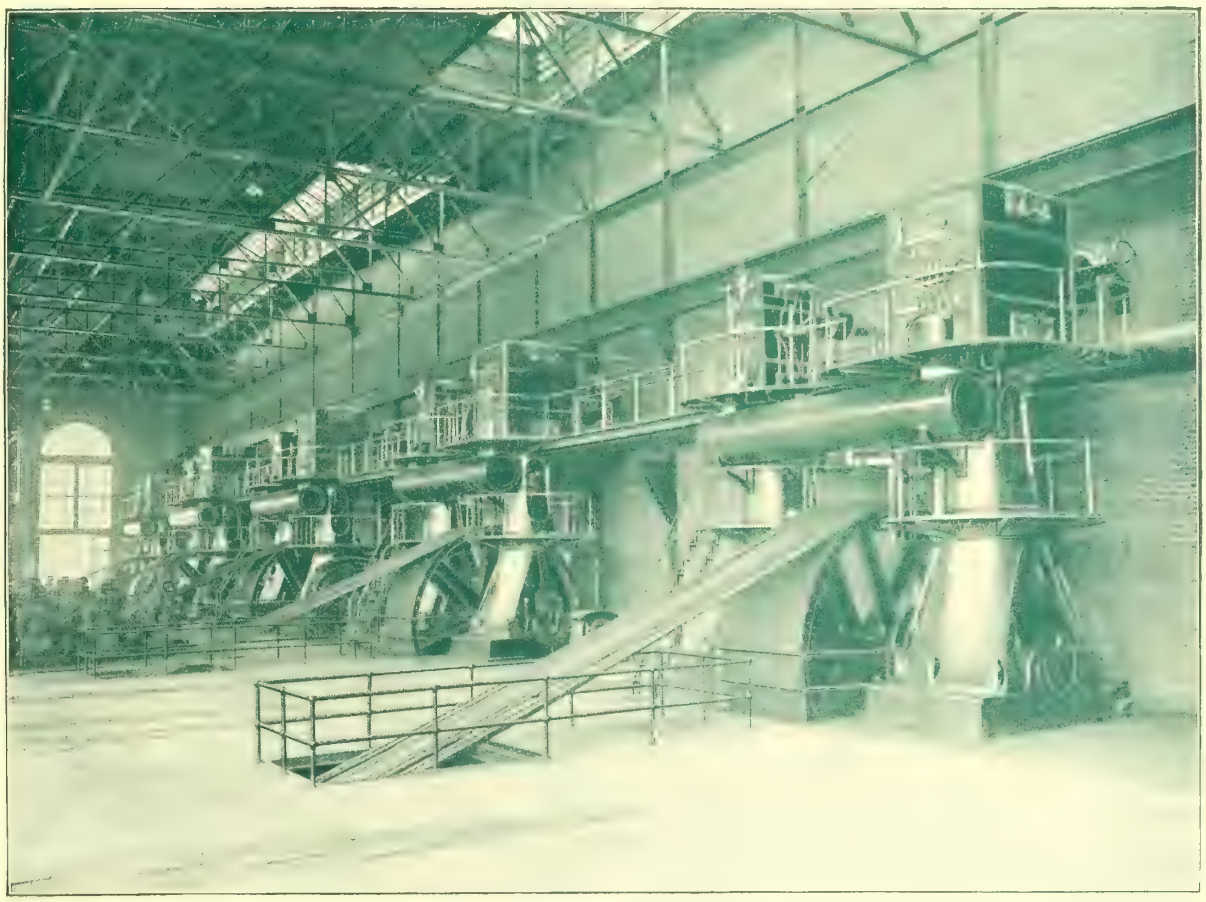


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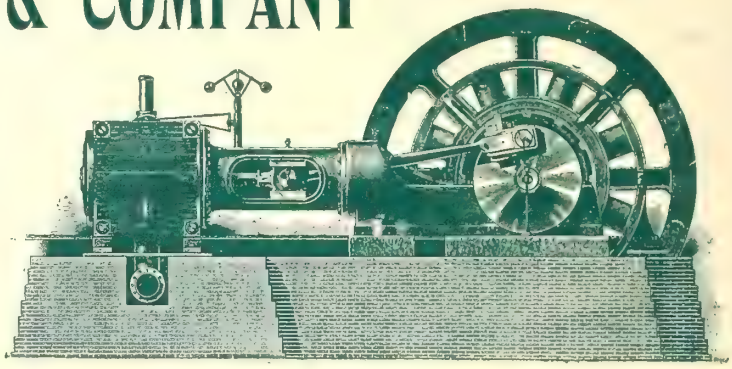
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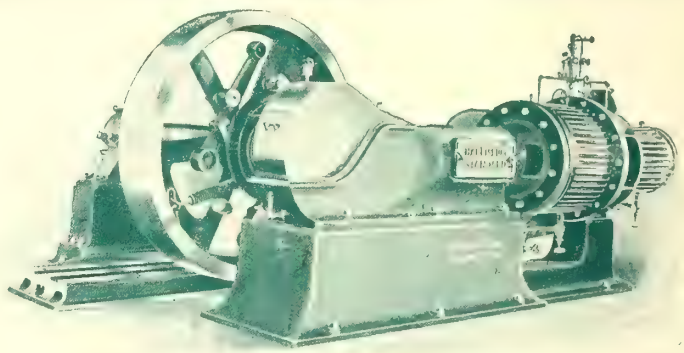
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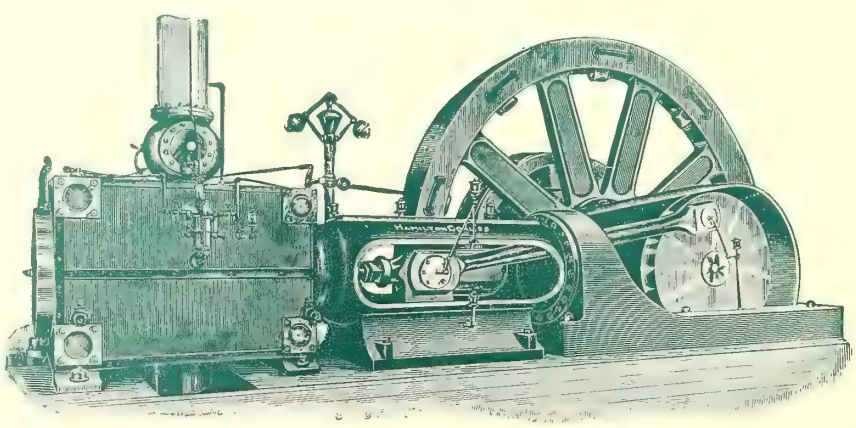
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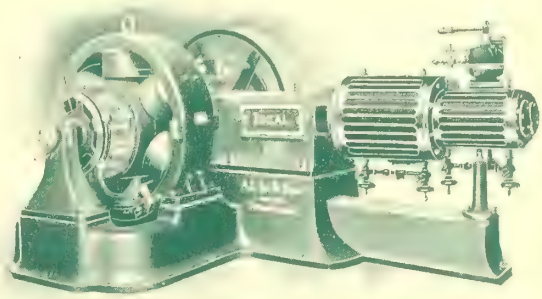
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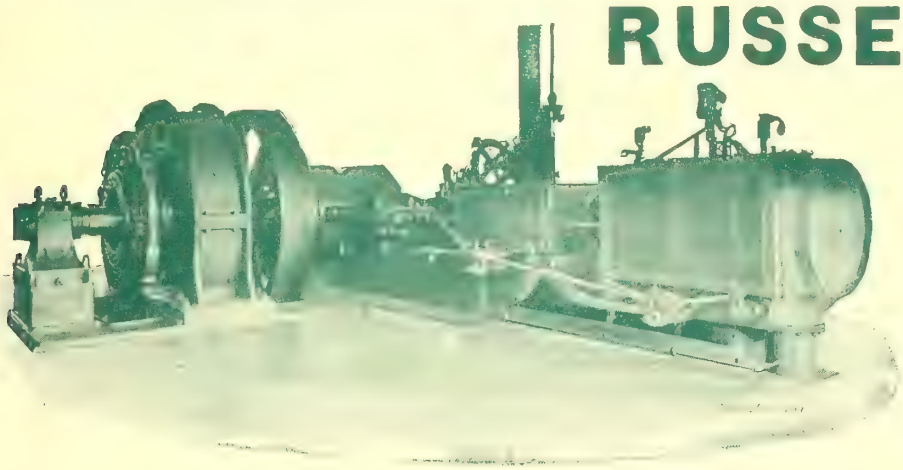
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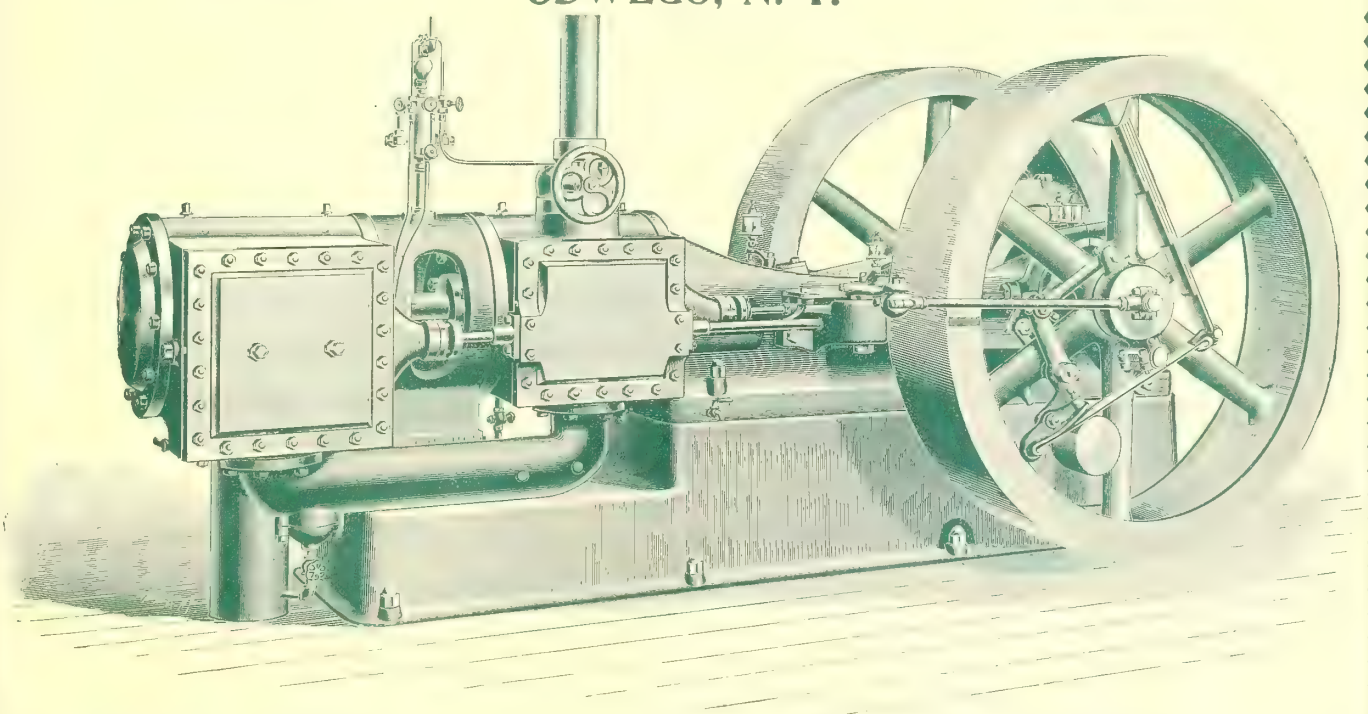


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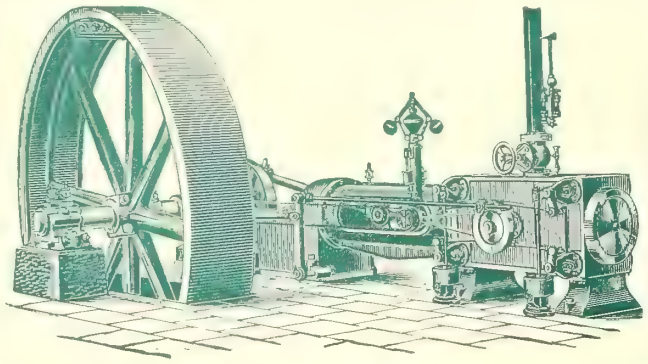
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The only Liberating Valve Gear without Springs or Hook Block. All Joints have Wrist Pin Bearings.



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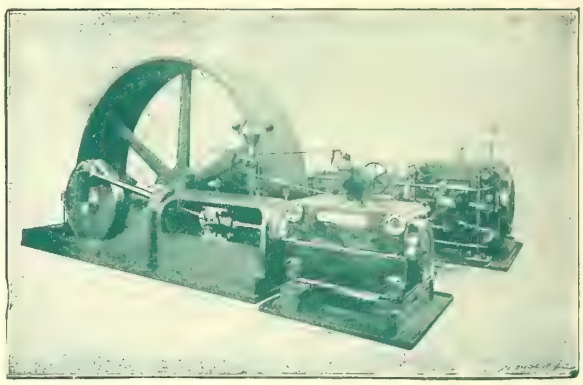
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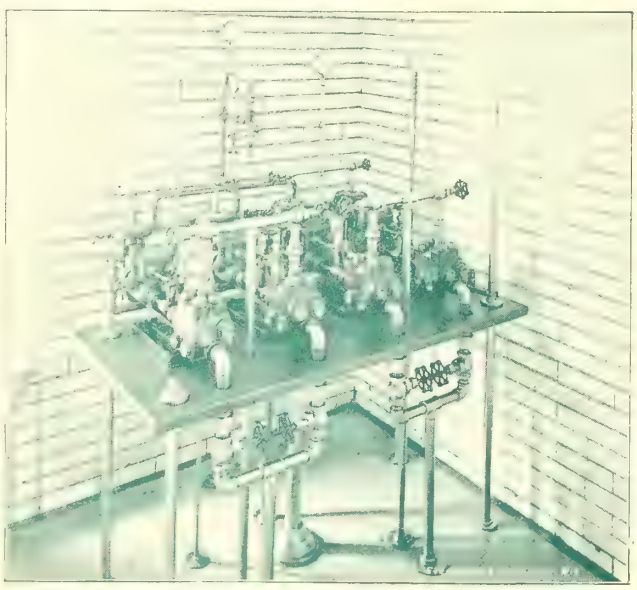
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The durability and good service of machinery depends, to a great extent, on the lubrication. The best constructed and most perfect machine may be seriously damaged or utterly ruined by neglect or imperfect lubrication. We have invented and patented a Perfect System of Automatic Lubrication, known as the SIEGRIST AUTOMATIC OILING SYSTEM.

In this system the lubrication is effected by the installation of the Siegrist Automatic Oiling Table, the required number of Siegrist Pressure Oil Cups and Siegrist Sight Feed Lubricators, also a first-class filter to filter the engine oil as it is returned from the bearings and working parts of the engine, thereby making a combination that cannot be surpassed as an investment for the saving of oil, and the displacement of the large number of men now required in the modern power plants to keep the multitude of oil cups filled and to carry the oil from engine to engine, all of which is displaced by the installation of our Automatic System. Send for Circular and full information.

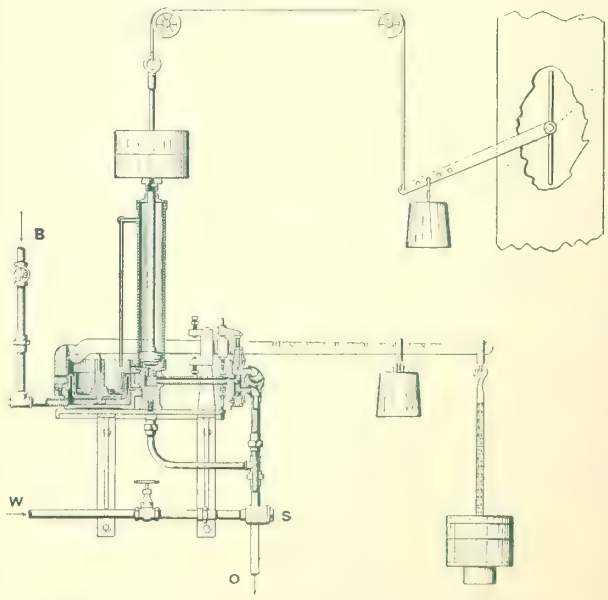
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Designed from a Scientific and Engineering Standpoint.
Simplest, Handsomest and Best in the World.

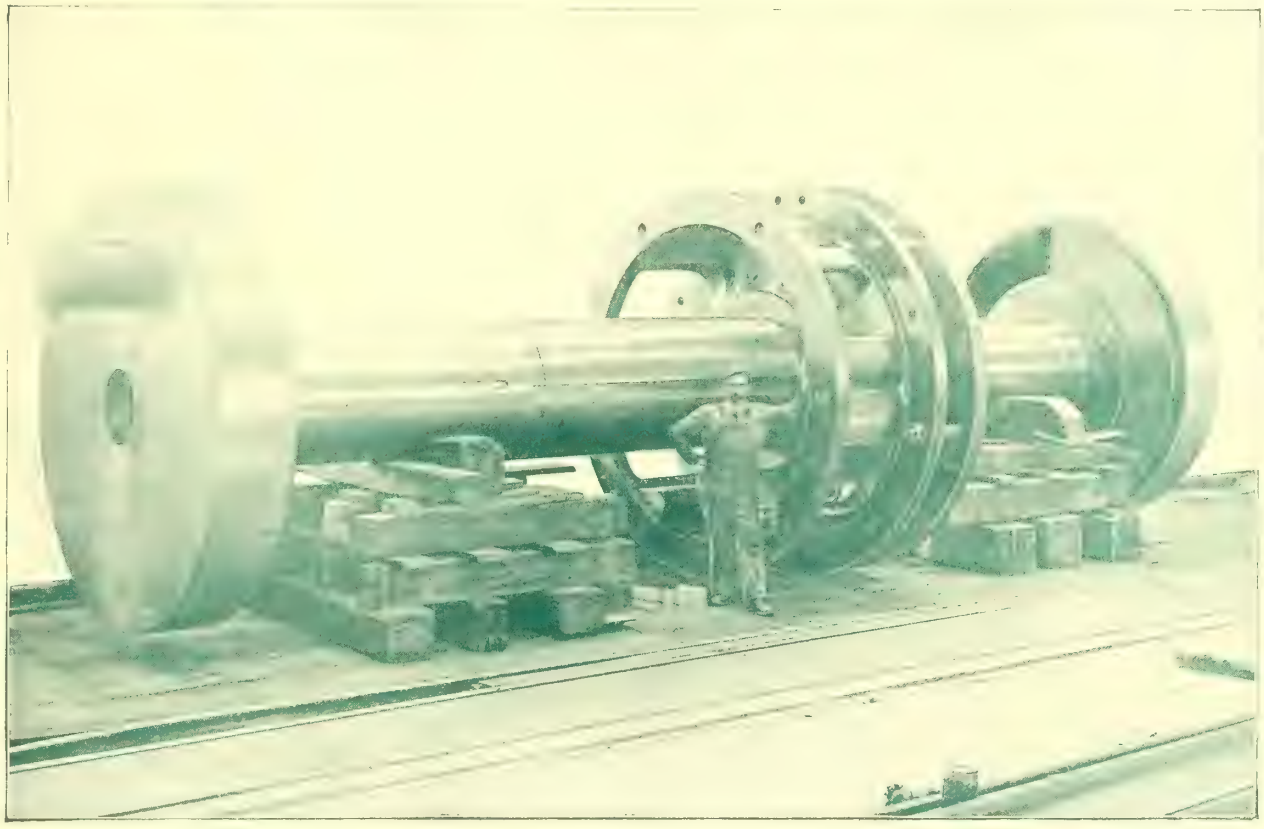


A GREAT FUEL SAVING APPARATUS. GUARANTEED TO HOLD THE HEAVIEST DAMPERS PARTIALLY OPEN

PATTERSON DAMPER REGULATOR CO.
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...ALL the Modern Street Railway Power Plants in Chicago are Supplied with

Hollow Forged Steel Shafts



SHAFT OF FLUID COMPRESSED NICKEL STEEL, HYDRAULICALLY FORGED ON A MANDREL, OIL TEMPERED AND ANNEALED

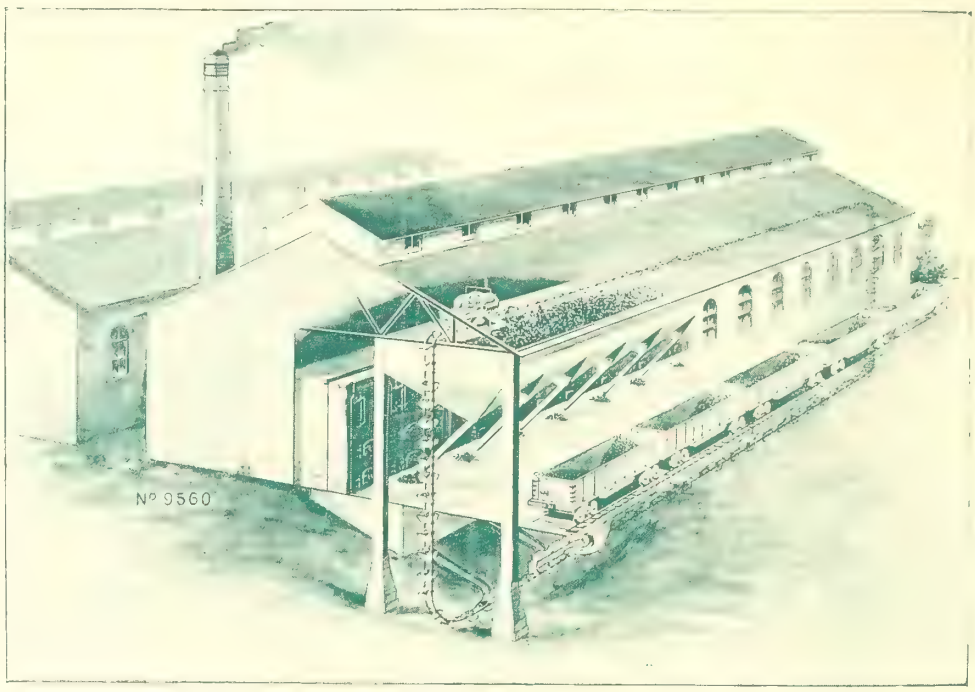
Diameter of Fly-wheel fit, 37 inches; Diameter of Journals, 34 inches; Diameter of Crank Disc fit, 32 inches; Diameter of Axial Hole, 17½ inches; Length, 27 feet, 10 inches; Weight of Shaft, 65,410 pounds; Weight of Crank Discs, 8 feet diameter, 58,004 pounds; Weight of Fly Wheel Hub, 46,986 pounds; Total Weight, 170,400 pounds.
The properties of the steel in the shaft are:

Elastic Limit, 50,000 pounds per square inch.
Elongation, 18 per cent. in test pieces 1 inch diameter, 10 inches long.

BETHLEHEM STEEL COMPANY

SOUTH BETHLEHEM, PA.

Coal Handling in Power Stations



Coal and Ash Handling Machinery Installed for the Detroit Citizens' Railway, Detroit, Mich.

In order that the operating expenses be reduced to a minimum, the station is fitted with a complete system of coal and ashes handling machinery. The coal is delivered from the railroad cars into the hopper shown in above cut, from which it is drawn into the conveyor, which carries the coal to the storage pocket, holding 1,000 tons, from which it is drawn to the stokers. The conveyor passes under the floor of the boiler room, and carries the ashes from the hopper under the boilers to the ash storage, from which they can be removed at will.

We have spent 27 years minimizing the cost of coal handling.

Our machinery for this purpose is in use in almost every city and port in America and in almost every country in the world.

We build "Industrial," Cable and Automatic Railways; Steam and Electric Hoisting Engines; Coal Crackers; Hunt Noiseless Gravity Conveyors, etc.

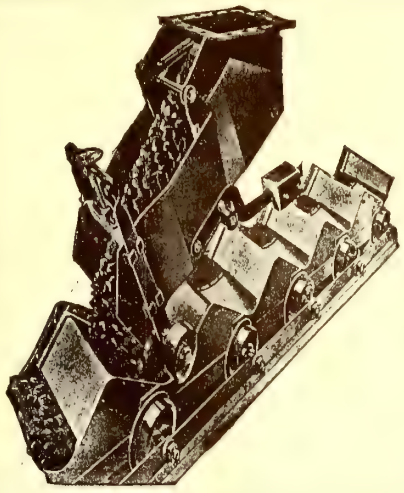
We will be pleased to correspond with those about to erect new or to revise their present plants.

HUNT

C. W. HUNT COMPANY

Elm Street, WEST NEW BRIGHTON

STATEN ISLAND, N. Y.



LINK-BELT COAL CARRIER

One of the interesting features of the "Link-Belt" Carrier is the Automatic Feeding Chute, shown by illustration. This device does not overfeed, underfeed or require attention. It is adjustable to all sizes and kinds of coal.

We have machines for the handling of any material under any conditions.

No one design is best for all, though the "Link-Belt" Carrier is the right solution for many of the Coal and Ashes handling problems at Electric Railway Stations and Power Houses. We will show you some of its other details later, and, if you wish, will be glad to mail you copy of our Carrier booklet.

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NICETOWN, PHILA. *49 DEY ST., NEW YORK CITY.*

STEAM SHOVELS FOR COAL HANDLING



Over Nine-tenths of all Coal Handling Plants in Boston and Vicinity Use Our Cable Road and Automatic Bucket System

IN NEW YORK THE NUMBER OF OUR SHOVELS IS DOUBLE THAT OF ANY OTHER MAKE

WE HAVE RECENTLY ERECTED AT THE PLANT OF THE NEW ENGLAND GAS AND COKE CO., EVERETT, MASS., FOUR MOVABLE STEAM SHOVEL TOWERS AND A

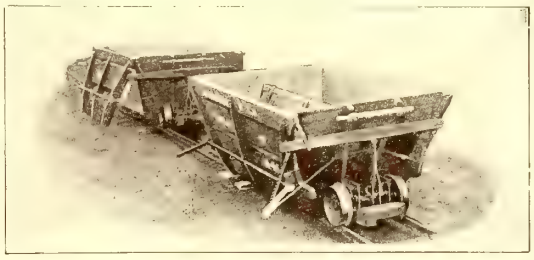
CABLE ROAD 4,200 FEET LONG

PLANTS RECENTLY EQUIPPED

E. L. HEDSTROM & CO., CHICAGO, - 2 MOVABLE TOWERS, 9 AUTOMATIC ROADS
GEO. LILL COAL CO., " - 2 " " 9 " "
STANDARD OIL CO., NEW YORK, - - STEAM SHOVEL AND STEEL POCKET

Plants Now Being Equipped With Our Towers and Shovels

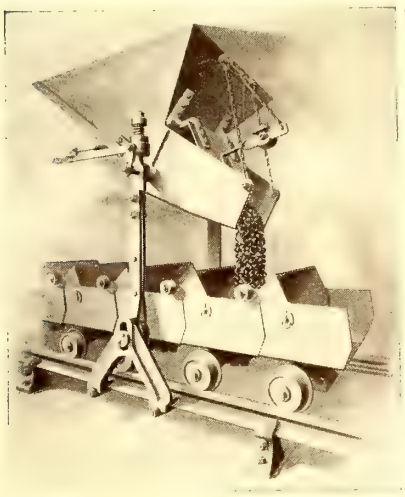
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JOHN A. MEAD MFG. CO.

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Steel Cable Engineering Company

Builders of Special Conveying and Elevating Machinery. Suited for All Requirements.

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Write us for catalogue.

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THE "99" FAMOUS WASTE OIL REFINER AND PURIFIER

is not a water-using fallacy, nor is it merely a strainer or settling tank.

By the correct application of HOT AIR (a new discovery) the Famous extracts the minute carbon and other suspended impurities. These injurious impurities are so minute that they readily pass through ANY kind of waste oil filtering material with the oil.

Capacities, 5, 10, 20, 40, 75, 150 and 300 Gallons Per Day

For full description, etc., of this modern device, address

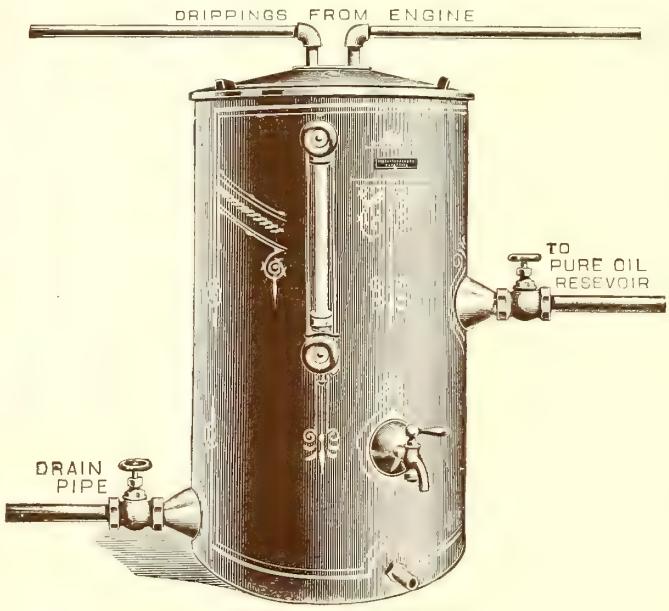
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316 NORTH MAIN STREET, - ST. LOUIS, MO.

...Gravity... Oiling System

❧❧❧During the past year or so, we have placed a great many of our Oiling Systems into some of the largest power plants, both here and abroad. This System insures neatness, cleanliness and economy in oil handling. The costs of installations are so trifling that the savings effected very quickly pay for the installation. Our Filters have been on the market nearly 10 years, are used in 24 countries, and have been adopted by 4 governments.

❧❧❧We manufacture a complete line of Oil Filters, from 3 to 150 gallons filtering capacity per day, to use with or without our Oiling System. We can equip the largest as well as the smallest power plant.



(PATENT APPLIED FOR)

CROSS OIL FILTER WITH NECESSARY FITTINGS TO USE WITH OUR OILING SYSTEM

...TESTIMONIALS...

BOSTON ELECTRIC LIGHT COMPANY
BOSTON, MASS.

May 25th, 1899

THE BURT MFG. CO.

Gentlemen:—The two 120-gallon Cross Filters are giving satisfaction. We hope to send you a photograph showing arrangement of Filters and oil tanks.

Yours truly,
JAMES T. BOYD, M.E.

LAURIE ENGINE COMPANY
MONTREAL

August 12th, 1899

THE BURT MFG. CO.

Dear Sirs:—You asked us some time ago to obtain for you some information about the two 120-gallon Filters we purchased. They were for the installation we were putting in, to be used at the Moutreal Street Railway Power Works of this city. We are in a position to report further, that they are working very satisfactorily, in fact much better than they anticipated. You may use this for any medium of advertising you may desire.

Trusting our report will be appreciated by you.

Yours truly,
LAURIE ENGINE CO.

CAPITAL TRACTION COMPANY
WASHINGTON, D. C.

August 4th, 1899

THE BURT MFG. CO.

Gentlemen:—Answering your inquiry of July 29th, I am pleased to state that the two 80-gallon Cross Oil Filters and Purifiers which our company purchased from you have been in use for sixteen months, and have given perfect results and much satisfaction. I have no hesitancy in recommending its use to all requiring a perfect filter.

Yours truly,
C. HOSHALL,
Engineer Grace St. Power Station, Capital Traction Company, Washington, D. C.

...OIL TANKS...

❧❧❧We also manufacture a complete line of Oil Tanks to use with our Oiling System or for other purposes. We can furnish any capacity desired made out of galvanized iron, brass, copper or sheet iron.

Upon application, we will be pleased to quote prices, send catalogues, list of users, testimonials, etc.

THE BURT MANUFACTURING CO.

AKRON, O., U.S.A.

LARGEST MANUFACTURERS OF OIL FILTERS IN THE WORLD

AGENCIES IN ALL OF THE PRINCIPAL CITIES OF THE WORLD

Chemists on Steam Economy

WATERS ANALYZED FREE

SCIENTIFIC BOILER FEED WATER TREATMENT PREPARED



DEARBORN HIGH GRADE OILS

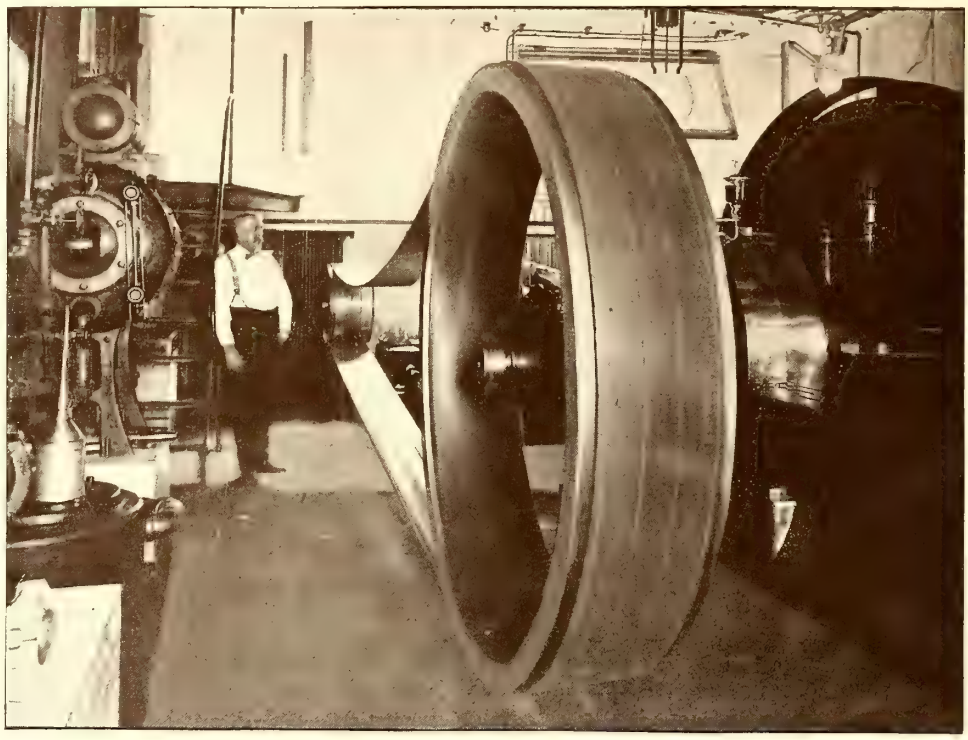
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BUFFALO, N. Y. BOSTON, MASS., AUG. 1, 1899

GENTLEMEN:—Having tried Cling-Surface on my 12″ dynamo belt (16 feet between centres), I have been able to carry full load with 22″ sag on belt with no perceptible slip. It surpasses my expectations and I can recommend it to do all that is claimed for it, if directions are followed.

Yours respectfully,
E. B. PRESCOTT, Engineer.

Four months ago this belt was as tight as a fiddle string, under about 1000 lbs. initial tension, and yet was slipping.

There is no slip now for it runs slack.

CLING-SURFACE did it.

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HIGH PRESSURE POWER PLANTS A SPECIALTY

Wrought Iron or Steel Pipe bent to any practical form.

EXCLUSIVE MANUFACTURERS OF THE VAN STONE JOINT, WHICH DOES NOT WEEP UNDER THE HIGHEST PRESSURES.

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MANUFACTURERS OF

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We desire to call special attention to our new Steam Valves with REMOVABLE BRONZE SEATS, extra heavy pattern, for high pressures. They are perfectly reliable for pressures of 125 lbs. and upwards and are the only valves in the market that will give the best satisfaction in this hard service.



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Send for descriptive Circular and prices. All genuine Chapman Valves bear the name, trade mark and monogram of the Company.

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Will record accurately any pressure or vacuum that it is possible to maintain in any receptacle or generator.





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Guaranteed not to leak at highest pressures.

Brass or Iron. Plain or Yoke Top.



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IS FAMOUS THE WORLD OVER.



Perfect in Design. Faultless in Workmanship.

Branden Pump Valve.

Rubber with Wire Coil Insertion.

THIS IS THE VALVE YOU WANT.

Will outlast several ordinary rubber valves.

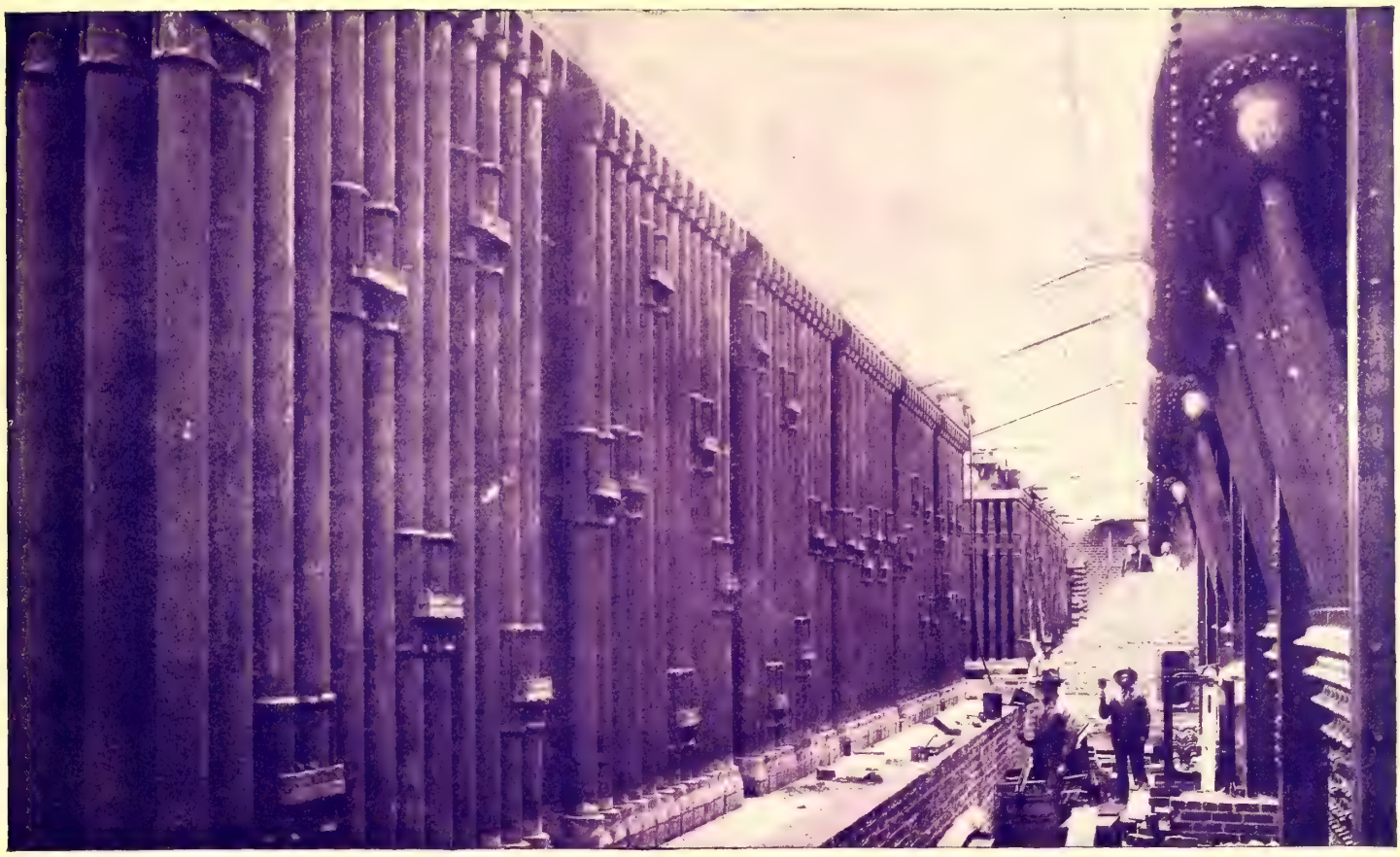
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6,000 H. P. GREEN'S FUEL ECONOMIZERS READY FOR BRICKING IN

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"The Actual Coal Saving 16 to 20%"

THE ABOVE IS FROM THE STATEMENT OF THE ENGINEER OF THE DETROIT RAILWAY COMPANY. HE ALSO STATED AS FOLLOWS

"Water Enters the Economizer at 80° and Left at 246°—on an Average"

...GREEN'S FUEL ECONOMIZER...

Utilizes Gases that are usually allowed to escape, and provides a large reserve of water heated to the evaporative point ready for immediate use in the boilers.

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THE GREEN FUEL ECONOMIZER CO.

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ECONOMIZER

(BURPEE'S PATENTS)
(BROOMELL'S PATENTS)

FOR HEATING AND PURIFYING FEED WATER FOR STEAM BOILERS
BY UTILIZING THE HEAT IN FLUE GASES

Mechanical Draft...

THE ideal steam plant of the future will be arranged on the induced draft system. The smoke fans will be built in the best possible manner and of ample capacity to handle the gases at a very low rate of speed. The engines attached to these fans will be strong and heavy, arranged to use steam in the most economical manner, and will be automatically regulated to the draft required.

American Fuel Economizers of ample proportions will be installed between the boilers and the smoke fans. These Economizers will be enclosed in the most approved style of sectional metallic casing.

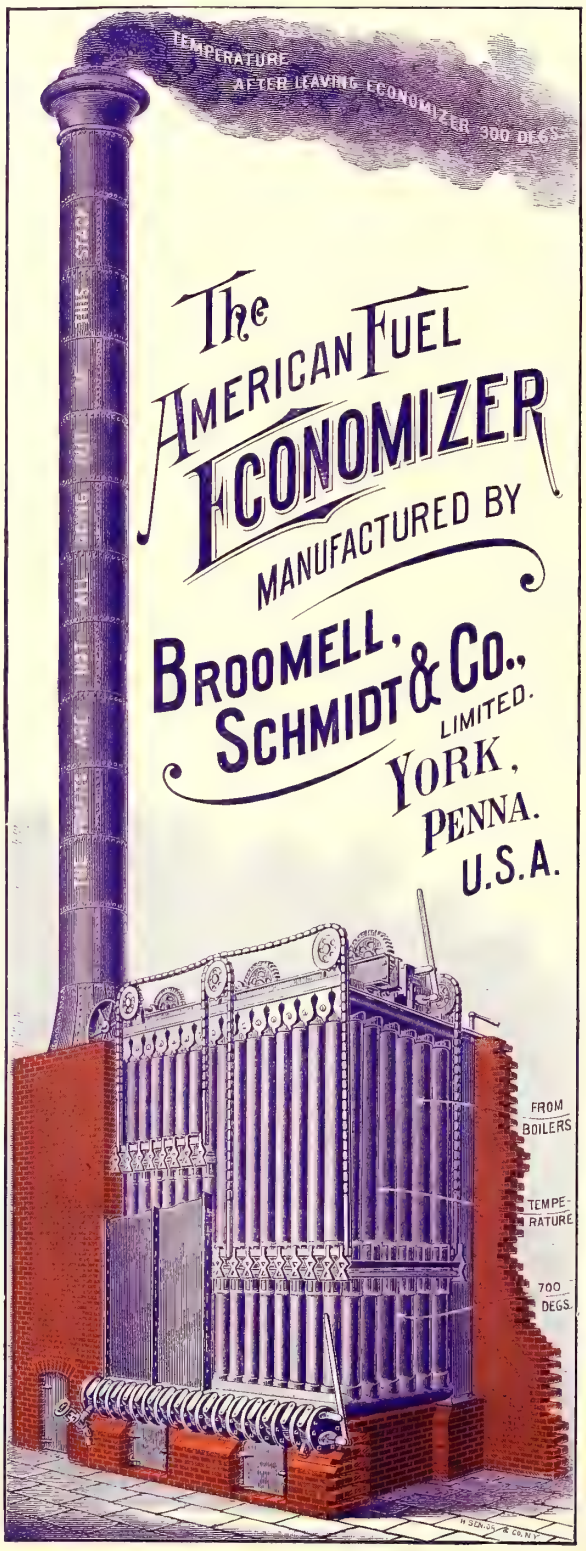
The boilers will be equipped with the latest pattern of mechanical stokers and smokeless furnaces, the whole making a complete and satisfactory plant which will produce steam at a cost below that on any other system

We are prepared to install induced draft systems and to guarantee all the above desirable results. We build our own engines and smoke fans, which are carefully designed and built in the very best possible manner from heavy steel plates strongly braced with angle and T irons.

We also recommend induced draft fans of very ample proportions. Mistakes that have been made on this system all come from using badly designed fans of entirely inadequate proportions.

Send full particulars, and will be glad to make plans and specifications.

BROOMELL, SCHMIDT CO.
(LIMITED)
YORK, PA.



American Fuel Economizer...

IF AN **American Economizer** is installed in your boiler plant, the results will be highly satisfactory for the following reasons:

1st. There will be an actual and genuine saving of fuel of from 10 to 25 per cent., which would otherwise be lost entirely.

2nd. There will be an increase in the capacity of your boiler plant, oftentimes sufficient to save investment in additional boilers.

3rd. There will be a great saving in the matter of boiler repairs, because the very hot water freed from impurities fed to the boiler prevents unequal expansion and accumulation of mud and scale.

4th. There will be less necessity to renew boilers, their lives being prolonged for the reasons given above.

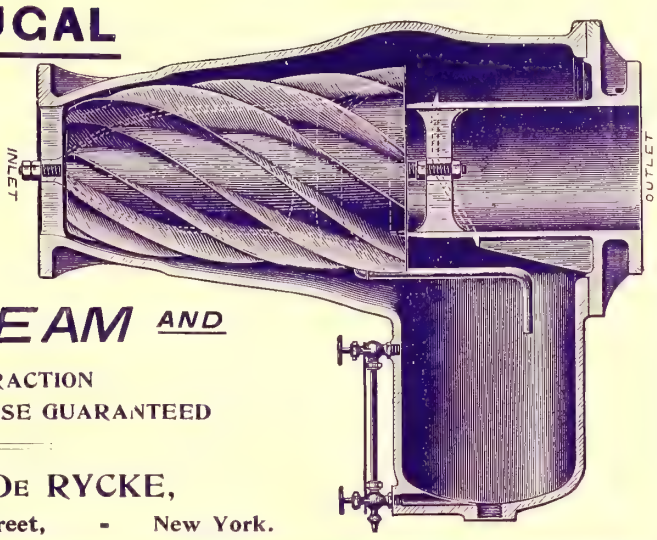
5th. There will be less necessity to shut down for cleaning boilers, because the impurities contained in the feed water are precipitated in the Economizer in place of the boiler. The slow movement of water through the Economizer gives the time required to accomplish this result.

6th. There will be a great improvement in the matter of steam pressure because of the large amount of very hot water contained in the Economizer, which is always ready to draw on in case of a sudden call for steam.

7th. There are very many uses for hot water in manufacturing plants other than for feeding boilers. Packing houses use the water for many purposes; sugar refineries find continued calls for large quantities of hot water; dye houses and bleachers use hot water continually. Mills or factories can be heated by the circulation of hot water drawn from Economizers without any cost whatever.

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CENTRIFUGAL

STEAM SEPARATOR
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ABSOLUTE EXTRACTION
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The WEBSTER System of Steam Heating Vacuum Feed Water Heater and Purifier.

Applicable to old or new Power Plants
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Standard Surface Condenser,

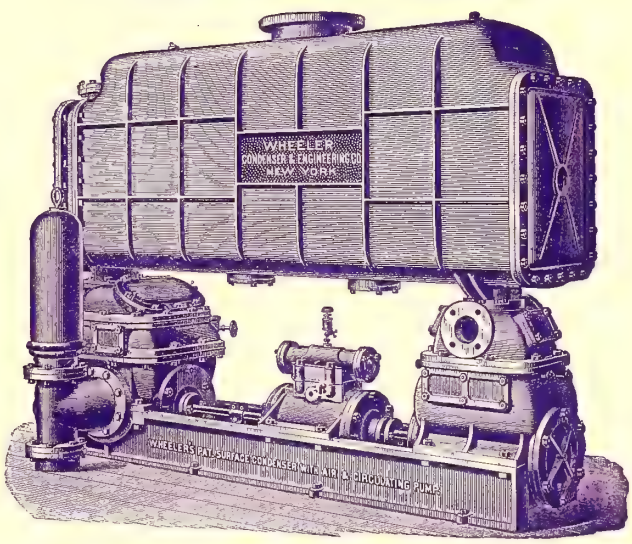
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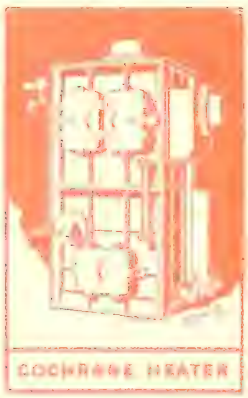
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We can also Refer to Many of the Largest Lighting Plants Throughout this Country and Europe



Why a Feed-Water Heater is Important.

Because for every 10° added to the temperature of the water before it enters a boiler about 1% of the total fuel otherwise required will be saved.

The theoretical saving is under one per cent. The actual saving, as demonstrated by numerous tests, both in this country and in Europe, ranges as high as one and four-tenths (1.4) per cent., with 1.2 as a fair average.

This means that if your initial supply (the cold water from your main, well, pond, or other source), has a temperature of 50° F. all the year round, you can, with exhaust steam at atmospheric pressure, heat this water to, say, 210° F.—a difference of 160°—and the saving will be from 16% up to 22%, with 19% as the average.

The Cochrane Heaters are noted for giving the full value of exhaust steam both for heating and really purifying water, for the ease with which they may be cleaned and for their general serviceability.

HARRISON SAFETY BOILER WORKS

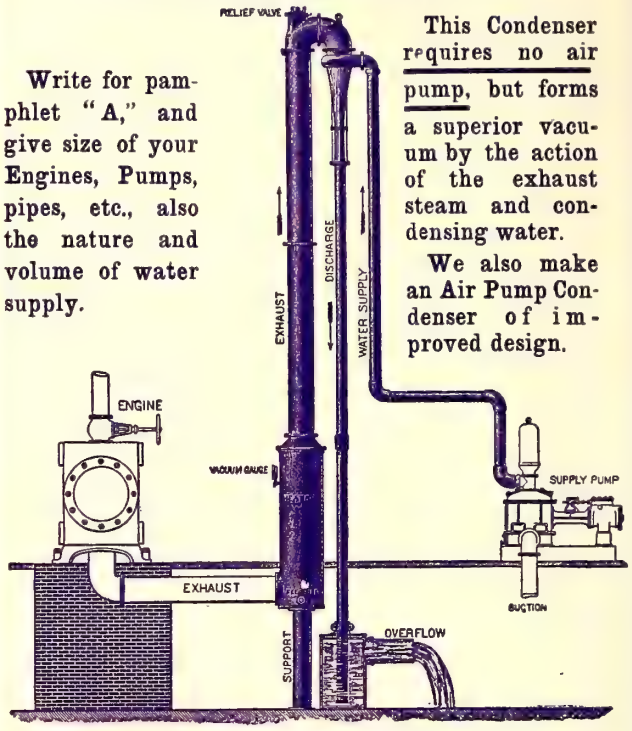
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"Injector"

CONDENSER



Write for pamphlet "A," and give size of your Engines, Pumps, pipes, etc., also the nature and volume of water supply.

This Condenser requires no air pump, but forms a superior vacuum by the action of the exhaust steam and condensing water.

We also make an Air Pump Condenser of improved design.

HENRY W. BULKLEY,

Manufacturer. 145 Broadway, NEW YORK.



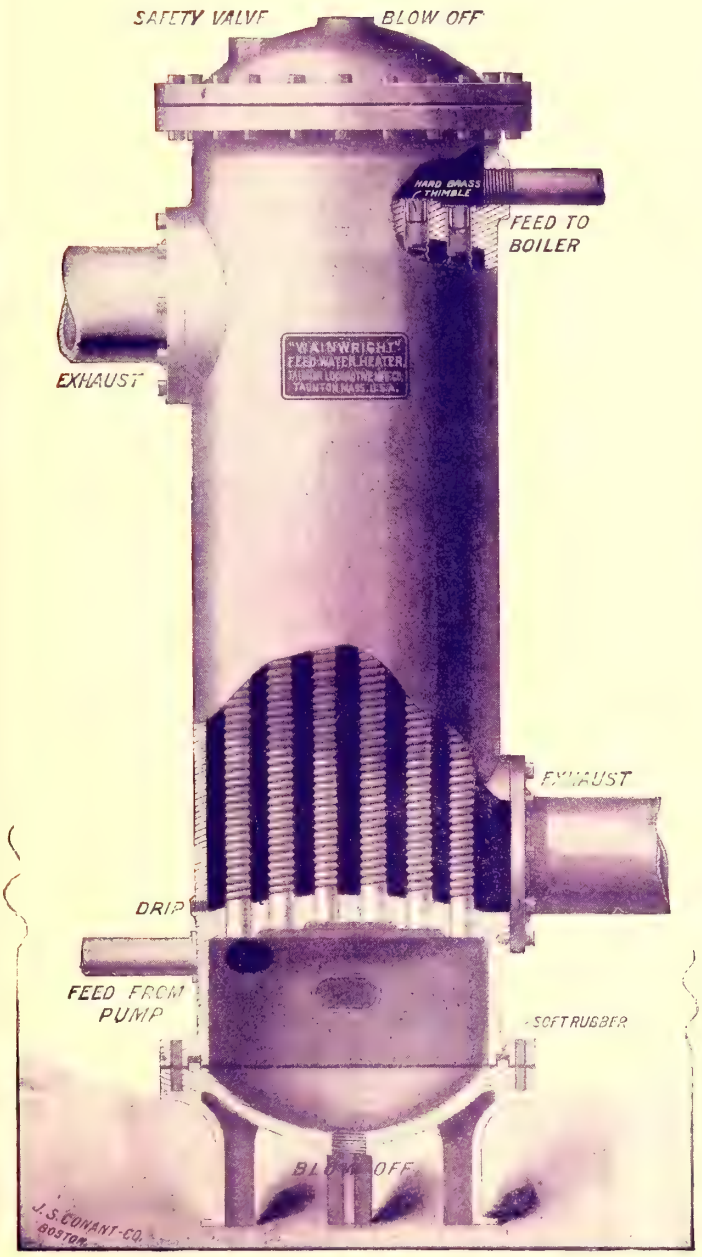


...WAINWRIGHT...

FEED-WATER HEATERS

CATALOGUE "E," 1899

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Taunton, Mass., U. S. A.



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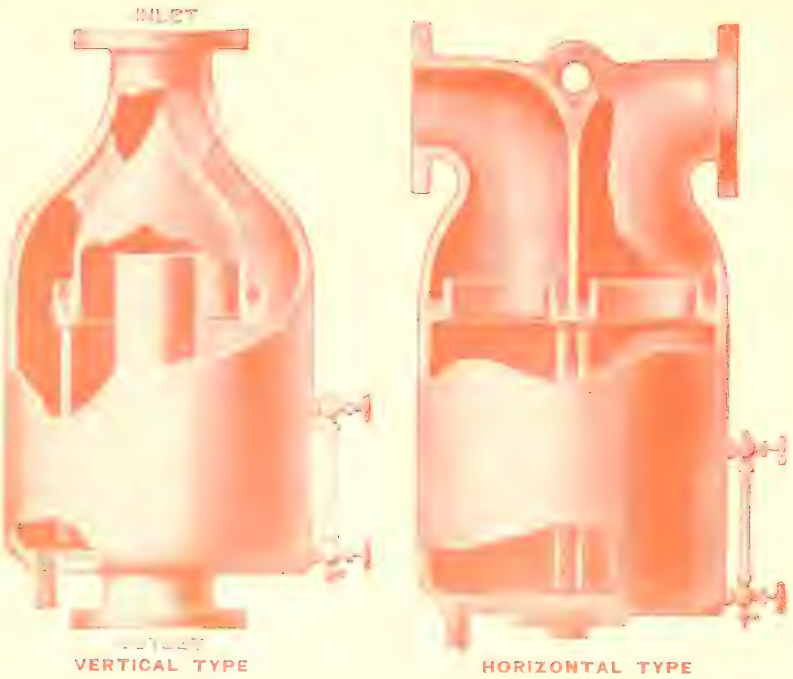
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WAINWRIGHT
Surface Condensers

SPECIFIED BY_____
UNITED STATES GOVERNMENT
FOR

MANILA REFRIGERATING
...PLANT...

WAINWRIGHT
..Expansion Joints..



HOPPES
Steam Separators and Oil Eliminators

ARE LARGER AND DIFFERENT FROM ALL OTHERS ON THE MARKET. . . . . .

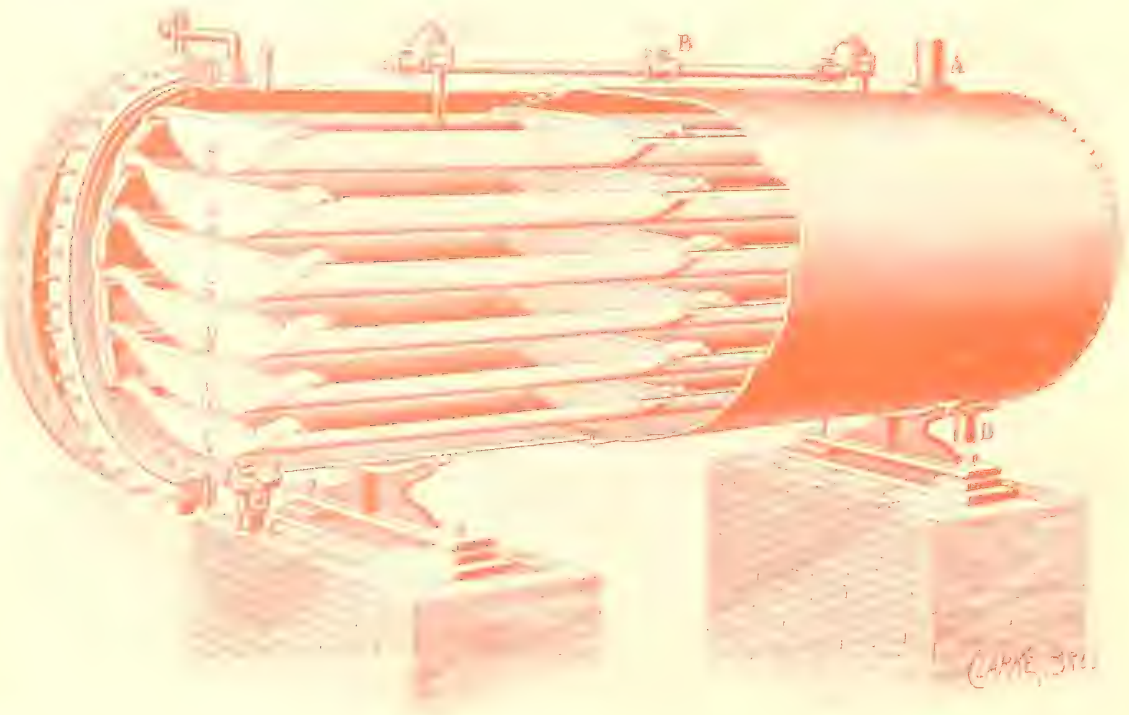
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THE BODY OF THE SEPARATOR IS TEN TIMES THE AREA OF THE PIPE

No "Baffle" Plates.
No "Zig-zag" Motion.
No "Corrugated" Surfaces.
No "Centrifugal" or "Whip Snapping" Motion.
No "Whirligigs" or other loose parts, but a Separator that Separates — Without Friction.



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ARE GUARANTEED TO HEAT FEED-WATER TO BOILING POINT

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Rails and Track Material

Bridges and Structural ...Work...

Street Railway Journal
October, 1899

FOR ALPHABETICAL INDEX TO ADVERTISERS, SEE PAGES 23-25

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We are the patentees of this form of Joint and have perfected it in all of its details. Our years of experience have enabled us to produce the only complete and perfect apparatus for Cast Welding Joints. We will be pleased to submit estimates for welding or quote price for complete Welding Outfits and License, thus enabling roads to do their own welding.



COMPLETE CONSTRUCTION OF ELECTRIC RAILWAYS

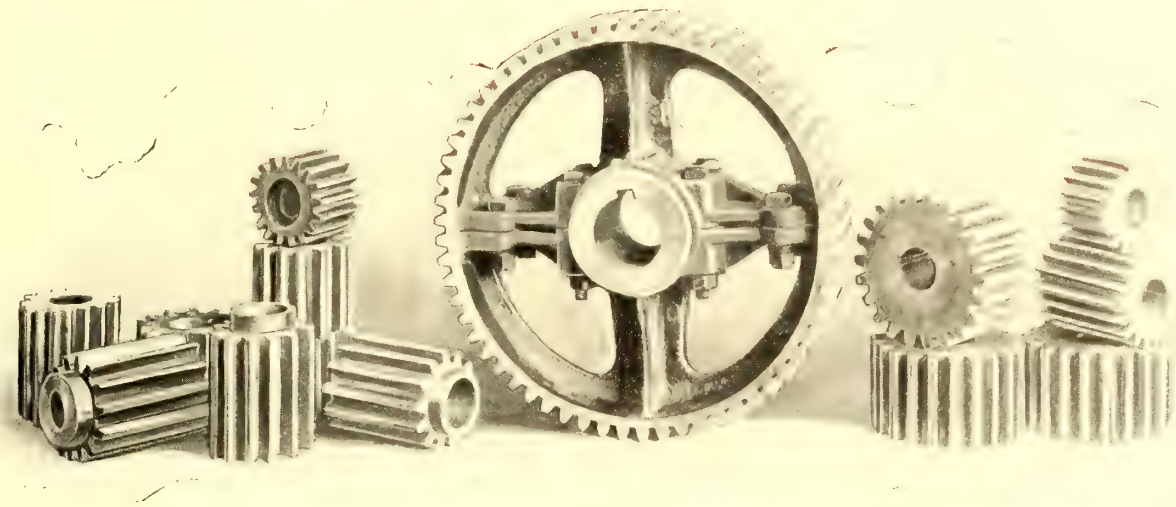
Our reputation in this line of work is well established. We are prepared to undertake the complete Construction or Re-construction of entire Electric Railways, Urban or Inter-Urban, including Power Plant, Roadway and Overhead, or any part thereof.

Eastern Representatives
WENDELL & MAC DUFFIE
26 Cortlandt St., New York

Southwestern Representative
L. P. QUENTIN
311 Security Building, St. Louis

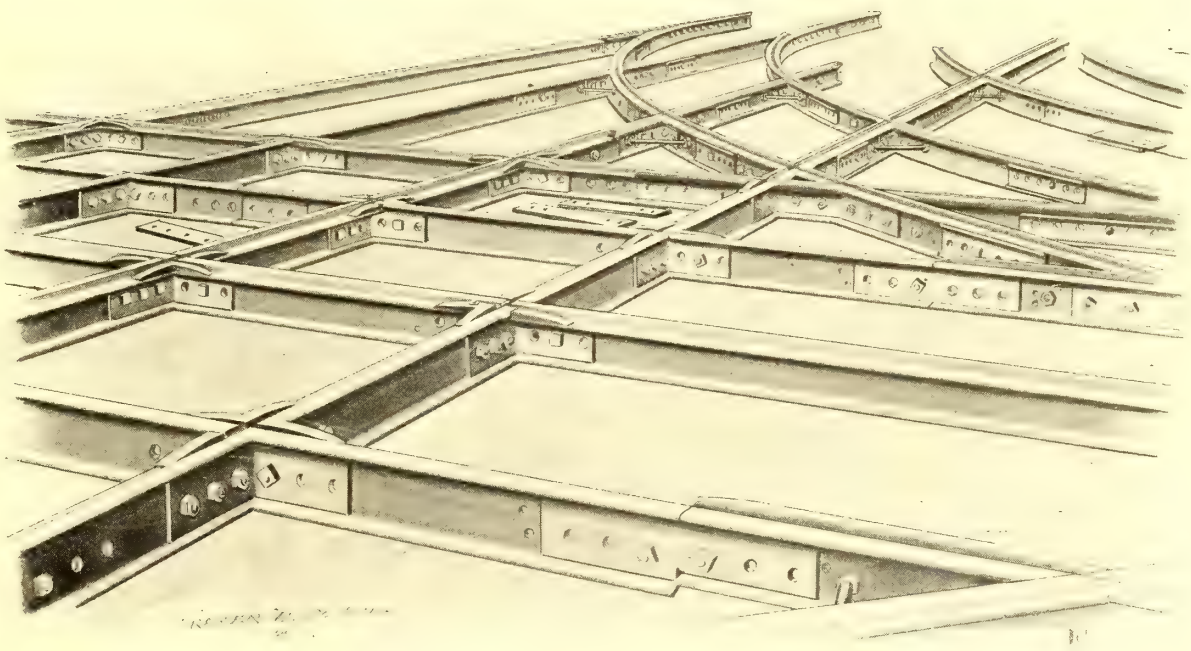
Pacific Coast Representative
IRA BISHOP
23 Stevenson St., San Francisco

THE FALK COMPANY, Milwaukee, Wis., U. S. A.



GEARS AND PINIONS

We aim to offer the GREATEST VALUE for the LEAST MONEY in GEARS and PINIONS and we claim that our gears cost LESS PER CAR MILE OF SERVICE than any others on the market. Our facilities for producing the most perfect work are constantly being added to. Prices always satisfactory.



SPECIAL WORK

We have just added a large number of the most modern and improved machines for this line of work, and our facilities for producing work of the highest quality are unsurpassed. We make FROGS, SWITCHES and CROSSINGS for electric, Cable and Steam Roads.

WRITE FOR ESTIMATES

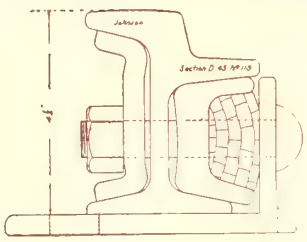
Eastern Representatives
WENDELL & MAC DUFFIE
26 Cortlandt St., New York

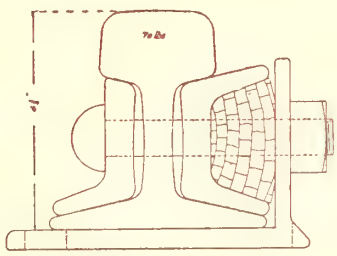
Southwestern Representative
L. P. QUENTIN
311 Security Building, St. Louis

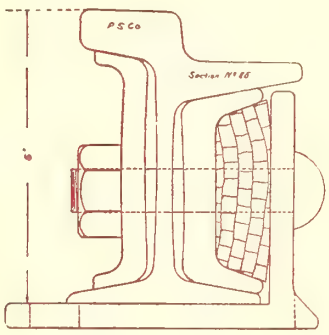
Pacific Coast Representative
IRA BISHOP
23 Stevenson St., San Francisco

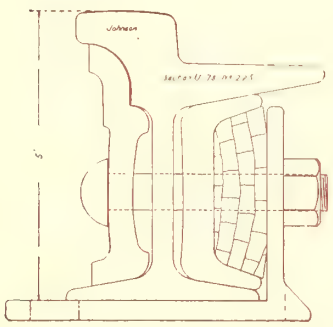
THE WEBER RAIL JOINT

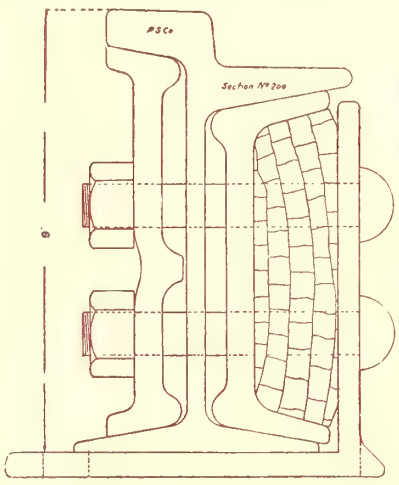
IS IN USE ON EVERY TYPE OF TEE AND GIRDER RAIL.











HAS A RECORD OF MORE THAN 10 SUCCESSFUL YEARS IN THE STEAM AND STREET RAILWAY FIELDS.

COSTS ABOUT 1/3 MORE THAN THE ANGLE BAR JOINT AND ADDS MORE THAN 1/3 TO THE LIFE OF THE RAIL.

THE JOINT IS SO CONSTRUCTED AS TO INSURE AN ABSOLUTELY PERFECT FIT AT EVERY POINT OF CONTACT, THE MOST IMPORTANT FEATURE IN A JOINT.

ITS SUSTAINING STRENGTH IS GREATER THAN THE RAIL ITSELF, AND IN MANY INSTANCES IS NOW IN USE ON THE THIRD SET OF RAILS.

ALL PARTS ARE MADE FROM ROLLED STEEL AND 100% OF THE JOINTS ARE GUARANTEED AGAINST BREAKING WITHIN THE LIFE OF THE RAIL.

THIS JOINT WHEN APPLIED TO OLD SURFACE BENT RAIL ENDS WILL RESTORE TO SURFACE IN A SHORT TIME. ON APPLICATION WE WILL NAME MANY REFERENCES AS TO SUCH REDEEMED TRACK.

WEBER RAILWAY JOINT MANUFACTURING CO.

EMPIRE BUILDING,

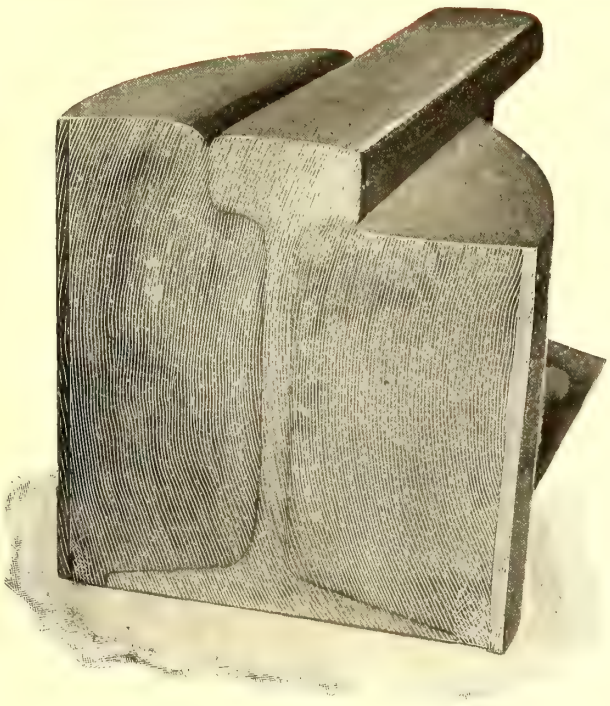
71 BROADWAY, NEW YORK CITY.

BOSTON: MASON BUILDING.

CHICAGO: OLD COLONY BUILDING.

BALTIMORE: EQUITABLE BUILDING.

Steel Jacket Cast Weld Joints



We are now on our third season of successful welding of our **Steel Jacket Cast Weld** railjoints, and among other contracts are now completing the contract for the Milwaukee Electric Railway and Light Company of 20,000 joints, and a contract for the Columbus Street Railway Company of 5,000, and have licensed the Calumet Electric Railway Company of Chicago to weld several thousands of joints under our patents.

Our **Steel Jacket Cast Weld Joint** is pronounced a success wherever it has been introduced, and our contracts have all been doubled.

The breakage of our joint has not been 1%, and the electrical conductivity has been over 100%.

The joint made by us must in every instance be a fused joint, that is, absolutely welded. Attaching to the sides of the rail as we do, there is nothing but the actual weld to hold the joint.

We have welded joints in sizes from a 3⅜ forty-pound "T" rail to a 9-inch ninety-two pound girder rail, all with equal success.

We are the pioneers in suburban welding. In 1898 we welded eight miles between Milwaukee and South Milwaukee for the Milwaukee Electric Railway and Light Company, and this year are welding fifteen miles between Milwaukee and Wauwatosa. This was all exposed rail on suburban lines, and the one year's test has proven the efficiency of our cast welding on exposed rails, and the additional welding this year proves the practicability and success of our joint on suburban track.

Some of the points of excellence of our steel jacket cast weld joint :

We heat the rail before welding.
We heat the jacket before welding.
We fuse our cast iron to the rail and the jacket.
This fusion makes the jacket, the rail, and the cast iron one integral body.
The fusion makes a perfectly welded joint of cast iron and steel outside and inside the welded joint.
The absolute fusion makes a perfect joint with electrical conductivity equal to that of the rail.
No ties have to be removed to weld our joint.
The firmness of the road-bed is undisturbed.
The sides of the joint are perpendicular and easy to pave against.
Our joint is as stiff as the rail itself and as durable.
It is not necessary to have any iron below the rail.
If you are interested in welding, write to us personally for prices and information,

Address: Milwaukee Railjoint and Welding Company,

MILWAUKEE, WIS.

Eastern Office: 1115 New England Building, Cleveland, O. HENRY L. PRATHER, General Agent.

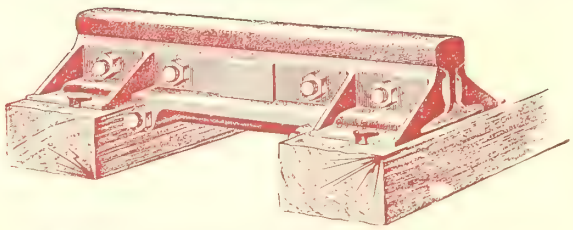
ATLAS RAIL JOINTS

We Stand with an Unbroken Record of Never a Complaint

TO AVOID DELAYS, WE ADVISE YOU TO ORDER AT ONCE

For the past two years we have been behind from four to six months on all deliveries. No charge for patents and we sell you at less price than you can buy the raw material. Every joint guaranteed as long as you run over them. You can't break them. You can't get them down. The alignment of your track is perfect. **Made of the Highest Grade of Malleable Iron.** We fit any rail or rails.

NOTICE **the large base surface on the ties! The bearings in contact with the rails! The truss under the meeting of the rail! The distribution of metal to brace against and resist the greatest strains.**



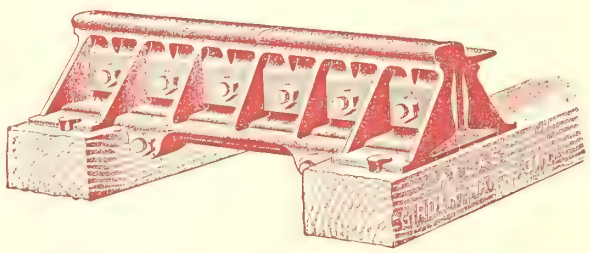
☞ Joint No. 1 is with a double truss, it is composed of two like sections, one on each side of the rail.



Joint Section No. 2.

Is to be placed on outside of rail and used in conjunction with an angle bar or fish plate.

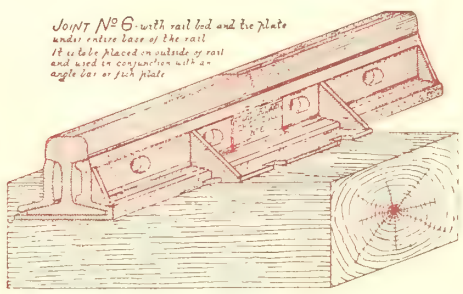
☞ Joint No. 2 with bed and tie plate under entire base of the rail. (All in one piece).

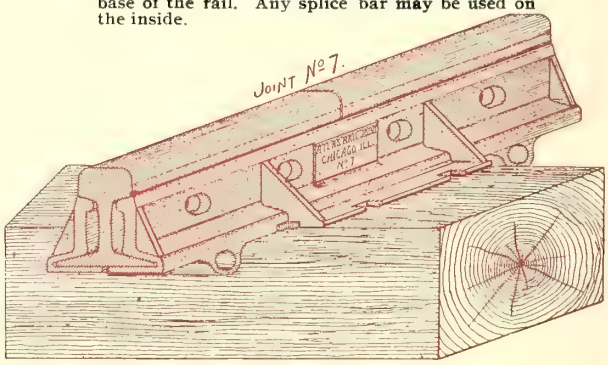


☞ Joint No. 4 is complete with double truss. It is composed of two like sections, one on each side of rail.

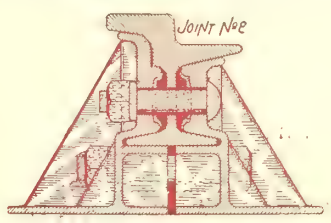


☞ Joint No. 5 with rail bed and tie plate under entire base of the rail. Any splice bar may be used on the inside.

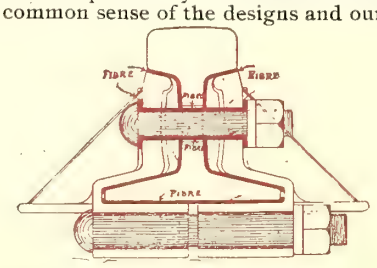




Any of our Joints are adapted to be changed to a "tie" joint—note No. 6 and 7. How about your troubles with COMPROMISE joints? These joints make the track continuous; in effect securing silence, comfort and economy. **Why are these results obtained?** A look at the joints will explain why. These are stronger and cheaper than any other joints. The ease with which they are applied, as well as the common sense of the designs and our experience, enables us to **guarantee them.**



☞ Joint No. 8 shows rail raised to surface of street to avoid the use of chairs.



☞ Joint No. 9 Water Proof Insulated.



☞ No. 3 Rail brace and tie plate combined. Made to fit any rail.

☞ DATA REQUIRED IN ORDERING JOINTS

1—Full size section drawing of rail with figured dimensions.
2—Distance of bolt holes center to center.
3—Center bolt holes from bottom of rails.
4—Size of bolt holes.
5—And if the above information cannot be sent in drawings, express end of rail with bolt holes in, and state amount allowed for expansion.

ATLAS RAILWAY SUPPLY CO.

Telephone, 792 Harrison

Suite 1654-7 Monadnock Block, CHICAGO, ILL.

THE TIME FOR ARGUMENT HAS PASSED

THE VALUE OF

Cast-Welded Rail-Joints

IS SO FIRMLY ESTABLISHED THAT IT IS
.. .. NO LONGER DISPUTED .. ..

We Beg to Inform

...STREET RAILWAY...
MANAGERS

And Others

THAT WE ARE

Still Making

CAST-WELDED

RAIL-JOINTS

OF SUPERIOR QUALITY
AND AT REASONABLE PRICES

OUR CAST-WELDED JOINTS ARE NOT AN INFRINGEMENT UPON ANY PATENTS.

OUR WORK SPEAKS FOR ITSELF
WRITE US WHEN IN THE MARKET

ADDRESS SUITE 1319-1322 MONADNOCK BUILDING
CHICAGO, ILL.

The American Improved Rail-Joint Co.

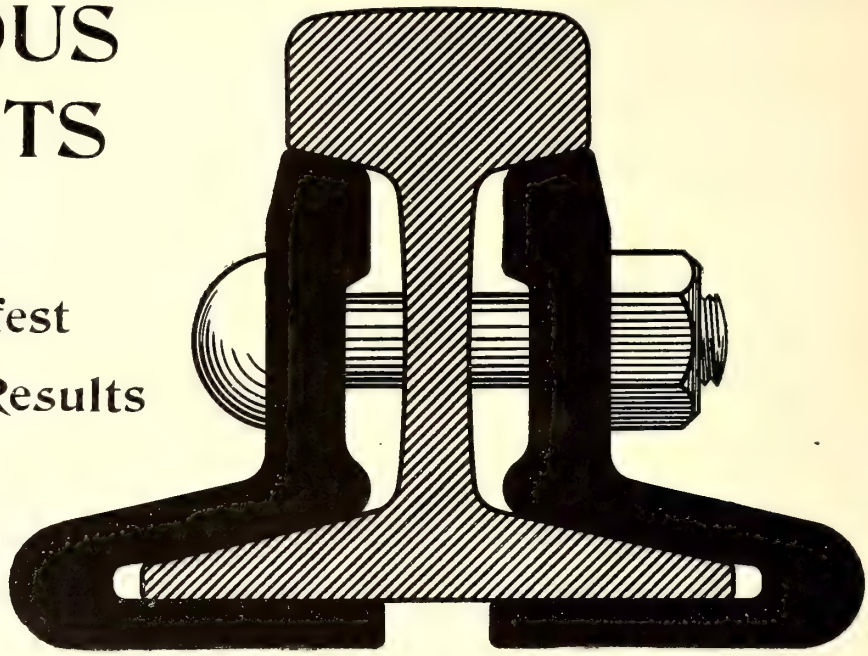
CONTINUOUS RAIL JOINTS

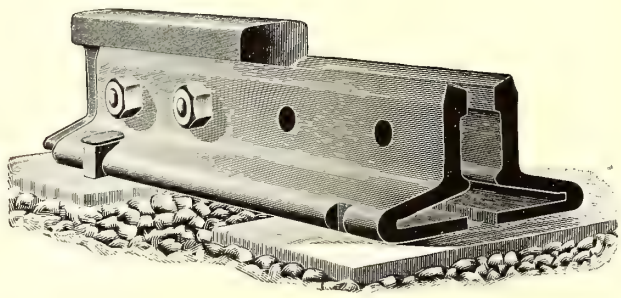
Fewest Parts

Strongest and Safest

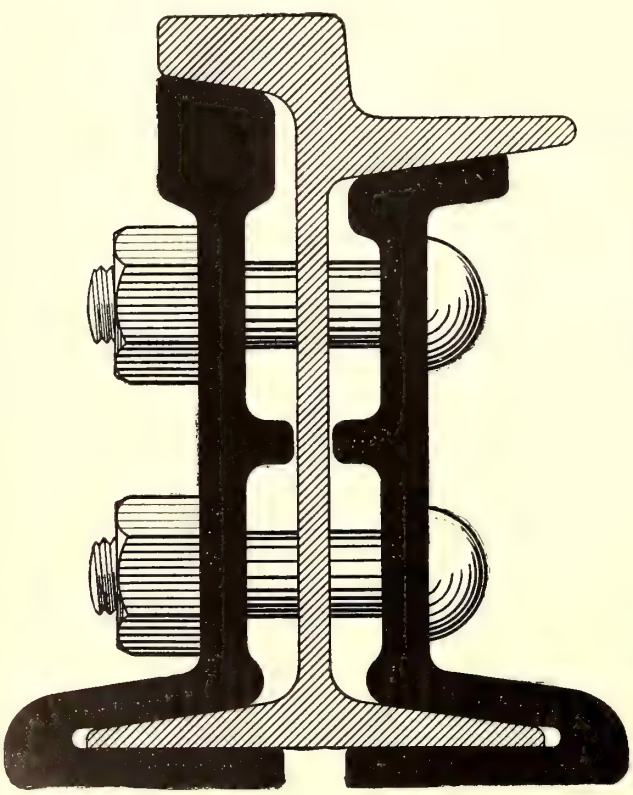
Best Economical Results

Provides for Increased Tonnage up to Date





MILLIONS IN USE ON EIGHTY RAILROADS IN THE UNITED STATES



Manufactured only by

CONTINUOUS RAIL JOINT CO. OF AMERICA

General Offices

908-911 Lawyer's Building

NEWARK, N. J.

Branch Agencies

BOSTON: John Hancock Building

CHICAGO: 917 Monadnock Block

ST. LOUIS: Security Building

The American Standard Rail-Joint

NEARLY 100,000 SOLD THIS YEAR



GUARD RAIL BRACE



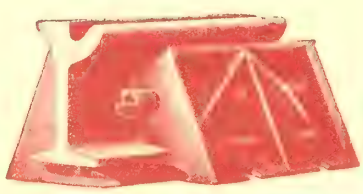


CURVE BRACE

No Bolts or Nuts to get loose. Can apply Ten while applying One of Angle Plates.







INTERMEDIATE OR CHAIR

The Base of our Joints are Wider than any others.

There is no joint made that will grip the rail so tightly as it does.

It is the only joint made that has a base that is double or over the base of the rail.



There is no other joint made that supports or braces the rail at the top as we do.

It is the only joint made where a special perfectly fitted pattern is made for each section of rail.

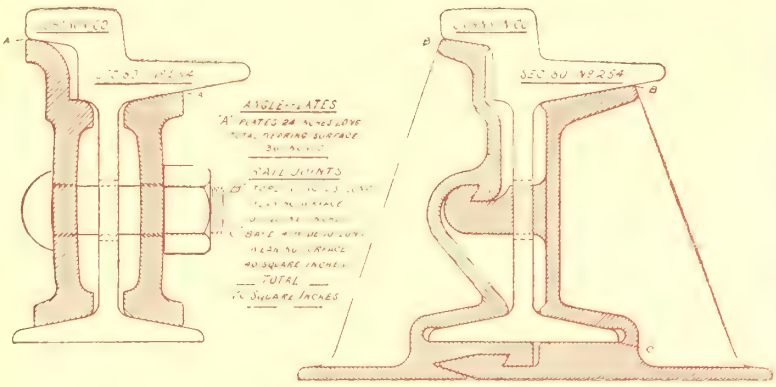
Made of any length—and to fit any rail.

It has a much greater wearing surface to support the rail than any other joint made.

Below find comparison showing the amount of square inches of our joints as compared with the usual angle-plates.

It is the only joint made that is ground to fit the rail.

It has a much greater wearing surface to support the rail than any other joint made.



They allow for equal distribution of expansion and contraction better than any other joint made.

They are more easily and quickly applied than any other joint, and much cheaper.

Having our own Malleable Iron Works completed, we are now prepared to give all orders prompt attention

THE CHISHOLM & MOORE MFG. CO.

CLEVELAND, OHIO

DIAMOND STATE STEEL CO.

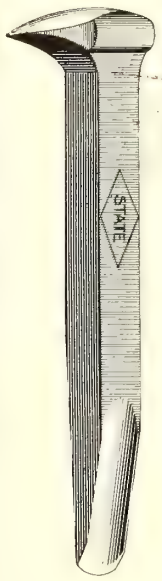
Established
1853

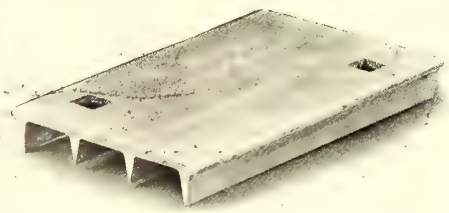
Incorporated
1899

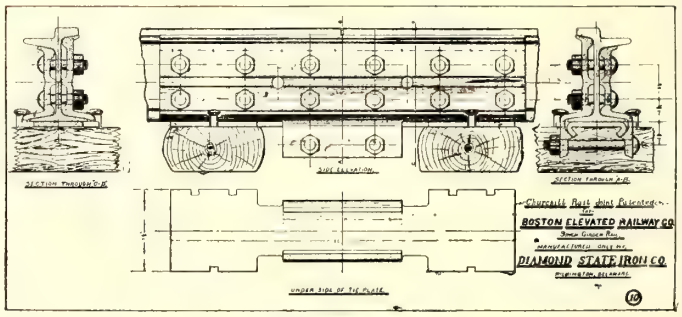
New York Office
29 BROADWAY

Philadelphia Office
REAL ESTATE TRUST BUILDING

Main Office
and Works
...WILMINGTON, DEL.







Manufacturers of the...

"CHURCHILL" RAIL JOINT

For all sizes of "T" and Girder Rails. A simple and strong device, based on correct mechanical principles.

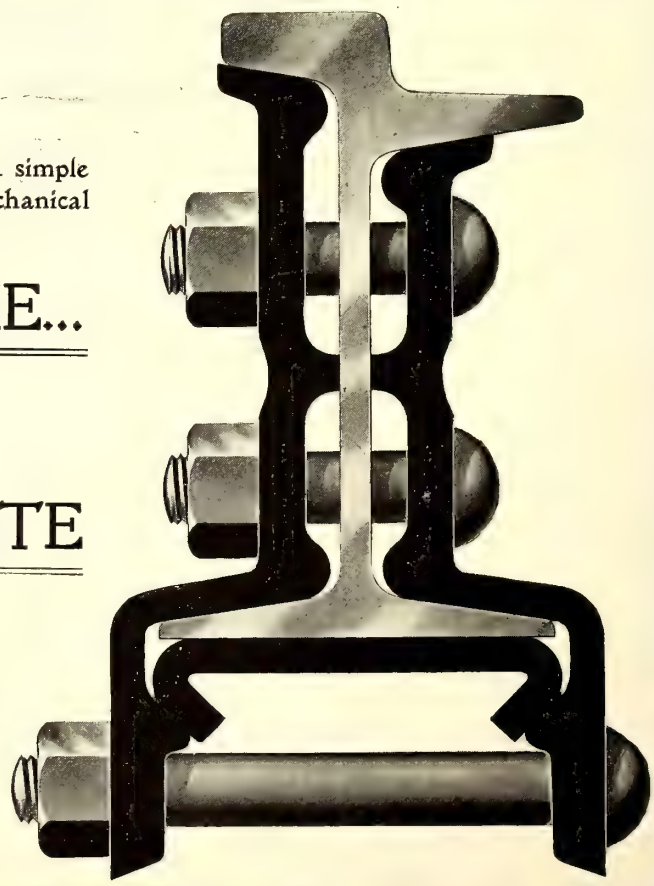
THE "DIAMOND" SPIKE...

Enters the wood with the least possible disturbance of fibre.

We also manufacture the

"DIAMOND" TIE-PLATE

Splice Bars, Track Bolts, Machine Bolts, Nuts and Washers; Boiler, Boat and Bridge Rivets, Bridge Rods, Merchant Bar Iron, Rivet Rods, Horse-Shoe Iron, Horse and Mule Shoes, Car and other Forgings; Machine, Track and other Castings.



HENRY L. PRATHER

1115 New England Building, Cleveland, Ohio

RAIL WELDING EXPERT

Inspection of tracks and estimates for welding on application.....

Manager Cleveland Office for the
MILWAUKEE RAIL-JOINT AND WELDING COMPANY

Cast Weld Steel Joints

Most perfect mechanically and electrically

THAT WE HAVE ACCOMPLISHED RESULTS WHERE OTHERS HAVE FAILED IS UNIVERSALLY ACKNOWLEDGED

OUR GUARANTY GUARANTEES

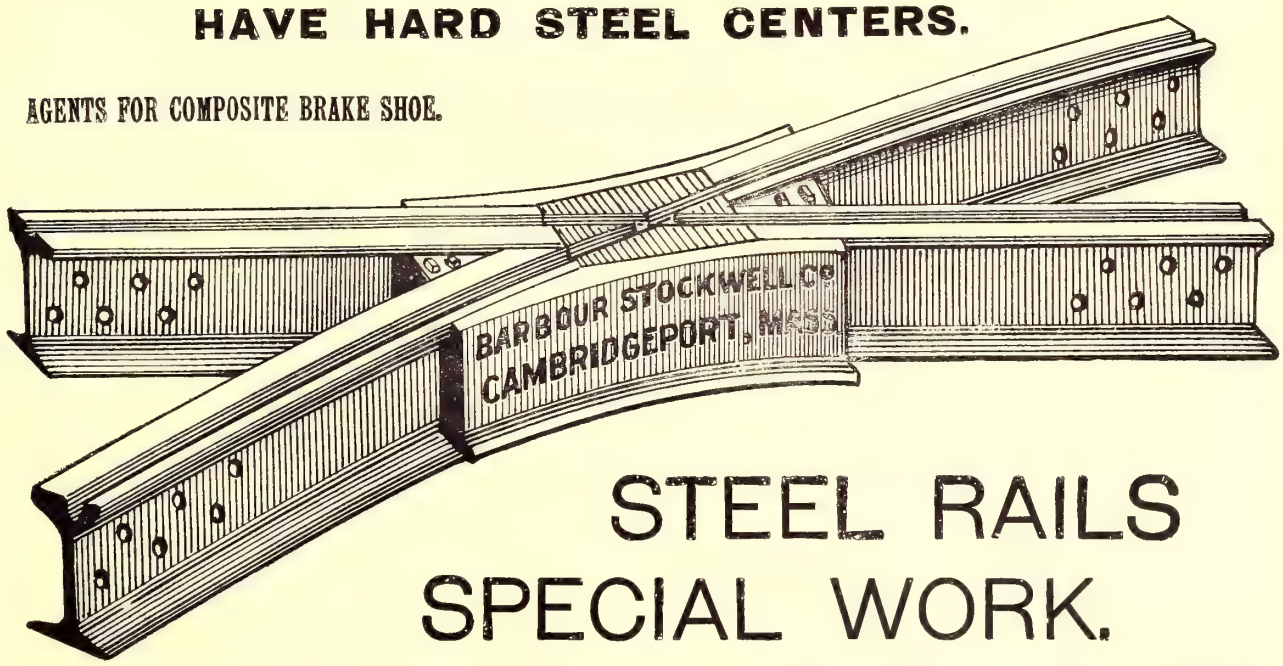
Territorial Agent for....

MORRIS ELECTRIC COMPANY, of New York, N. Y.
"MORRIS" ONE PIECE RAIL BOND

BARBOUR-STOCKWELL CO.

SWITCHES, MATES AND FROGS HAVE HARD STEEL CENTERS.

AGENTS FOR COMPOSITE BRAKE SHOE.



STEEL RAILS
SPECIAL WORK.

205 Broadway, - Cambridgeport, Mass.

BUSINESS ESTABLISHED IN 1859

AND "IN THE LEAD" IN 1899.

WM. WHARTON, JR. & CO.

INCORPORATED.

PHILADELPHIA, PA.

... Girder and Other Rails for Street Railways ...

WE ARE PREPARED TO FURNISH PROMPTLY, GIRDER RAILS, GUARD RAILS, SHANGHAI TEE RAILS AND STANDARD TEE RAILS, COMPLETE WITH FITTINGS. LET US KNOW WHAT YOU WANT AND WE WILL FURNISH IT.

MANGANESE STEEL SPECIAL WORK

Our MANGANESE STEEL SPECIAL WORK has proven under the severest service to be *the best in America*, and after most exhaustive investigation by thorough engineers from abroad, it has been selected by them as *the best anywhere made.*

It gives the longest and most satisfactory service, and while slightly higher in first cost, is by far *the cheapest in the end.*

Theoretically, the intersecting points of special work should be made of a metal as much better than the straight track rails, as the conditions of wear at these points are more severe than they are on the straight track.

After careful investigation and experimenting we became convinced that "MANGANESE STEEL," if it did not fully come up to these theoretical requirements, did so more nearly than any other available metal. This metal, invented by Mr. Hadfield, of Sheffield, England, is unique in that it combines extreme hardness with great malleability, it being possible to bend nearly double pieces of raw "MANGANESE STEEL" castings one-half inch thick, which are at the same time so hard that they can scarcely be touched with a drill. The meaning of this is, that not only are its individual particles extremely hard, but that they adhere to each other with great tenacity, and the combination of these two qualities is the secret of the superior ability of this metal to resist wear. Hardness alone is not sufficient. We hence have adopted "MANGANESE STEEL" for use at the intersecting points of our special pieces.

We have the SOLE RIGHT IN THIS COUNTRY to use this metal in track structures.

We are equipped to Cast-Weld Joints in new or old track. This idea originated with us.

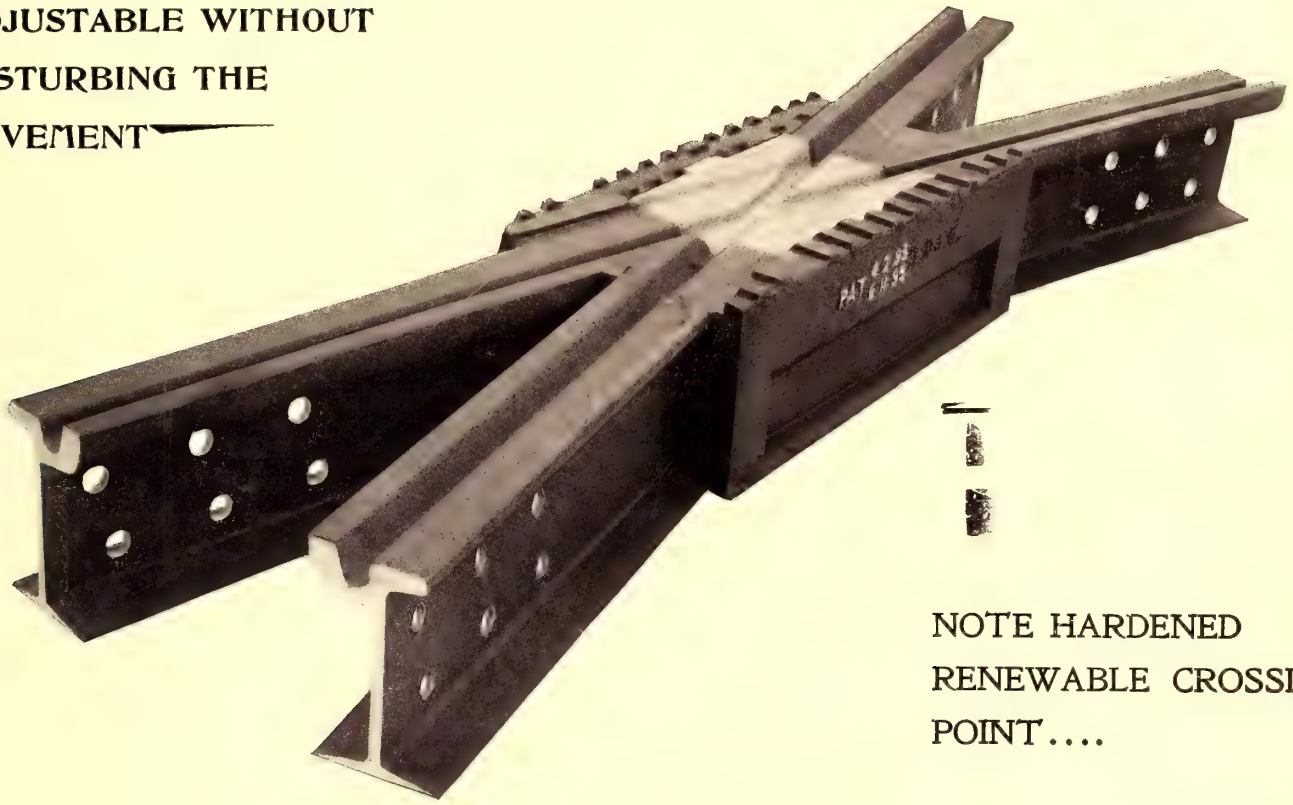
We are prepared to contract for the Building of Track and for Overhead Construction or for the entire Equipping of Roads.

We manufacture Brake Shoes and all kinds of Railway Castings.

GUARANTEE SPECIAL WORK

Insured to Wear as long as the Abutting Curve Rails..

ADJUSTABLE WITHOUT DISTURBING THE PAVEMENT



NOTE HARDENED RENEWABLE CROSSING POINT....

GUARANTEED TO OUTLAST ANYTHING ON THE MARKET

WRITE FOR PARTICULARS

THE LORAIN STEEL COMPANY

JOHNSTOWN, PA.

AN AUTOMATIC ELECTRIC TRACK SWITCH



that is simple and practical,
that will work at all times and not get out of order,

IS JUST WHAT YOU ARE LOOKING FOR.

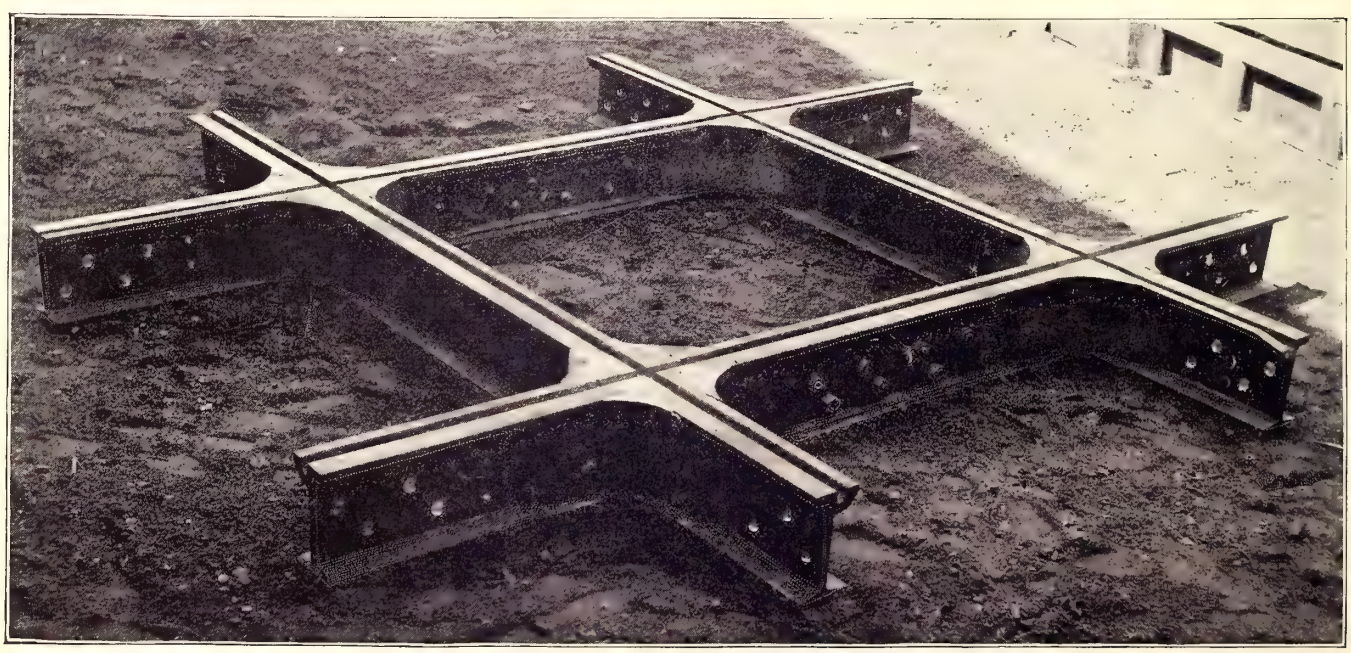
Such a Switch is manufactured by the

New York Switch and Crossing Company,

HOBOKEN, N. J., U. S. A.

This Switch is doing perfect work on some of the best roads in this country. No appliance to put on cars. Write for convincing testimonials and full particulars.

WE WILL FURNISH YOU ONE ON TRIAL.



WE MANUFACTURE

SPECIAL TRACK WORK

OF EVERY DESCRIPTION.

STEEL CONSTRUCTION IN ALL BRANCHES

BUILDINGS DESIGNED AND ERECTED IN ALL PARTS OF THE WORLD

ROOF FRAMES, TRUSSES and GIRDERS
BLAST FURNACES and STEEL WORKS
CUPOLAS, LADLES, CONVERTERS
BOILERS, TANKS and HEAVY PLATE WORK

GAS HOLDERS, PURIFIERS, Etc.
OPEN HEARTH FURNACE CASINGS
CHIMNEYS, RIVETED PIPE, CORRUGATED IRON

Riter-Conley Manufacturing Company Pittsburgh, Pa., U. S. A.

New York Office: 39-41 Cortlandt Street

ELECTRIC RAILWAY SPECIAL WORK,

Frogs, Switches, Curves, Crossings, Rail Braces, Etc.

THE WEIR FROG CO.,
CINCINNATI, OHIO.

RAILS

Joint Fastenings, Tie Rods, Knees, Bolts, Spikes, &c. Curved Rail and Special Switch and Frog Work a Specialty.

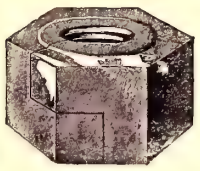
Harrington, Robinson & Co.,
276 FRANKLIN ST., BOSTON.

RAILS **GEORGE H. CAREY,** CARS
1 Broadway, New York.
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"The power plant building which you furnished to our Company has been very satisfactory indeed, and we consider your system of construction especially suitable for power plant work."

E. F. BAKER, GENERAL SUPERINTENDENT, THE BRUSH ELECTRIC COMPANY, BALTIMORE, MD.

"I wish to state that the roof of our electric light station which your Company built for us a few years ago, and which roof was covered with the 'Patent Anti-condensation Corrugated Iron Roof Covering,' has proved itself satisfactory in every particular. The roof is well designed and strong in all its parts, we being able to hoist 20,000 pounds at any point (which has been done on several occasions). I will also state that there has been no condensation of moisture on the underside of this roof since its erection in February, 1894. I believe this kind of roof to be the only practical fire-proof construction for electric light and power stations."

C. F. HEWITT, SUPERINTENDENT, THE ELMIRA MUNICIPAL IMPROVEMENT COMPANY, ELMIRA, N. Y.

"Replying to your letter of July 20th, enquiring as to our experience with your 'Patent Anti-condensation Corrugated Iron Roof Covering' furnished us in 1892, we desire to state that we have never noticed any tendency towards condensation whatever."

L. A. PHILLIPS, SUPERINTENDENT AND SECRETARY, NEW YORK AND QUEENS LIGHT AND POWER COMPANY, FLUSHING, N. Y.

"In reference to our fire-proof roof covering that you furnished us for our power house, which was built in May, 1897, having now been up for two years, we find upon looking the matter up that there has never been one drop of water come through on our generators since the roof was installed, and we consider the covering referred to the best on the market for its purpose, and if we were to build another power house to-morrow we would use your roofing for it."

E. C. TERRY, SECRETARY, THE FARMINGTON RIVER POWER COMPANY, HARTFORD, CONN.

"Relative to 'Anti-condensation Corrugated Iron Roof Covering,' I can say that during the two years use we have found it works as represented, being entirely free from drip, and would use the same again if we were to rebuild."

CHARLES F. PRICHARD, GENERAL SUPERINTENDENT, LYNN GAS AND ELECTRIC COMPANY, LYNN, MASS.

"In 1893, we put on our boiler house at Electric Station one of your 'Patent Anti-condensation Corrugated Iron Roof Coverings.' It has served its purpose very well, we have had no trouble from condensation, and as far as we can see it is in good condition to-day."

AUG. WOLFF, CHIEF ENGINEER, THE NASSAU ELECTRIC RAILROAD COMPANY, BROOKLYN, N. Y.

"In relation to the 'Anti-condensation Corrugated Iron Roof Covering,' we beg to say that we have never had any trouble with this roof, either from sweating or leakage, and consider it a first-class piece of workmanship."

JOHN N. CANDEE, MANAGER, POUGHKEEPSIE ELECTRIC LIGHT AND POWER COMPANY, POUGHKEEPSIE, N. Y.

"Your 'Patent Anti-condensation Corrugated Iron Roof Covering' has been in use for five years; is in good condition now, and has given us excellent satisfaction."

NORMAN McD. CRAWFORD, GENERAL MANAGER, HARTFORD, STREET RAILWAY COMPANY, HARTFORD, CONN.

"We have used your 'Patent Anti-condensation Corrugated Iron Roof Covering' for some time past and have found it entirely satisfactory. The application of asbestos paper to the lower or inner side of the roof entirely prevents the formation of condensation and is particularly desirable for use in power stations where the difference in temperature ordinarily causes dripping from the roof during the winter months."

L. BENTLEY, SUPERINTENDENT, THE NEW LONDON STREET RAILWAY COMPANY, NEW LONDON, CONN.

"I take pleasure in stating that your 'Patent Anti-condensation Corrugated Iron Roof Covering' which has been in use on our power house for the last three years, has given entire satisfaction, and I can heartily recommend it to anyone contemplating the building of a power station. I fail to see how it could be improved, as it has answered every requirement, and has needed no attention as yet."

C. E. DOOLITTLE, MANAGER, THE ROARING FORK ELECTRIC LIGHT AND POWER COMPANY, ASPEN, COL.

"We take pleasure in stating that we are very much pleased with the iron roof and 'Patent Anti-condensation Corrugated Iron Roof Covering' which you furnished for our electric power station in the fall of 1892. The roof has never dripped, condensed moisture from the underside, or caused any trouble of any kind whatever."

ROBERT McCULLOCK, VICE-PRESIDENT AND GENERAL MANAGER, CITIZENS' RAILWAY COMPANY, ST. LOUIS, MO.

"In reply to your inquiries as to our satisfaction with a car-house roof which you erected for us in 1894, I will say that it is in perfect condition to-day; it is water-proof as well as fire-proof, there is no dripping from condensed moisture, its architectural appearance is pleasing, and if I was ordering another roof, I would say, duplicate this, as I could suggest no desirable change."

B. B. NOSTRAND, JR., TREASURER AND MANAGER, THE SING SING ELECTRIC LIGHTING COMPANY, SING SING, N. Y.

"The 'Anti-condensation Covering' with which you lined the corrugated iron roof furnished us in 1894, has fulfilled the guarantee made for it, and we have not been troubled from condensation of moisture and are well pleased with it."

R. CRAWFORD, SUPERINTENDENT, THE STAMFORD GAS AND ELECTRIC COMPANY, STAMFORD, CONN.

"We have found your 'Anti-condensation Corrugated Iron Roof Covering' to be all that you claimed, and recommend its use in electric stations or buildings which must be free from the drip caused by condensation."

JOHN H. KELMAN, GENERAL SUPERINTENDENT, STANLEY ELECTRIC MANUFACTURING COMPANY, PITTSFIELD, MASS.

"Relative to the 'Anti-condensation Corrugated Iron Roof Covering' which you applied to the iron building you constructed for us in 1893, we have had no trouble whatever from condensation on the interior surface of this roof. The asbestos lining accomplishes the desired results. We have used this building as an insulating department in which it is very necessary that no condensation on the roof should occur."

W. O. HALLOWELL, SUPERINTENDENT TORRINGTON AND WINCHESTER STREET RAILWAY COMPANY, BURRVILLE, CONN.

"Will say that we have had your 'Patent Anti-condensation Corrugated Iron Roof Covering' in use on our power plant for over two years, and it does not drip or condense moisture from the underside. I consider it a first-class fire-proof roof covering."

H. W. YORK, CHIEF ENGINEER, THE UNITED ELECTRIC LIGHT AND POWER COMPANY, NEW YORK, N. Y.

"The 'Anti-condensation Roofs' which you placed on our 28th and 29th Street stations about four years ago have given entire satisfaction in every way, and we have never been annoyed by any dripping from the underside, although the largest roof is over the engine-room of our 28th Street station where the air is always moist and warm."

CHARLES A. RICHARDSON, PRESIDENT, THE WORCESTER CONSTRUCTION COMPANY, WORCESTER, MASS.

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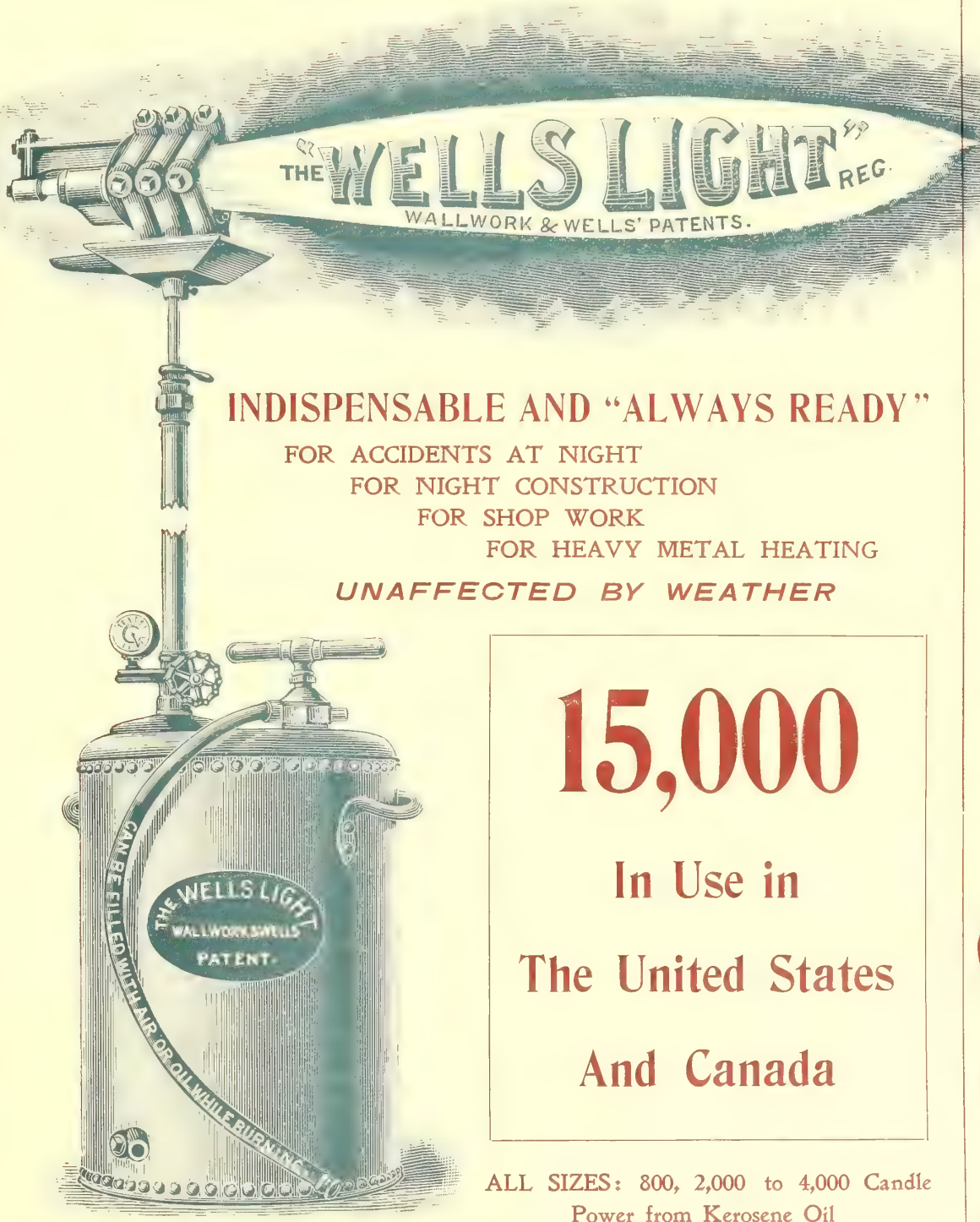
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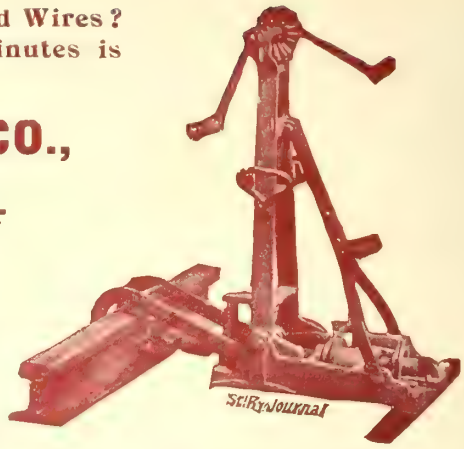
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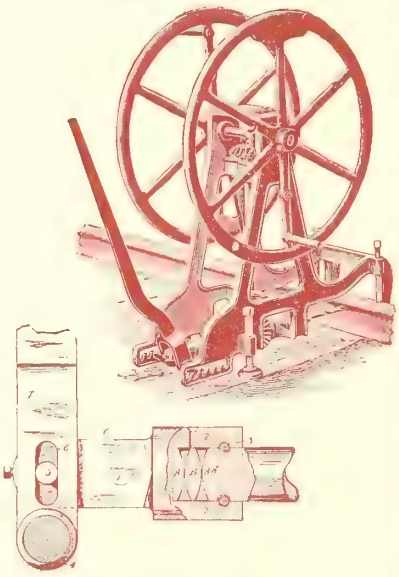
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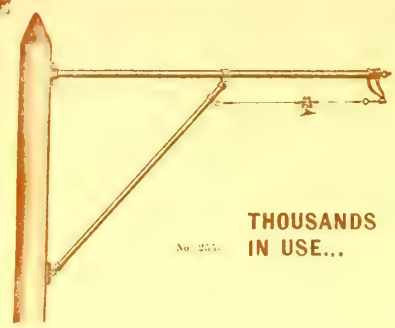
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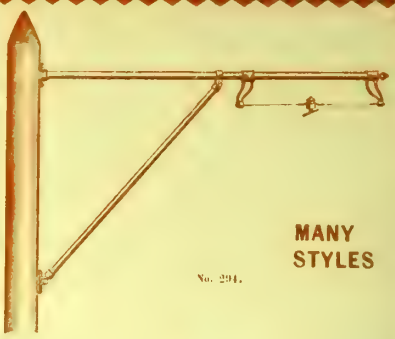
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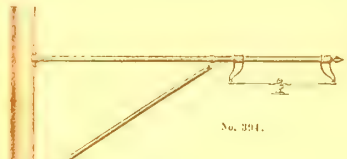
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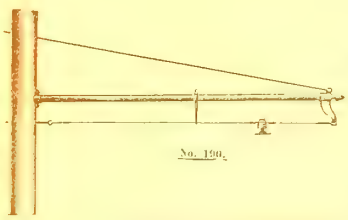
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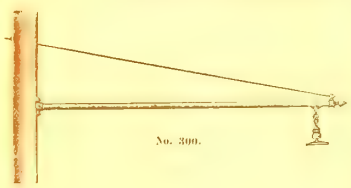


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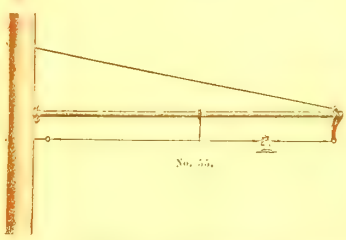


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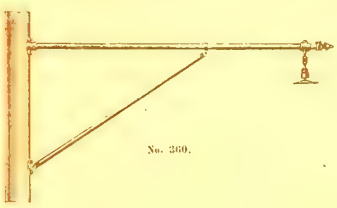


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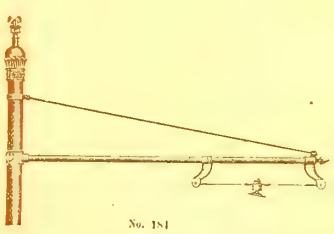


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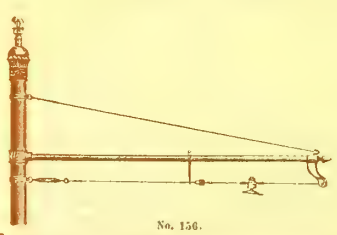


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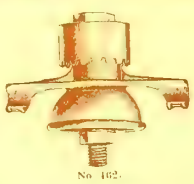


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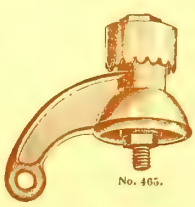
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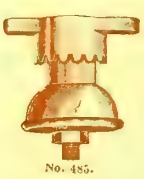
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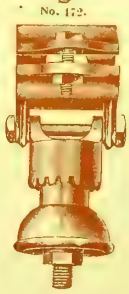
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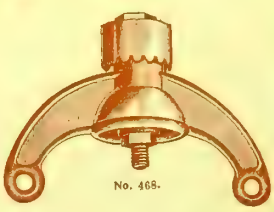
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No. 1111.



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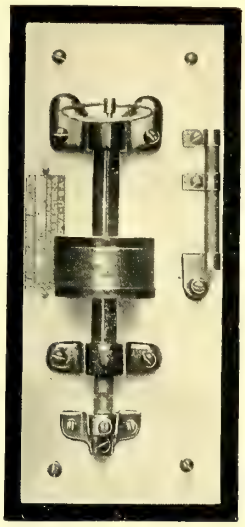


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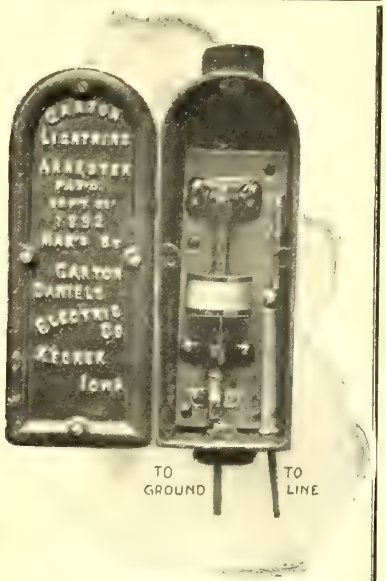


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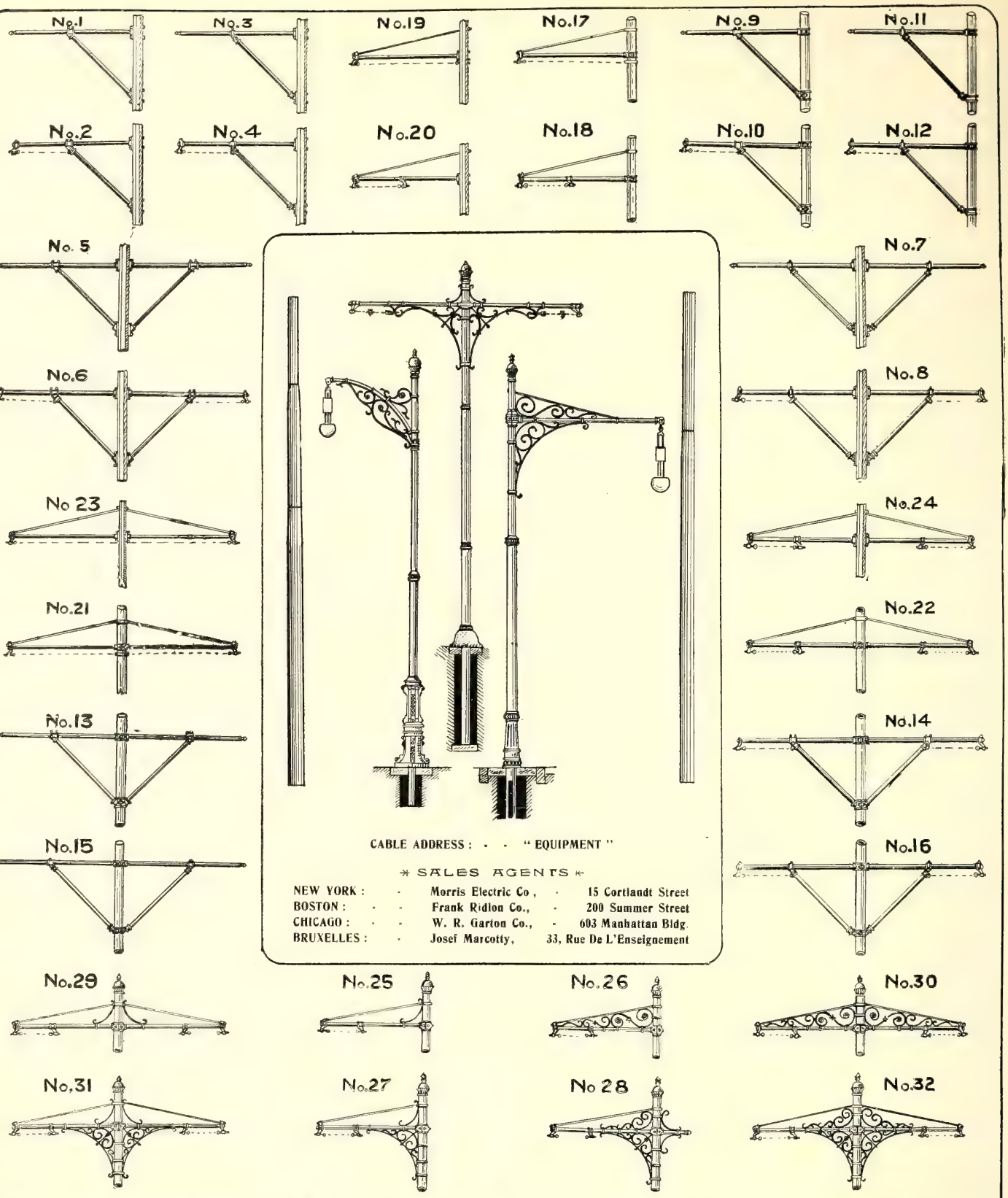
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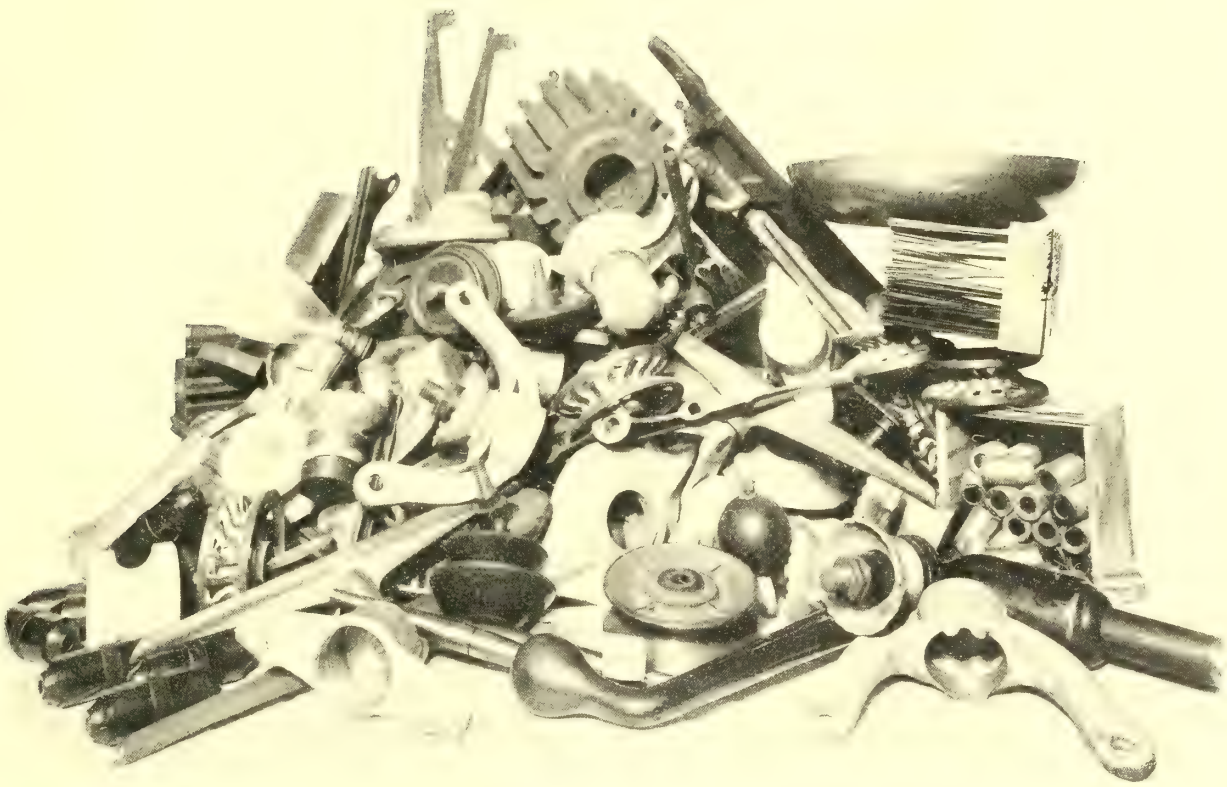
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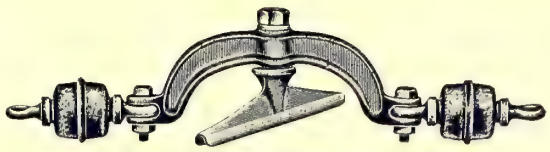





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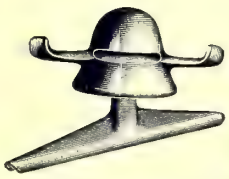
No. 805—BROOKLYN STRAIN.



No. 355—DOUBLE GIANT PULL-OVER.



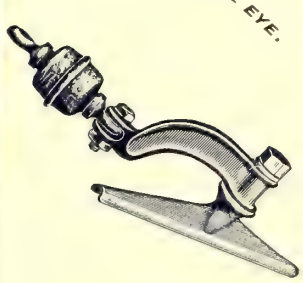
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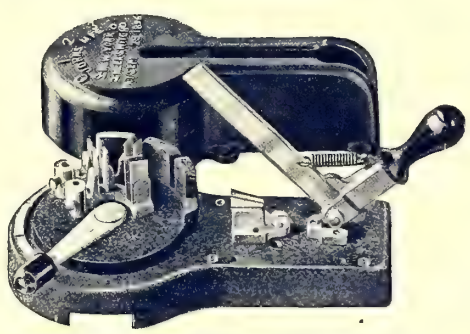
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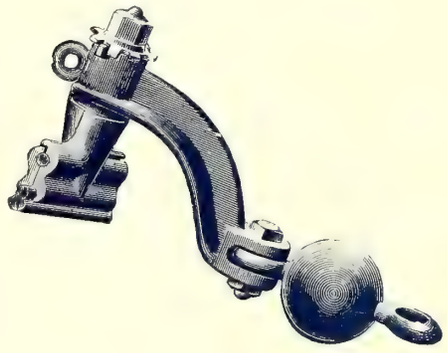
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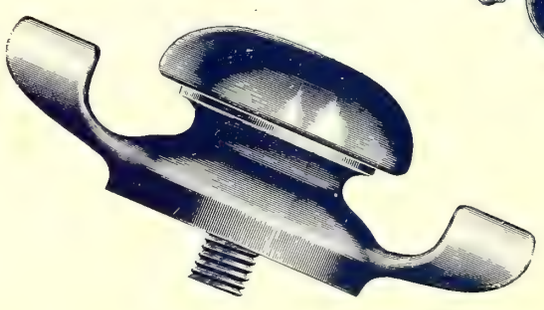
JNO. A. ROEBLINGS' SONS CO. — Trenton, N. J.
Columbia Rail Bonds, Hard Drawn Copper Trolley Wire and Feeder Wire

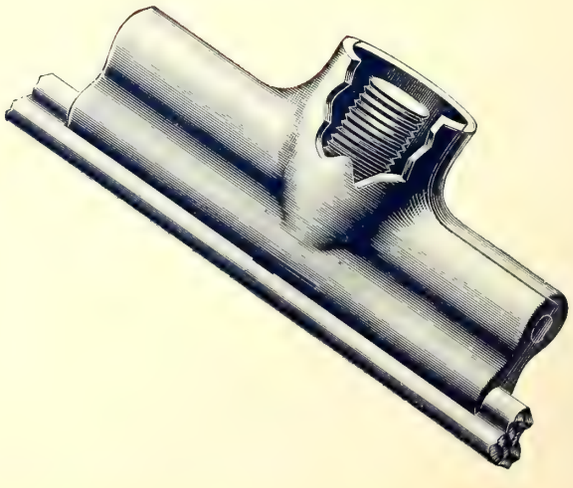
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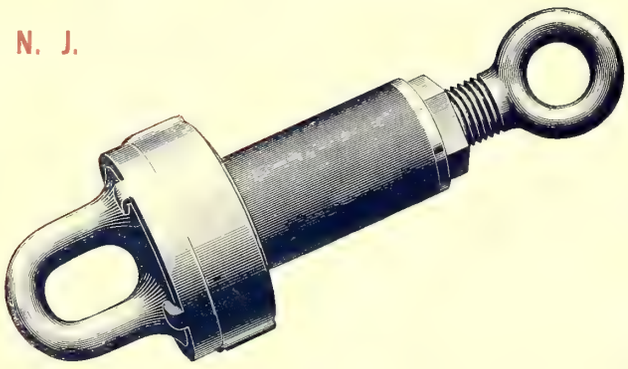
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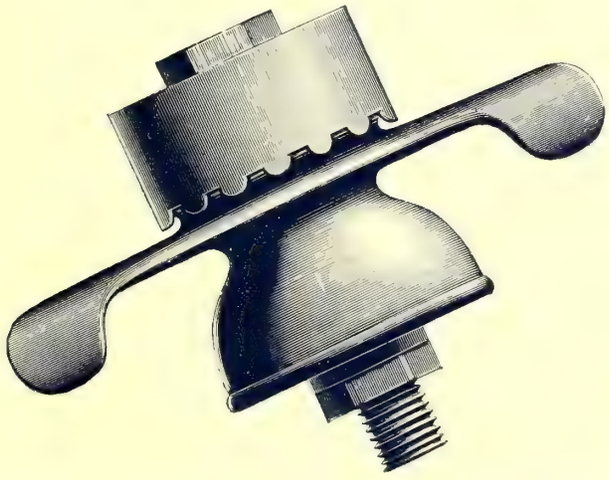
STAR BRASS WORKS Kalamazoo, Mich.
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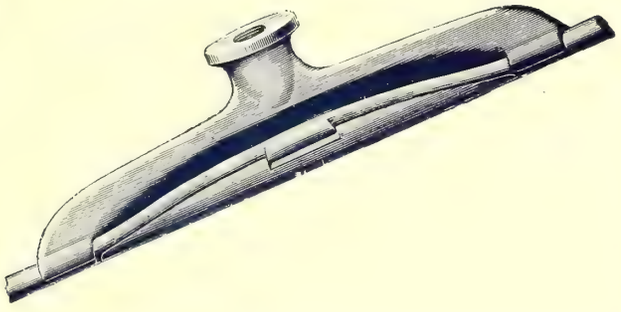
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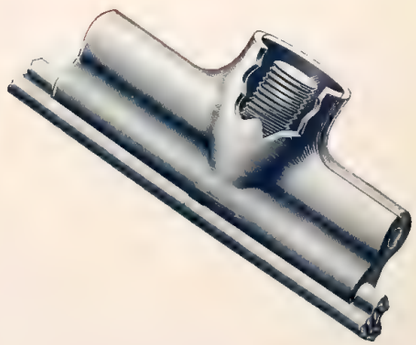
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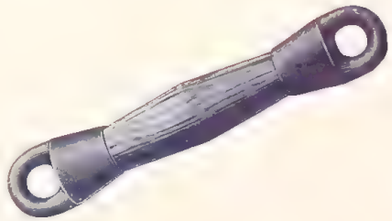
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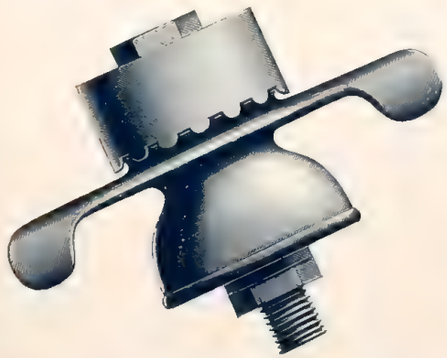
A. O. SHOONMAKER — New York
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EASTERN CARBON WORKS — Rahway, N. J.
Self Lubricating Motor Brushes

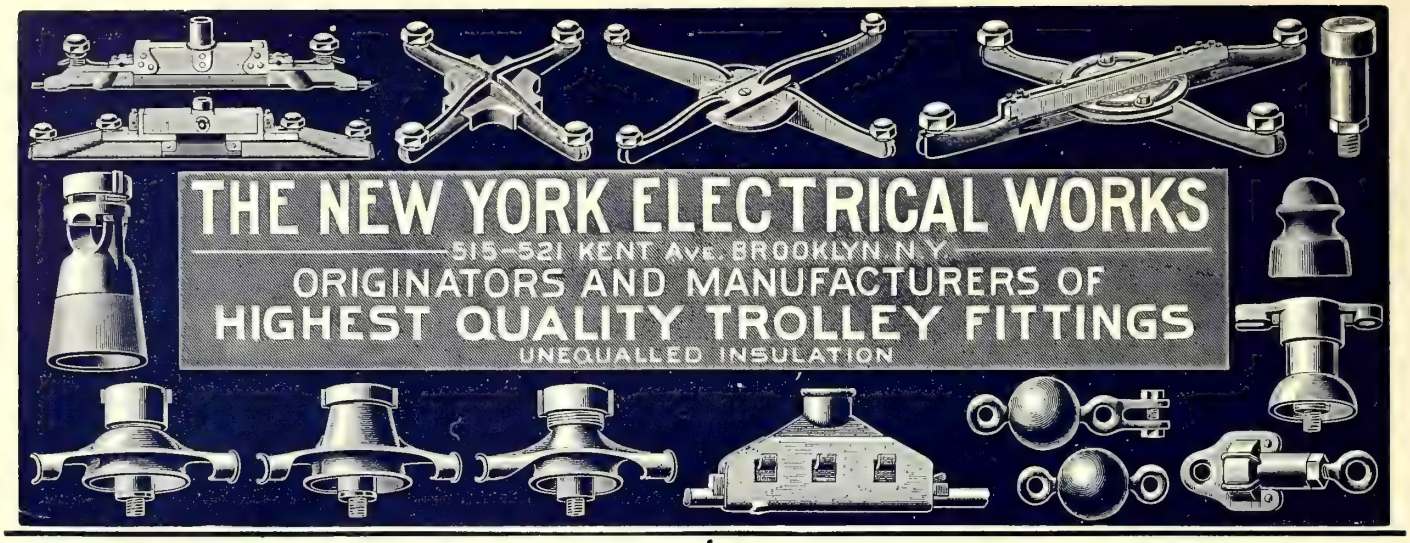


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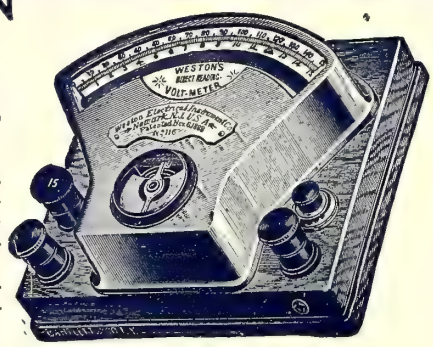
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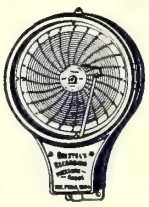
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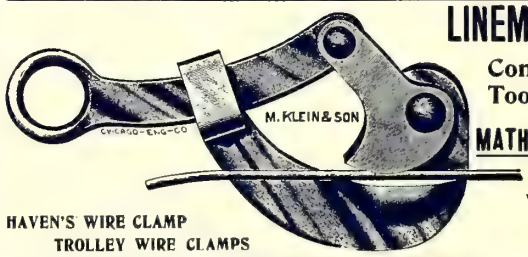
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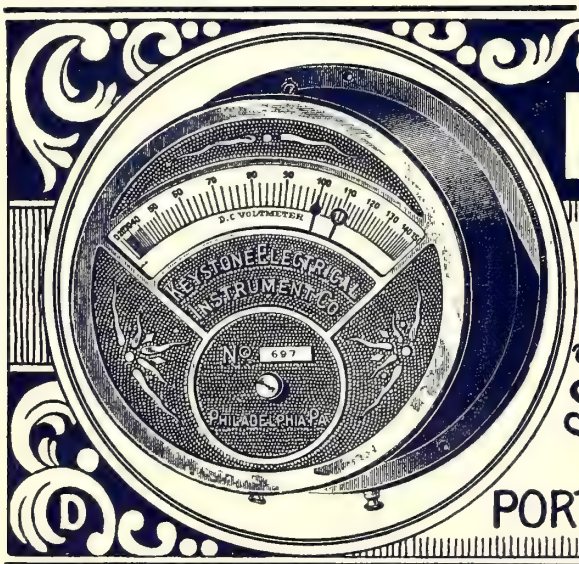


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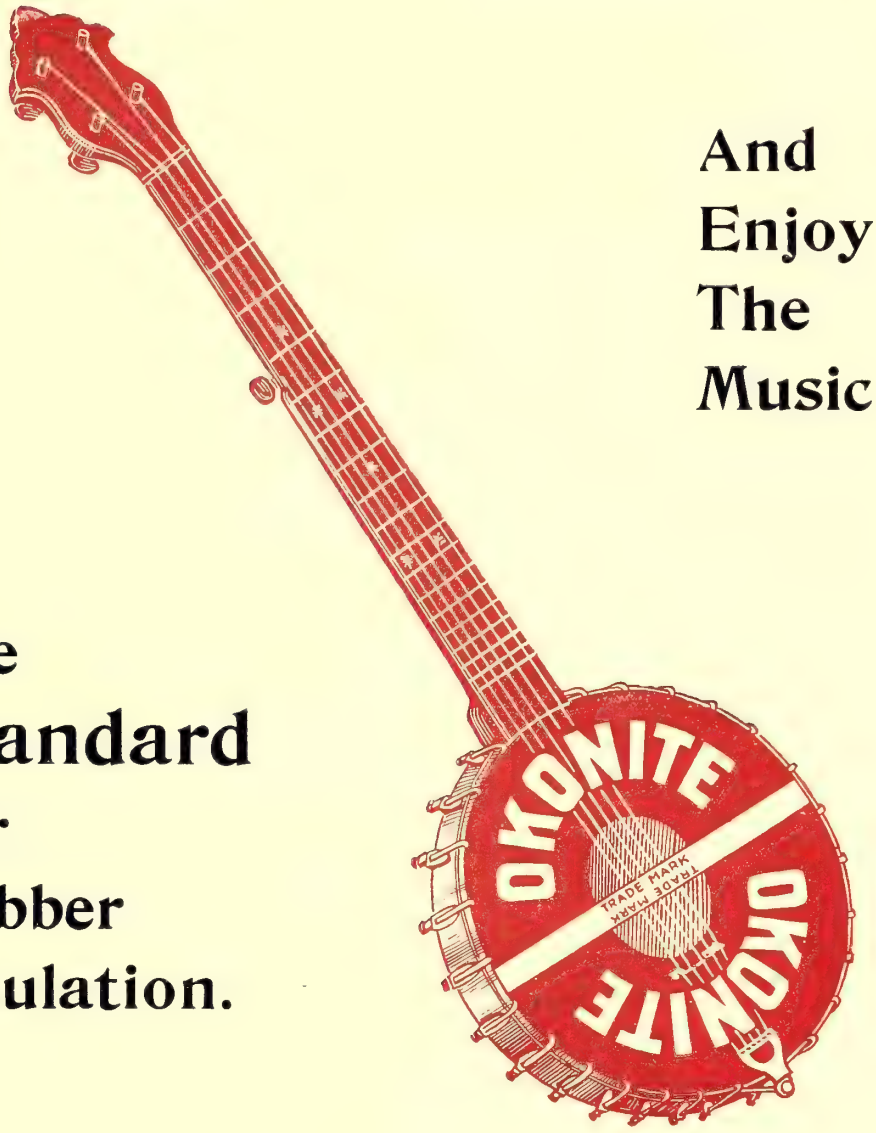
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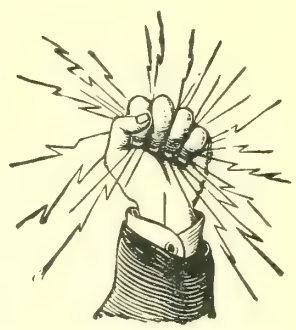
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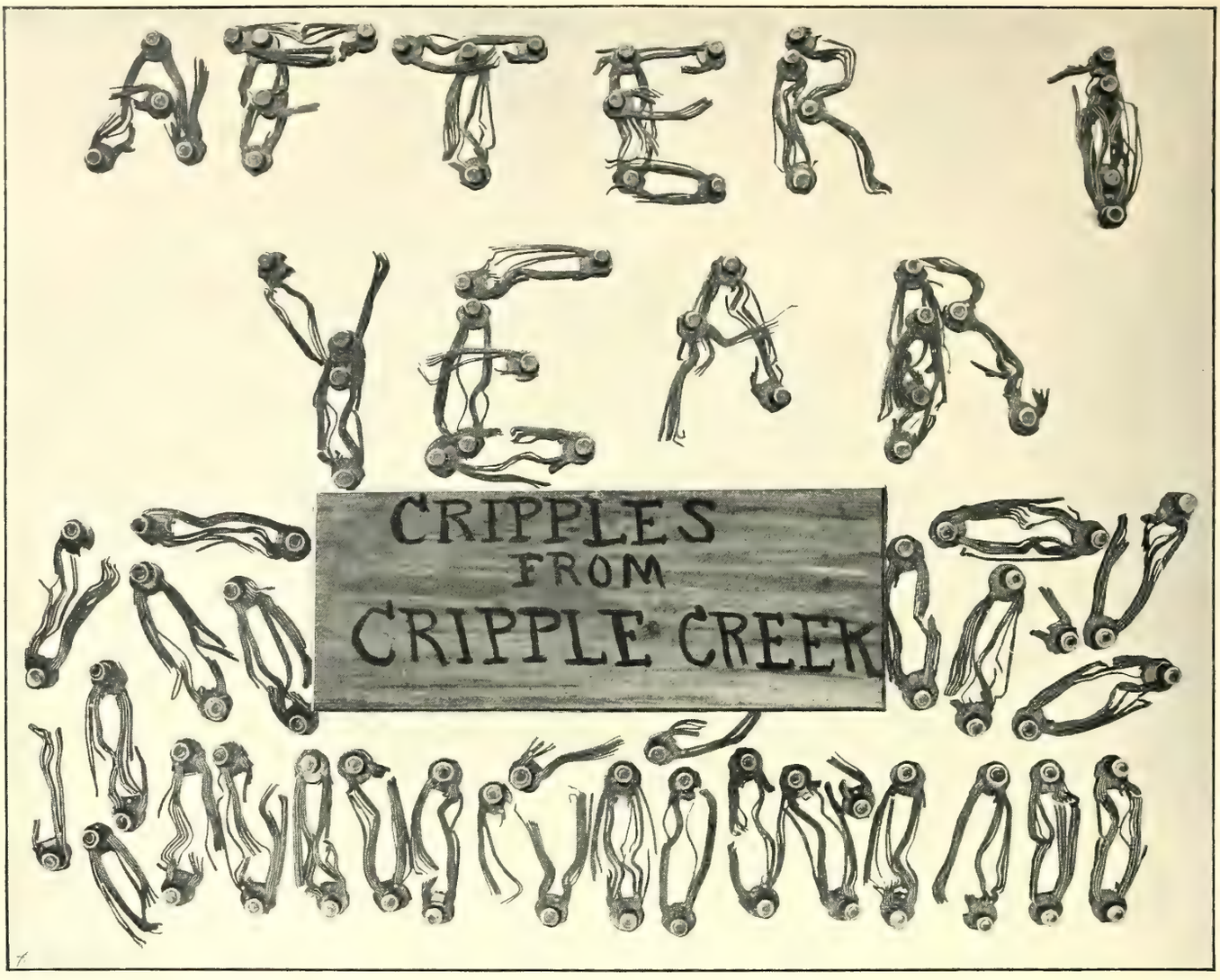
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MANUFACTURERS OF

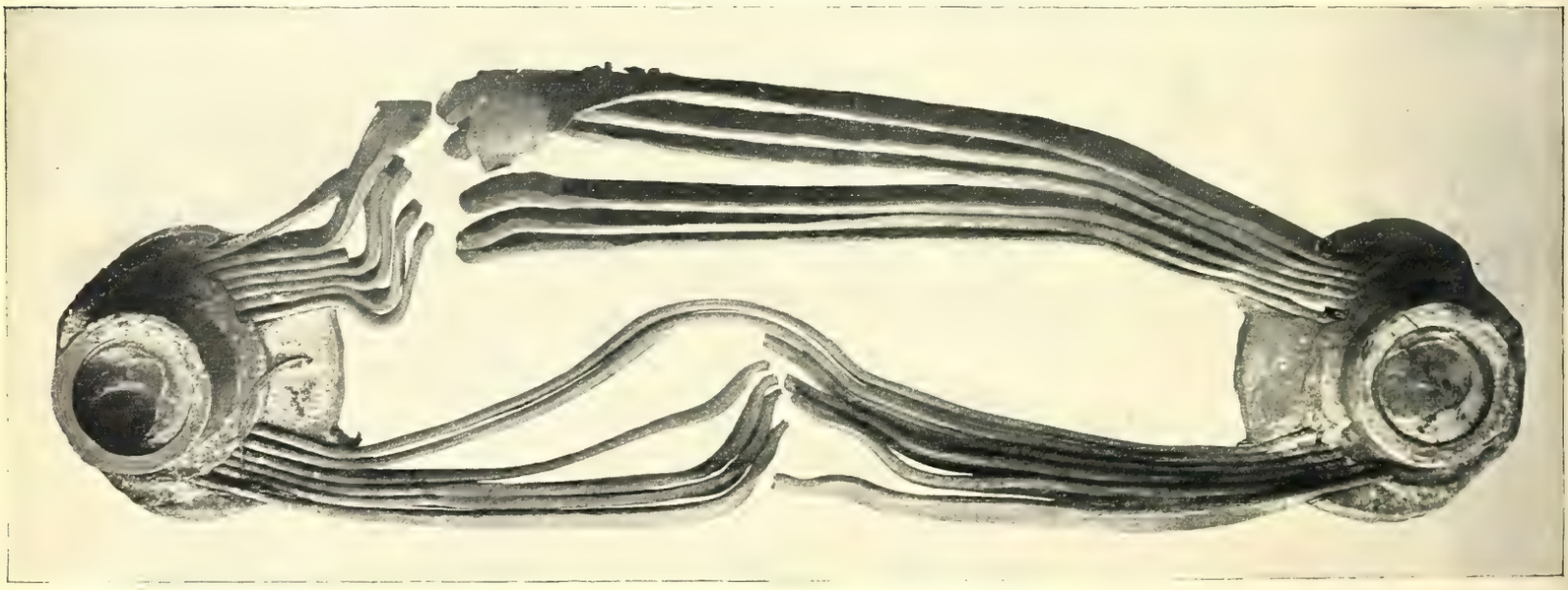
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COPPER WIRE, *Hard and Soft Drawn.*

General Office and Works, WILKES BARRE, PA.
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ONE OF THESE BONDS IS SHOWN BELOW FULL SIZE.



THESE flexible bonds were used one year on ballasted road with heavy rail, and are now being replaced with Plastic Bonds.

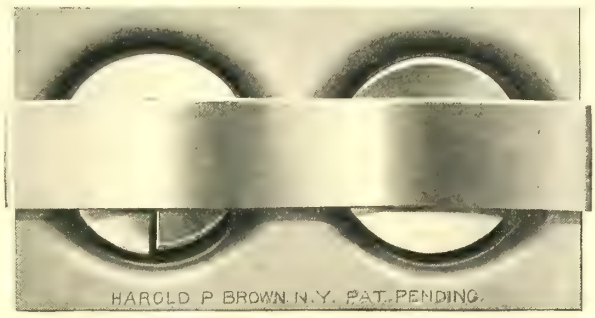
The joints were well maintained, and the rail ends show no wear. We have had complaints from Plastic Bonds after some three years use on track with loose joints, though never a case like this.

But we have predicted this, and on the next page you will see how we meet this trouble.

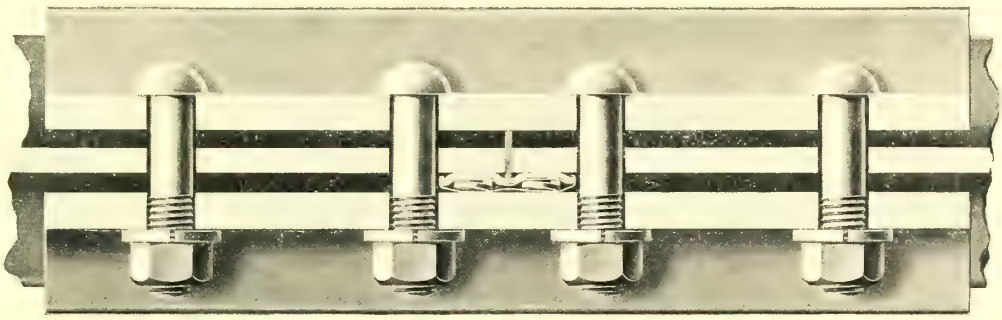
THE SOLID COPPER BOND



FRONT



BOTTOM



SECTION

THE above full size cuts show the No. 00,000 bond for rails with 9-32 inch bonding space. It is made of a rectangular piece of rolled electric copper 3 inches long, 1¾ inches high and ⅛ of an inch thick.

A cup-shaped projection is pressed near each end so as to give a contact against rail web close to the end of rail.

Inside the cups is a piece of sheet steel supporting a pair of special steel springs; the sheet is used to keep springs from wearing into copper. These pieces are held together by a small sheet-iron strap.

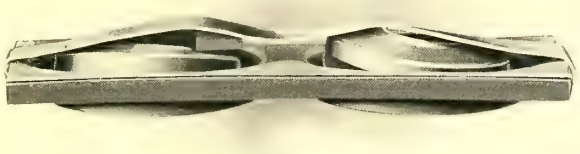
The entire bond is amalgamated to prevent rusting and the contact surfaces are covered with Plastic Alloy. The springs are proportioned to give a pressure of 1,000 lbs. per square inch when angle plate is bolted up. The bond does not interfere with the mechanical fit of angle plate, and the sharp web on top of spring cuts through the soft iron strap and into angle plate, thus aiding conductivity of the bond.

To apply this bond it is only necessary to brighten rail web beyond end bolt hole with the usual hand-power grinder and emery wheel.

The surfaces are then amalgamated and covered with a thin layer of Plastic Alloy. When rail ends move under passing cars, the bond is held against the rails by the springs, and the motion maintains the electrical contact.

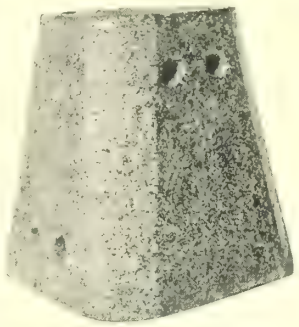
The depth of the springs is varied to suit the clearance between rail and angle plate, and the size of the copper will be altered to suit.

This bond is the cheapest and most efficient copper bond on the market, and its performance is guaranteed when used in accordance with directions.



EDGE

HAROLD P. BROWN, - 120 Liberty Street, New York





Third-Rail Insulators OF

"Reconstructed Granite" (Patented)

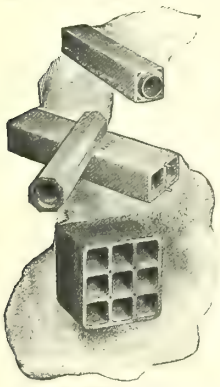
afford perfect insulation

Fire, Frost, Water and Acid Proof

THE BEST INSULATION FOR CONTACT RAILS.

RECONSTRUCTED GRANITE CO., 14 DEY STREET, NEW YORK.

American Vitrified Conduit Co.



Manufacturers of...

VITRIFIED GLAZED CONDUITS

Contractors for...

Installation of Underground Conduits

GENERAL OFFICE...

39 CORTLANDT ST., NEW YORK

PRESTON, COHEN & CO.

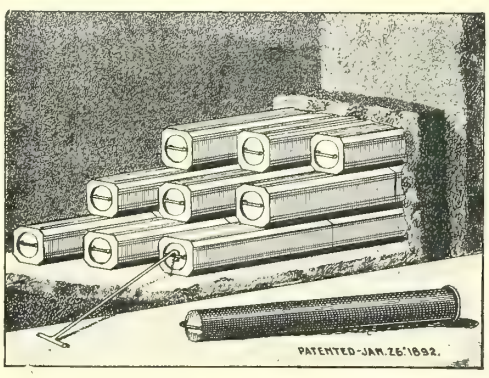
MANUFACTURERS' AGENTS FOR

Street Railway and Electrical Supplies

1004 Real Estate Trust Bldg., Philadelphia.

When writing to Advertisers, please mention the STREET RAILWAY JOURNAL.

The H. B. Camp Co.'s Vitrified Clay Conduit.



For Underground Telephone, Telegraph and Electric Light Wires and Underground Trolley System for Electric Street Railways.

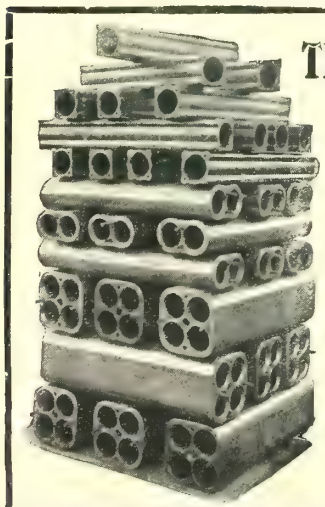
MANUFACTURED BY **THE H. B. CAMP CO., Aultman, O.**

Our conduit is made of specially prepared clays, is thoroughly vitreous and glazed, making it acid, gas and water proof, and is not affected by electrolysis. Standard size is 3 inch internal diameter. However, we can make any size or multiple duct. Our patent mandrel used in laying our conduits prevents the possibility of shoulders, and insures good alignment of bore. We claim for strength, economy, durability, cheapness and perfect insulation it is the best, and is used by the most prominent companies. Any information promptly given.

Write for catalogue.

THE H. B. CAMP COMPANY,

AULTMAN, OHIO, U. S A.



THE MASON VITRIFIED SALT GLAZED TERRA COTTA CONDUITS

FOR UNDERGROUND ELECTRIC WIRES.

FIVE POINTS OF EXCELLENCE.

1st. Being of *Vitrified* Terra Cotta they do not absorb water and when properly laid are indestructible by the elements.

2d. Being Salt Glazed *inside* as well as out they offer little or no resistance by friction in drawing the cables.

3d. Our *standard length of 30 inches* is the most suitable to insure perfect vitrifaction and glazing, is most easily handled, least liable to breakage in handling, and consequently the most economical.

4th. Being connected by dowels, perfect registration and alignment are secured without the aid of skilled labor, and once laid the joints are not displaced by ramming concrete or otherwise.

5th. As no mortar or other substance is allowed to enter the ducts while being laid there is no cleaning of them required preliminary to drawing the cables.

THE POTOMAC TERRA COTTA CO., 36 Corcoran Building, Washington, D.C.

For Protection,

HERE'S

A Combination Hard to Beat

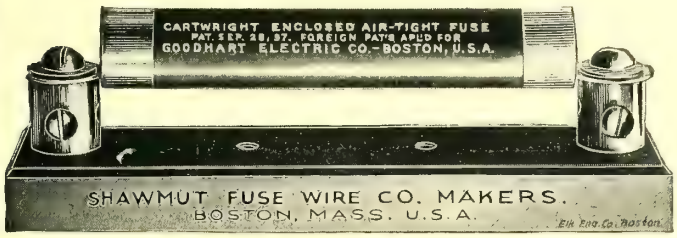
Elden Circuit Breakers
FOR YOUR STATION.

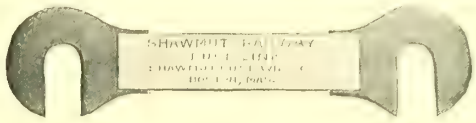
Shawmut Railway Fuses
FOR YOUR MOTORS.

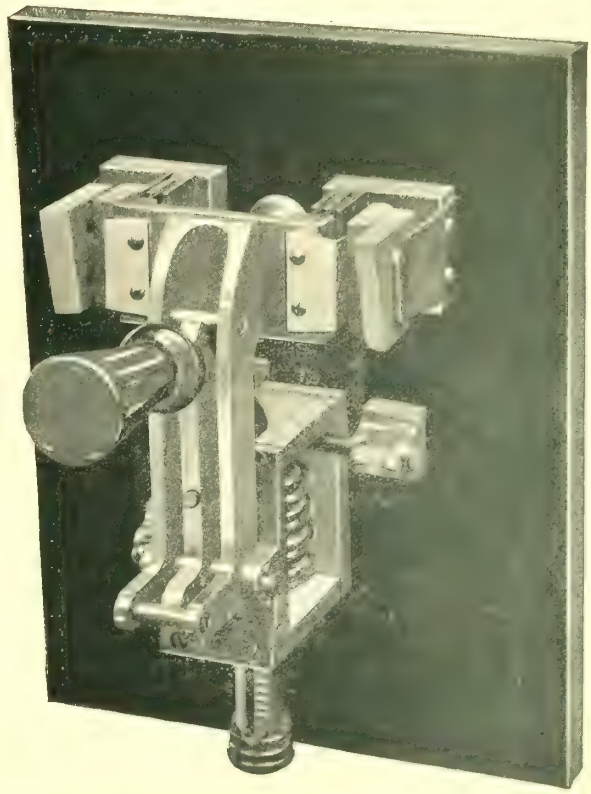
Cartwright Enclosed Fuses
FOR YOUR HEATERS.

CHASE-SHAWMUT CO.

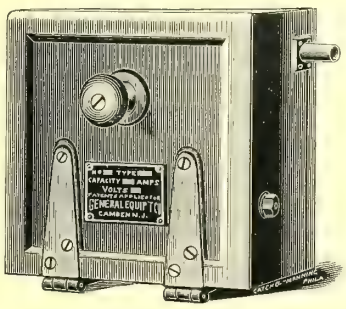
171 Fort Hill Square BOSTON, MASS.

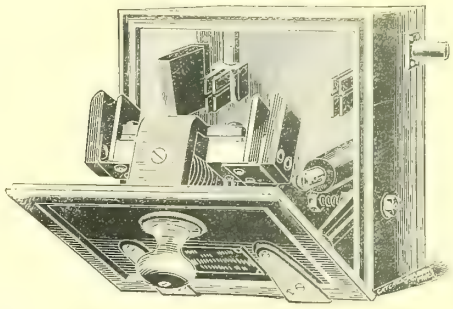






A Successful Car Circuit Breaker





All working parts enclosed in an asbestos lined oak box with slate base and metal lid. Upon overload, lid opens, breaking the circuit and permitting the gases to escape.

Perfect mechanical and electrical construction. Enclosed springs, roller bearings, auxiliary carbon contracts, permanent calibration. No fuses required.

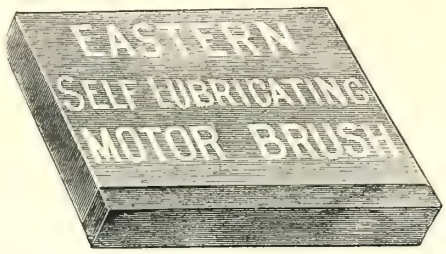
The adjustment cannot be changed by motormen.

GENERAL EQUIPMENT COMPANY

FACTORY, CAMDEN, N. J.

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Successors to
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Rw'y { *ARMATURE COILS*
REWINDING
COMMUTATORS

Send for sample of the BEST COILS made in the West.

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MANSFIELD TEMPERED COPPER COMPANY

Manufacturers of Pure Tempered Copper Cold Forged Commutator Bars. Bronze, Brass and Aluminum Castings. Our Commutator Bars are true to gauge, free from blowholes and shrink spots. Bronze bearings of long life and even mixture. Brass castings of best quality.

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MANSFIELD, O.

... AGENTS ...

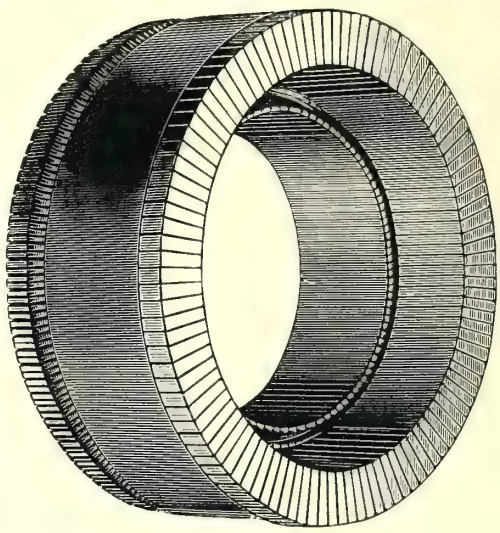
Rudolf Lovrek, Vienna, Austria; Isaac Braithwaite & Son, Kendal, England; Preston, Cohen & Co., Philadelphia, Pa.

H. P. CAMERON,

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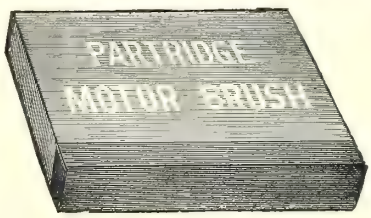
ASSEMBLED COMMUTATORS



For all styles of Railroad Armatures.

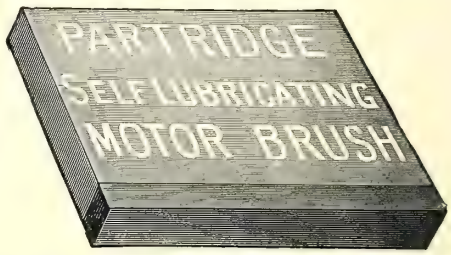
These Commutators are made from the best drop-forged segments, insulated with the finest amber mica.

I shall be pleased to ship one of my Commutators for inspection to any street railway company in the United States. If not satisfactory it can be returned, and I will pay freight both ways.



The Partridge Self Lubricating Motor Brush

has stood the test of time, and stands alone to-day as being the best and only satisfactory brush for street railway and generator service in the world. These are broad claims, but we can substantiate them with practical tests.



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PARTRIDGE CARBON WORKS, SANDUSKY OHIO . . .

ROLLDROP AND DROP-FORGED

HAVE STOOD THE TEST OF TIME

COMMUTATOR BARS

THE FOREST CITY ELECTRIC CO.,
CLEVELAND, O., U.S.A.



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New York City, No. 18 Cortlandt St.
Phi adelphia, Pa. 1225 Betz Bldg.
Chicago, Ill., 542 The Rookery.
St. Louis, Mo., 607 Security Bldg.

C Paper, Fiber, Rubber — TELEPHONE AERIAL

A Fiber, Rubber, Paper — TELEGRAPH HOUSE

B Rubber, Paper, Fiber — ELECTRIC LIGHT UNDERGROUND

L For All Service — POWER SUBMARINE

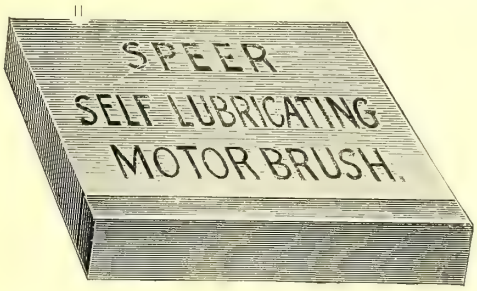
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High Grade Rubber-covered and Weather Proof Wires, Conduits and Accessories Furnished and Installed for All Classes of Service.

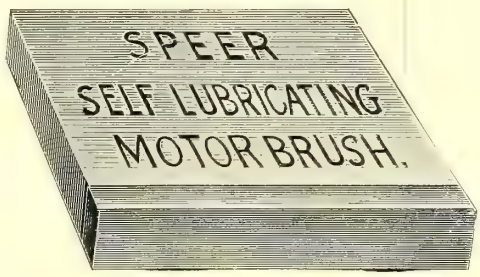
THE NOT IN THE TRUST

SPEER CARBON CO ST. MARYS PENNA., U.S.A.

UNDER the direct management of **Mr. J. S. Speer** (formerly of the Partridge Carbon Co.), whose long experience in the manufacture of CARBON BRUSHES is an assurance that our goods will be of the very highest quality. We have a new model factory specially designed, built and equipped for this work. We shall make a specialty of CARBON BRUSHES, embracing in our manufacture every type required. Our unequalled facilities will enable us to supply the entire Electric Railway trade with the very best CARBON BRUSHES ever produced.



We solicit your trade and guarantee unqualified satisfaction. Export trade given particular attention...



MORRELL'S HYDRAULIC REFILLED

COMMUTATORS

LONG MILLER-KNOBLOCK LIFE

We carry Assembled Commutators in stock for all Street Railway Motors ✱ ✱ We guarantee them, and if not right will pay freight both ways ✱ ✱ We do the most expert rewinding ✱ ✱ We carry Armature Coils in stock.

A. W. MORRELL, Manager.

THE MILLER-KNOBLOCK COMPANY,
SOUTH BEND, INDIANA.

DROP FORGED **PURE LAKE COPPER**

COMMUTATOR SEGMENTS,



For all the Standard Railroad Motors.

Accurate Bar, Highest Conductivity, Moderate Price.

Manufactured by .. VAN WAGONER & WILLIAMS HARDWARE CO., Cleveland, Ohio.

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PYRO PAINTS (Patented Dec. 1, 1891), after fourteen years of tests, have proven their absolute indestructibility by the action of the elements.

Five times the durability of any other paint, is guaranteed on Cars, Trucks, Bridges, Poles (iron or wood), Roofing, and all Surfaces, whether cold or heated.

The only paints that will stay on galvanized iron.

The only perfect insulator for electric wires. Coiling does not break or crack the coat. The only paints that are proof against rust under all conditions.

The only paints worthy of the name "FIRE PROOF."

"The Shearer-Peters Paint is the best we have ever used. We have adopted it as our standard for locomotive front ends, etc."—W. H. Lewis, Superintendent Motive Power, N. & W. Railroad.

"We have never yet found any paint excepting the Shearer-Peters Pyro that would stand the combination of heat and steam such as our works are subjected to."—Wm. N. Morgan, Superintendent Crozer Iron Co.

"Roofing covered with Shearer's Patent Pyro Paint, in Winfield, Kan., fourteen years ago, is still all right—both metal and wood. The best paint on earth."—B. F. Wood, for seven years a member of School Board. [Mr. Wood refers to any bank in Winfield.]

Send for our booklet, which tells what Pyro Paints have done for others. Actual time tests are what count.

MADE ONLY BY

THE SHEARER-PETERS PAINT CO.

CINCINNATI, OHIO, U. S. A.

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THE W. R GARTON COMPANY

CONSULTING ENGINEERS AND MANUFACTURERS' AGENTS

ELECTRICAL AND MECHANICAL SUPPLIES

LIGHT : POWER : TRANSMISSION : RAILWAY

SUITE 603-604 MANHATTAN BUILDING
315 DEARBORN STREET, CHICAGO

WE EXTEND YOU A MOST HEARTY INVITATION TO MAKE US A CALL WHILE AT THE CONVENTION

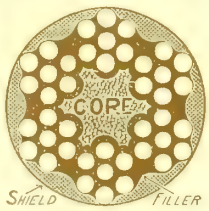
The manufacturers we represent are among the most prominent in the world, and offer a complete line.

AT TATTERSALLS



WHY NOT PRESERVE YOUR
WIRE ROPES,
MANILA ROPES,
GEARING?

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THE IRONSIDES COMPANY,
Columbus, Ohio, U. S. A.

STERLING
EXTRA INSULATING VARNISH

The Sterling Varnish Co.,

325 WATER STREET, PITTSBURGH, PA.

The Standard
FOR Perfect
Insulation

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ELECTRICAL COMPOUNDS.

ARMATURE AND FIELD COIL VARNISH.

INSULATING TAPE.

Send for Samples and Prices to
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81 & 83 John St., New York.

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To Whom It May Concern.. ..

This is to certify that I have used CLARENCE BROOKS & CO.'S Varnish on and off for the past twenty years, and I believe it to be the best Varnish made in this country, and equally as good as the English, both in durability and brilliancy. I am finishing one hundred cars with it now. My experience proves that CLARENCE BROOKS & Co. are one of the best and most reliable houses in this country to deal with.

ROBERT A. WALSH, Master Painter
Third Ave. Railroad Co., New York City

June 12, 1899.

WARD LEONARD

CIRCUIT BREAKERS AND RHEOSTATS

PERFECT WORKMANSHIP

HIGHEST FINISH

SPECIFIED BY

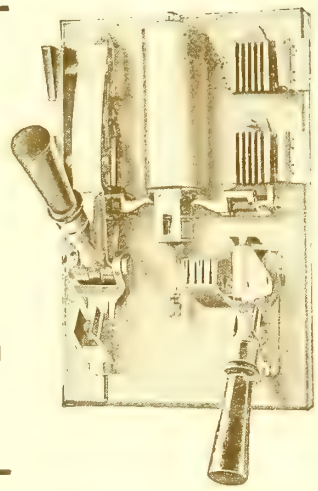
U. S. NAVY

700 TO 1650 AMPERES

PRICE $118.00

£24

600 Francs



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PRICE $35.00

£7. 4s.

185 Francs

Electric Tramway Pattern

IMPOSSIBLE TO CLOSE ON SHORT CIRCUIT

HAMMER-BLOW TO START SWITCH

GREATEST RELIABILITY & SIMPLICITY

EASE AND CHEAPNESS OF REPAIR

THE STANDARD OF EUROPE AND AMERICA

WARD LEONARD ELECTRIC CO.,

BRONXVILLE, N.Y., U.S.A.

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"ANY OLD THING"

WE can show you at the Chicago Convention the finest line of supplies ever produced, and which has made New England Street Railways famous. The prices are no higher than you have been paying for the "Any Old Thing" qualities.

Bibber-White Company

Manufacturers

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300 K. W. Unit of Self-Cooling Type

If so, you will require switchboards and static transformers. We are prepared to build *either* for *any* specifications. We further hold ourselves in readiness to give you the benefit of our experience along these lines. As builders of the largest static transformers and also highest tension transformers in practical use, and also by reason of our close attention for years to work of this character, we are prepared to meet any conditions that may arise.

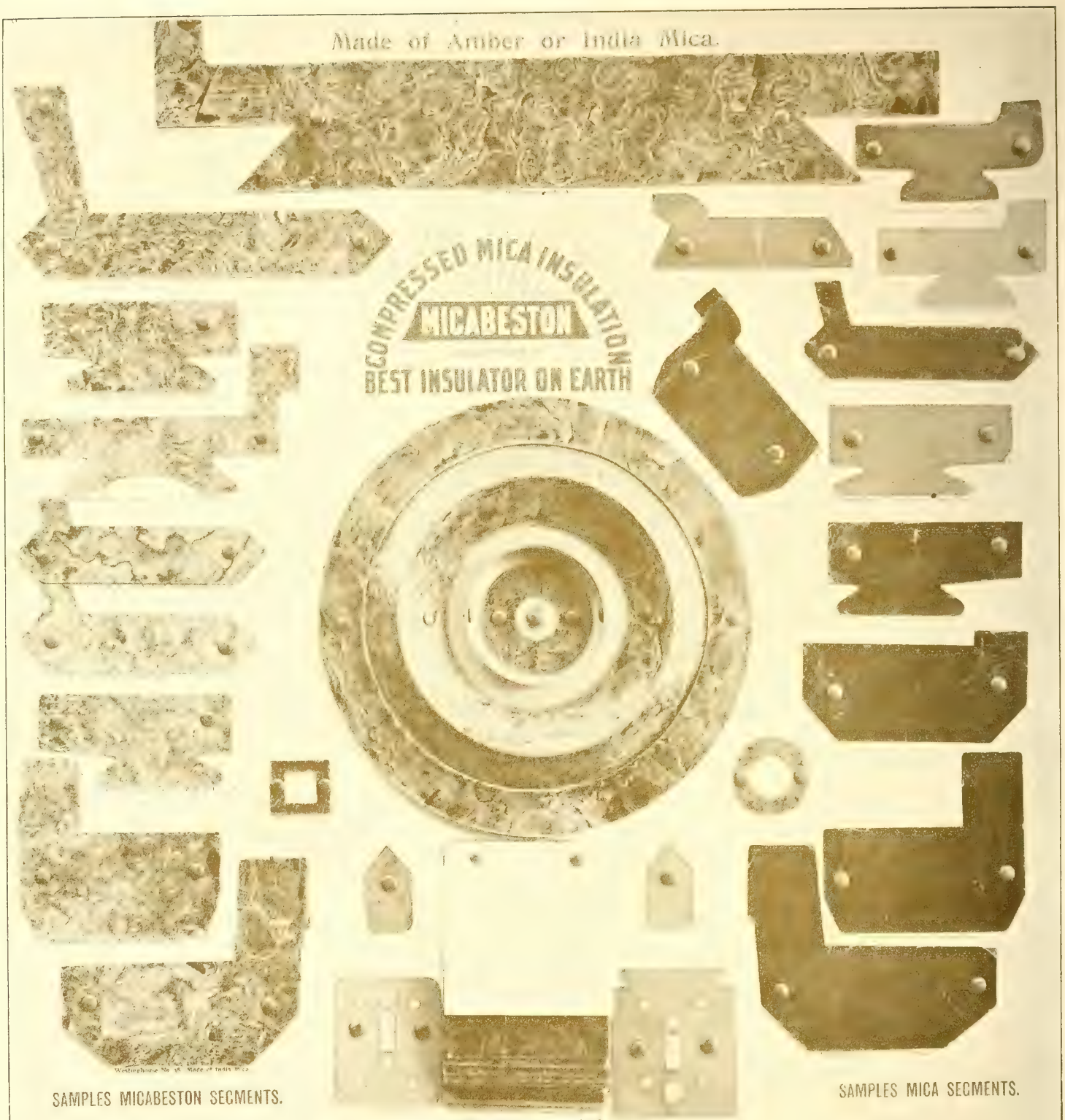
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WAGNER ELECTRIC MFG. CO.

GENERAL OFFICES and FACTORY

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Branch Offices
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PHILADELPHIA: 1000 Betz Bldg.
CHICAGO: 1510 Marquette Bldg.
SAN FRANCISCO: 120 Sutter St.



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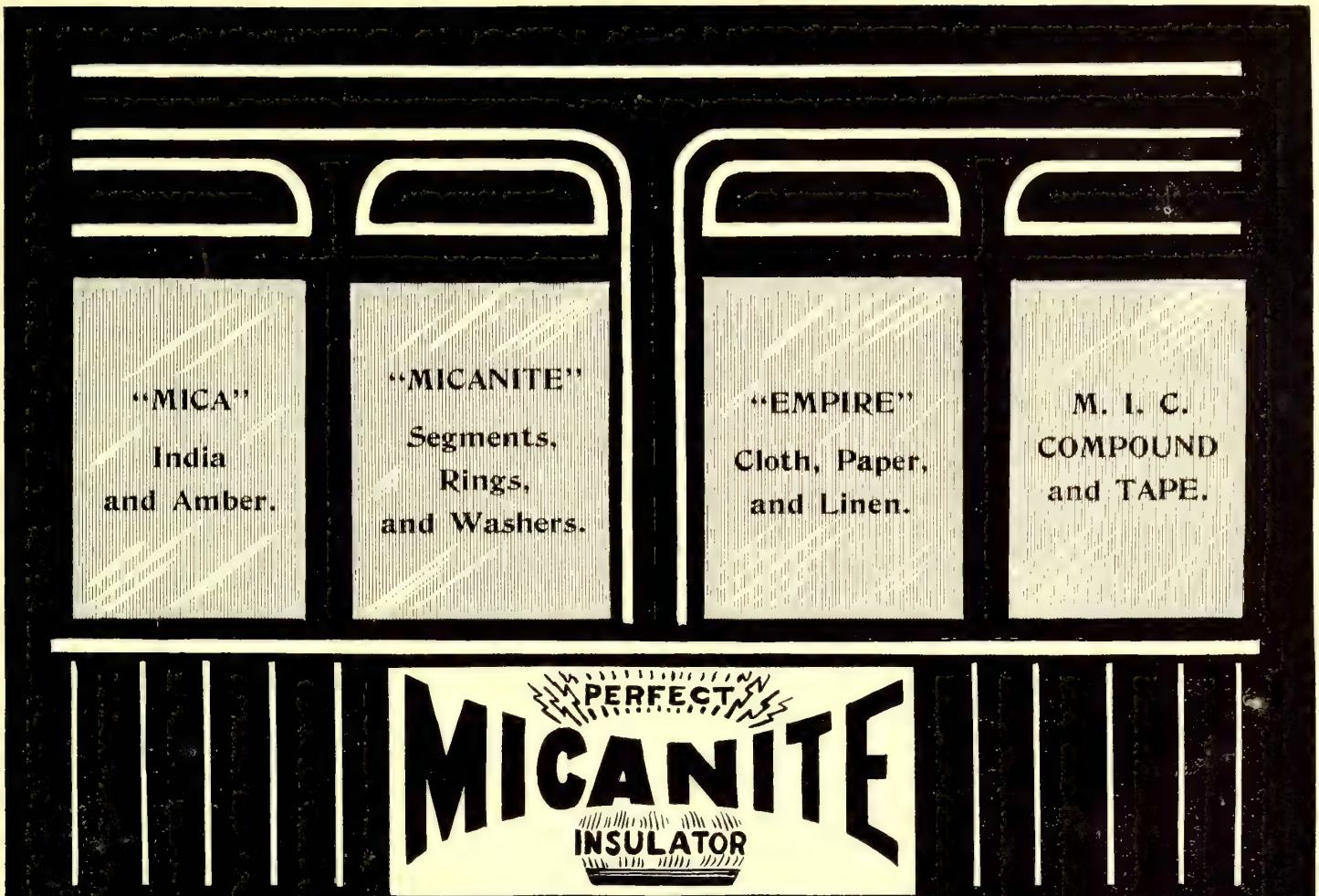
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Manufactured by

W. H. SILLS MICA CO.

60 = 62 = 64 Michigan Avenue, = = = Chicago, Ill., U. S. A.

IMPORTERS OF AMBER AND INDIA MICA.



Successful railway managers and electrical engineers specify our lines of insulation

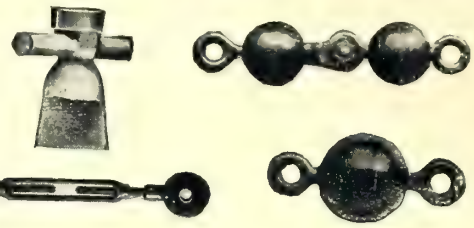
MICA MICANITE

Experience teaches that to get the best results electrically, they must have the highest possible grade of material

Eugene Munsell & Co. **Mica Insulator Co.**

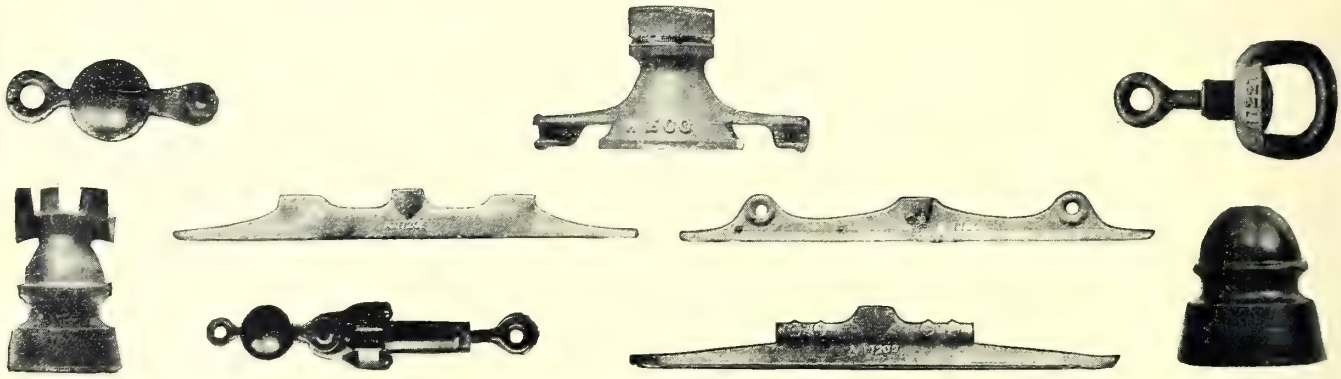
NEW YORK CHICAGO LONDON

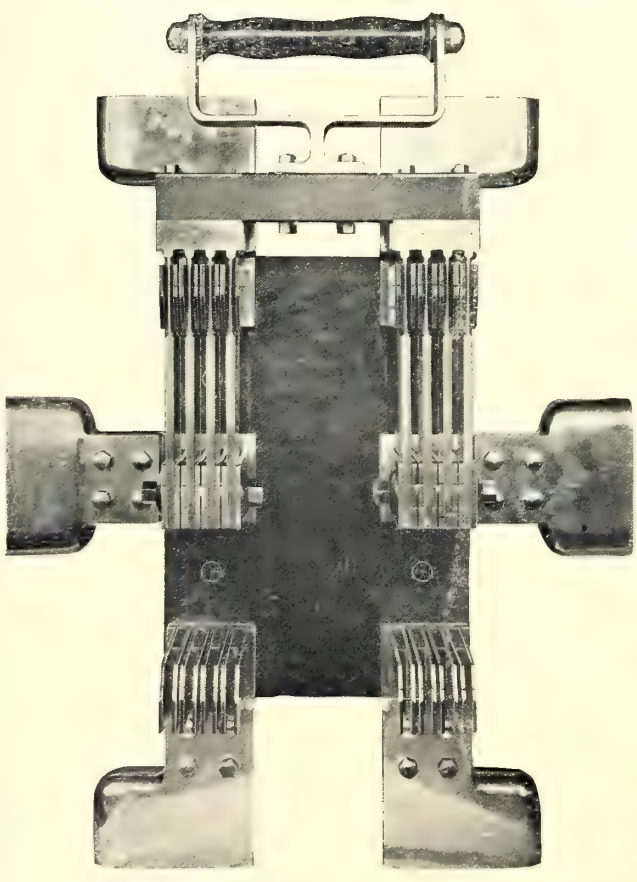





WESTERN ELECTRIC CO.

NEW YORK CHICAGO





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Badt-Goltz Engineering Co.
MONADNOCK BLOCK

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DYNAMO PANELS
FEEDER PANELS
INSTRUMENT PANELS, ETC.

KNIFE SWITCHES
....AUTOMATIC SWITCHES

CONNECTING LUGS
BUS BARS, ETC.

General Railway
Switchboard Work

ZIMDARS & HUNT

...MANUFACTURERS OF...

Electric Light and Power Specialties

127 FIFTH AVENUE, NEW YORK

CLASSIFIED CYCLOPAEDIA OF MANUFACTURERS, DEALERS, ETC.

SECTION I.
FINANCIAL AND ENGINEERING

SECTION II.
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SECTION III.
ELECTRICAL MACHINERY, MOTOR POWER SYSTEMS.

SECTION IV.
STEAM PLANT EQUIPMENT.

SECTION V.
RAILS AND TRACK MATERIAL. BRIDGES AND STRUCTURAL WORK.

SECTION VI.
LINE MATERIAL, POLES, RAIL BONDS, ELECTRICAL SUPPLIES ETC.

SECTION VII.
CAR AND TRUCK EQUIPMENT.

SECTION VIII.
ROLLING STOCK.

SECTION VII

Car and Truck Equipment

Street Railway Journal
October, 1899

FOR ALPHABETICAL INDEX TO ADVERTISERS, SEE PAGES 23-25

STATIONARY AND PORTABLE
...Air Compressors...

You will find these compressors useful for a variety of purposes, more numerous than we can briefly state, but the principal ones are as follows:

They furnish compressed air for blowing out dust from motors mounted on car trucks, for blowing out dust from generators in the power house, for blowing dust out of car cushions, for sand blasting and cleaning rusty iron, for white-washing and painting car barns by means of compressed air, for operating air lifts and hoists, for lifting car bodies or trucks, for air jacks arranged either on a truck to wheel about or arranged on a track in the pit. We manufacture both air hoists and air jacks in all varieties. You will also find the portable air compressor useful in drilling holes for bonding your rails. By connecting a fish pole with the trolley wire and making a ground connection with the wire and coupling your air drill to the tank on the truck, you can then drill the holes for the bonds much quicker than in any other way. You can also use this compressor to advantage in connection with the oiling system of your engines and generators by elevating the oil up to the level of the filters. For chipping and riveting hammers, and in special work where air drills are very convenient and much quicker than ratchets.

The portable air compressing apparatus, up to and including size D-4 compressor, is of suitable weight so that the truck can be hauled around by hand and can therefore be used in car barns and shops where air hoists and compressed air tools are installed, thereby avoiding the necessity of an expensive system of air piping.





Table Showing Dimensions, Weights, Etc. of Christensen Motor Compressors

Compressor No.	No. of Cylinder.	Cylinder Size, Inches.	Cubic Ft. Free Air per Minute.	Armature Speed.	Dimensions.			Weights			Telegraph Code.
					Length, Inches.	Width, Inches.	Height, Inches.	Net.	Boxed for Shipment.		
									Domestic.	Foreign.	
AA-1	2	5 x 2½	11	1350	21 13/16	18 5/16	17¼	446	513	593	Cabal
B-2	2	6½ x 3	20	1100	28 1/16	21 5/16	21⅜	785	863	953	Celt
C-3	2	7½ x 4	35	1150	32¼	24⅛	23 7/16	1080	1195	1325	Chief
D-4	2	8½ x 4	47.6	1100	35 7/16	25	25 1/16	1198	1325	1460	Climax
3 D-4	3	8½ x 4	75	1200	35 7/16	31	25⅛	1380	1530	1680	Coda
3 E-5	3	8½ x 9	100	800	56⅜	40	39¾	4600	4800	4900	Crav
3 EE-5	3	8½ x 9	155	800	56⅜	40	39⅜	4650	4850	5000	Cuth
3 F-6	3	10 x 12	285	700	58	43	46½	8500	8800	9000	Cyma
6 E-5	6	8½ x 9	200	700	56⅜	50	49	5500	5900	6200	Comrade
6 EE-5	6	8½ x 9	310	600	56⅜	50	49	8900	9400	9800	Capella
6 F-6	6	10 x 12	570	600	58	56	55	16800	17400	18000	Cheston

Christensen Engineering Company

OFFICE and WORKS
720 to 728 HANOVER STREET

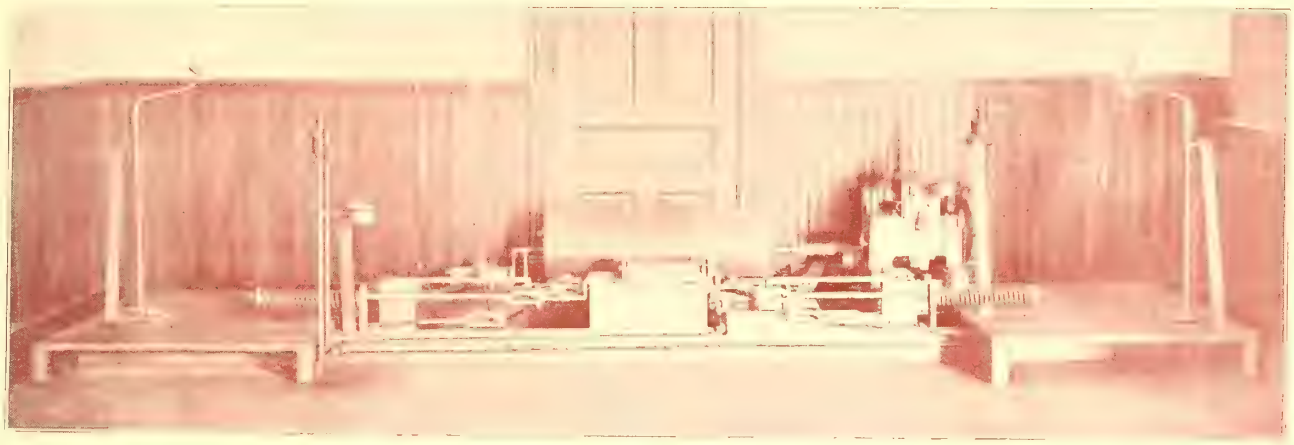
MANUFACTURERS OF AIR BRAKES

MILWAUKEE, U.S.A.

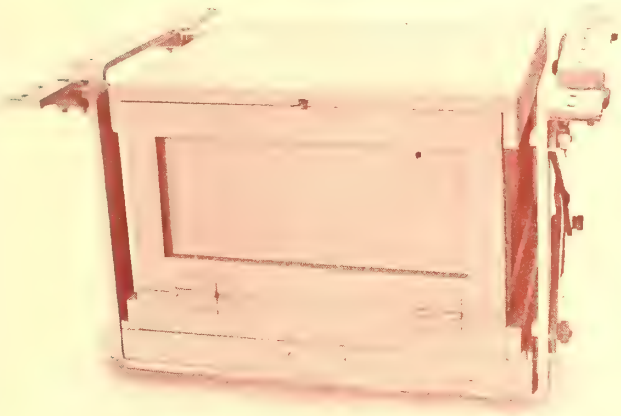
Cable Address
"Coco"

See also Pages 67 and 203

Christensen Air Brakes



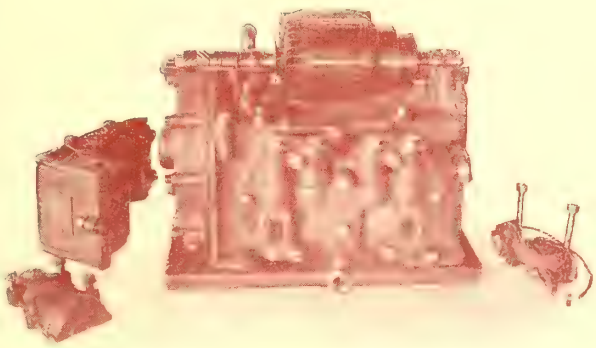
INSTRUCTION EQUIPMENT



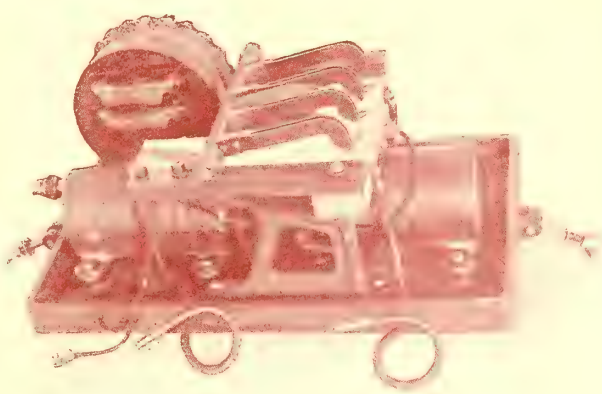
BOX CLOSED



BOX OPEN



READY FOR REMOVAL OF ARMATURE



AUTOMATIC CONTROLLER

Christensen Engineering Company

OFFICE and WORKS
720 to 728 HANOVER STREET

MANUFACTURERS OF AIR BRAKES

MILWAUKEE. U.S.A.

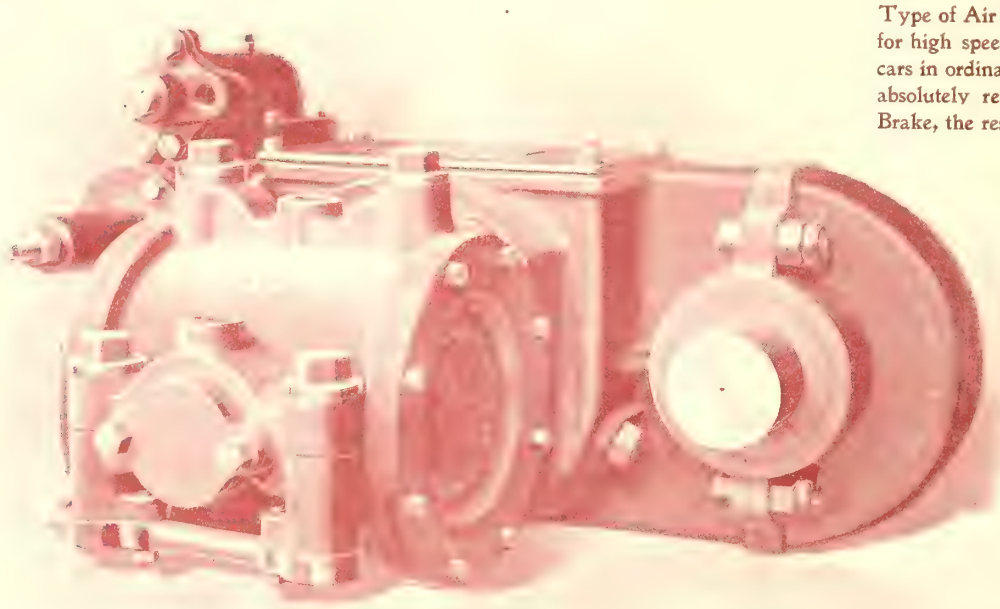
Cable Address
"Ceco"

See also Pages 67 and 204

Standard Air Brakes

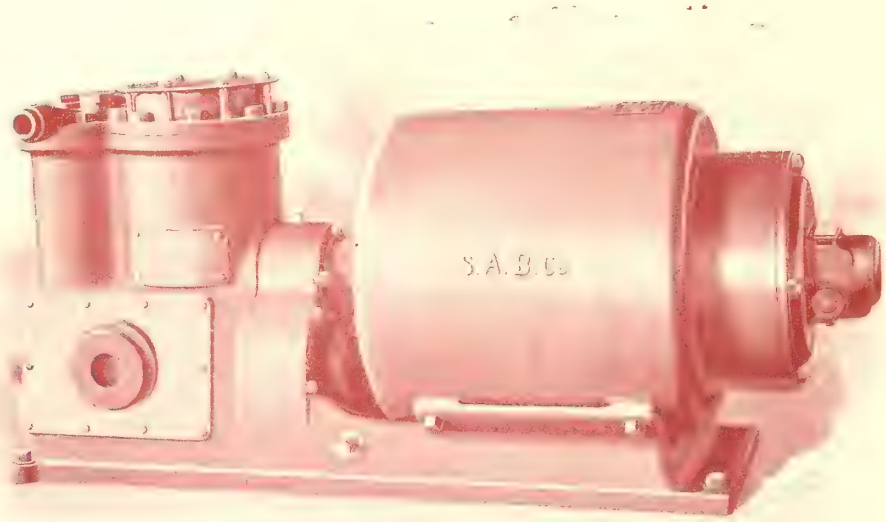
("THE PIONEERS")

FOR RAPID TRANSIT RAILWAYS



Our Geared Axle Driven Compressor Type of Air Brake is equally adapted for high speed interurban cars or for cars in ordinary city service. It is an absolutely reliable and efficient Air Brake, the result of several years experimenting and was perfected by us early in 1898. It is of moderate cost, inexpensive to maintain, compressor works only as needs require, and maintains, automatically, maximum air pressure for every stop. It has numerous points of merit possessed by no other air brake manufactured.

GEARED AXLE DRIVEN COMPRESSOR



Our Motor Driven Compound Compressor Type is particularly adapted for elevated trains or any heavy electric service. Slow speed and low gear ratio, together with uniform load on cranks and entire absence of shocks on passing centres, insure quiet running and long life.

Being compounded is of much higher efficiency than single stage compressors.

Is dust and rain proof, self oiling and is designed and built to last for years. The results with this type have been so satisfactory that we have made it our standard for heavy service.

MOTOR DRIVEN COMPOUND COMPRESSOR

THE STANDARD AIR BRAKE CO.

168 Broadway, New York City

JOSEPH R. ELLICOTT, General Manager — FACTORY, JERSEY CITY, N. J.

MESSRS. PETTEE & McCUTCHAN, No. 60 State Street, Boston, Mass.

RISDON IRON WORKS, San Francisco, Cal. Sole Agents for the Pacific Coast.

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SEE OPPOSITE PAGE

"Pioneer," One who goes before to remove obstacles and prepare the way for others.
STANDARD DICTIONARY.

THIS COMPANY is the recognized Pioneer in the development of the Air Brake and its practical application to rapid transit service.

As pioneers we have removed the numerous obstacles, and have not only prepared the way, but are running our works to their fullest capacity to keep up with orders.

We early recognized that there were such a large variety of conditions to meet that no one type of Air Brake could practically fulfill them all.

To properly meet these requirements we have perfected the various systems of Air Brakes and are prepared to furnish the proper type of brake best adapted to any class of rapid transit service.

We build both automatic and direct systems, with air supplied by either independent motor driven compressor, axle compressor, or by storage reservoir. We will also furnish the vacuum system when conditions warrant its use. Each system has its advantages.

Our new catalogue describes and illustrates these various types and systems so fully as to enable the railway manager to determine what particular type of our Air Brakes is best suited to meet his particular requirements.

Perhaps our experience may also be of some benefit to you, as it extends over a period of 10 years in Street Railway Brakes, and considerable longer time with steam railway service.

THE STANDARD AIR BRAKE CO.
168 Broadway, New York.

(See opposite page).

The Storage Air Brake

WON'T STOP

THE EARTH, BUT WHEN APPLIED TO

A CAR

PROMPT AND RELIABLE BRAKING IS INSURED

"IN A JIFFY"



Twelve cars like the above on the Detroit & Pontiac Railway equipped with the Storage System. In operation one year. *Not one dollar for repairs.* Never failed to act instantaneously.
Contract awarded for the Storage System solely on its distinctive merits, against four competitors.

ORDERS RECEIVED SINCE MAY 1st, '99...

Kansas City and Leavenworth Ry. Co.,	10	Brake Equipments
Cleveland & Eastern Ry. Co.,	8	" "
Detroit, Rochester, Romeo & Lake Orion Ry. Co.,	6	" "
Mahoning Valley Ry. Co.,	3	" "
Detroit & North Western Ry. Co.,	12	" "
Sandusky and Interurban Elec. Ry. Co.,	3	" "

Why We Got Their Orders and Out-distanced our Competitors

Simplicity, No Complications of air pump, motor, controller, etc. All eliminated. Absolutely Noiseless, No Repairs required, Never Out of Order.

...Perfect Braking is only obtained by using the Storage System...

LOOK FOR EXHIBIT OF THE STORAGE AIR BRAKE IN TATTERSALL'S

The Old Hand Brake was good enough

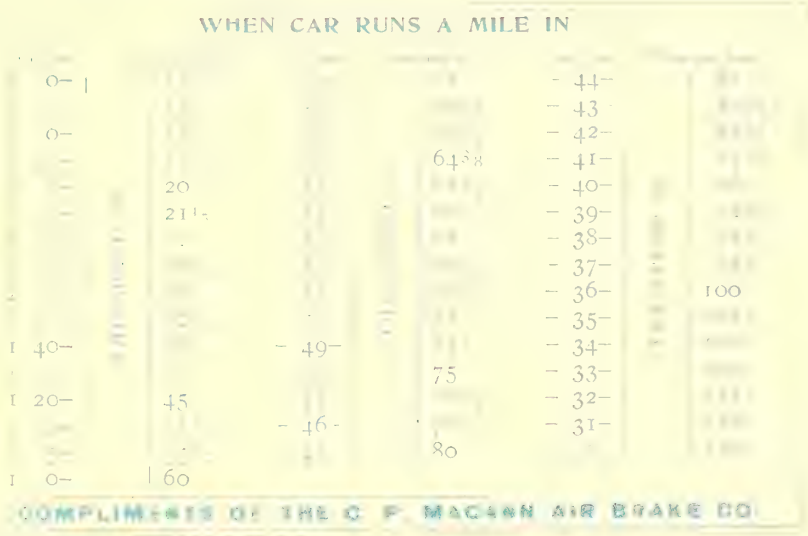
...FOR HORSE CARS...

But nowadays steam railroads are being closely followed in all departments of electric railway work.
Use AIR BRAKES and be sure your contract calls for the *best*, only to be found in equipping with

THE STORAGE AIR BRAKE

CUT THIS OUT AND INSERT IN YOUR MEMO. BOOK

OUR BRAKES BRAKE



SELLS ON SIGHT

DON'T EQUIP YOUR CARS WITH

ANY BRAKE BUT

The Storage Air Brake System

Sole Manufacturers...

The G. P. MAGANN AIR BRAKE CO.

WM. D. RAY, General Manager

46 Campau Bldg., DETROIT, U.S.A.

Chicago Office
HANNA & GRAY
1626 Marquette Building

Toronto Office
E. C. RUTHERFORD
7 Henderson Block

AVOID ACCIDENTS

EQUIP YOUR CARS WITH

Sterling Safety Brakes

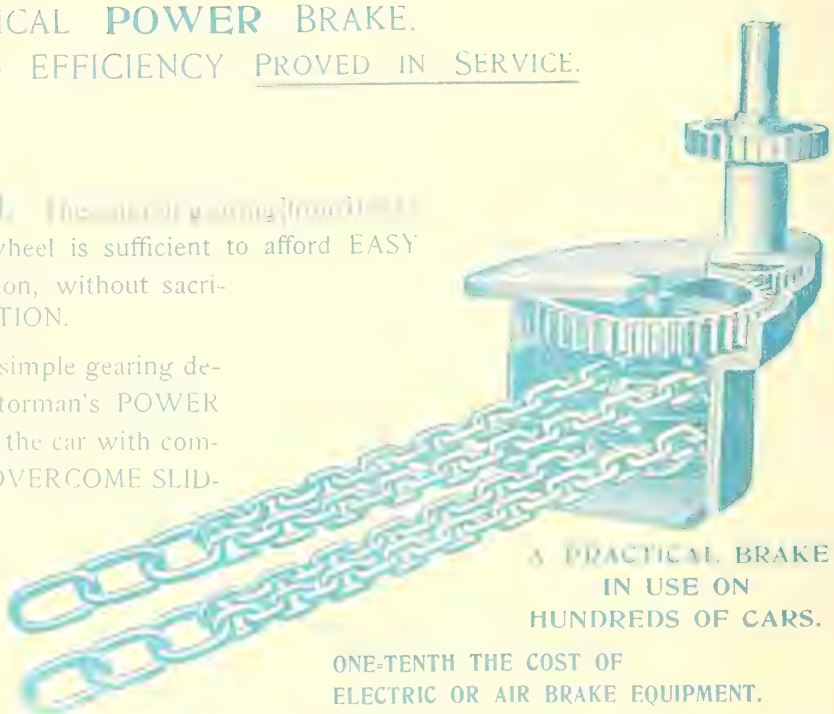
A MECHANICAL **POWER** BRAKE.

RELIABILITY AND EFFICIENCY PROVED IN SERVICE.

ADVANTAGES:

EASE OF OPERATION. The [illegible] post to double sprocket wheel is sufficient to afford EASY and POSITIVE manipulation, without sacrificing QUICKNESS of ACTION.

GREAT POWER. The simple gearing device MULTIPLIES the motorman's POWER and enables him to control the car with comparative ease, and greatly OVERCOME SLIDING of WHEELS, thus [illegible] positive stop in any [illegible]



A PRACTICAL BRAKE IN USE ON HUNDREDS OF CARS.

ONE-TENTH THE COST OF ELECTRIC OR AIR BRAKE EQUIPMENT.

SAFETY. Due to multiplied power and double chain connection. Should one chain break the other BECOMES OPERATIVE INSTANTLY.

ECONOMY. The wear on chain is reduced to the minimum, being EQUALLY DISTRIBUTED, thus avoiding the continual "grinding," wearing through and replacing of chain, common to the ordinary brake.

STERLING INSULATING





COMBINES GREATEST STRENGTH AND HIGHEST INSULATING QUALITIES.

...ALSO..

FENDERS, SAND BOXES AND COMMUTATORS.





Sterling Supply & Mfg. Co.

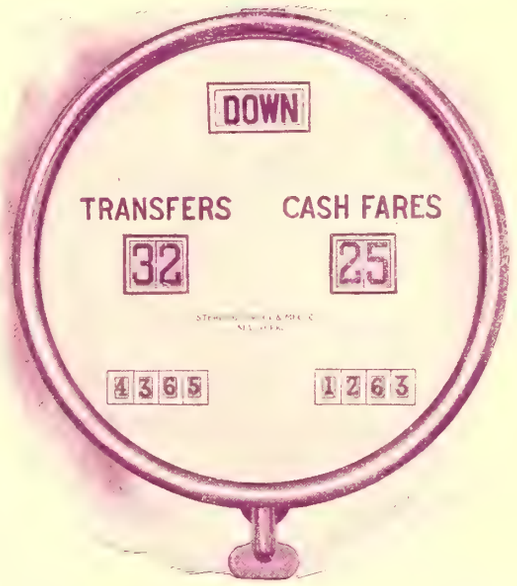
141-155 EAST 25th STREET, NEW YORK

STERLING FARE REGISTERS

DISTINCTIVE FEATURES....

SIMPLICITY OF DESIGN
SUPERIOR WORKMANSHIP....





...WE OWN MANY OF THE OLDEST, AS WELL AS SEVERAL OF THE LATEST FARE REGISTER PATENTS, AND HAVE NOT BEEN COMPELLED TO RESORT TO INTRICATE MECHANISM TO "GET ROUND" AND AVOID EXISTING PATENTS....

"Quality Our Foundation"

Sterling Supply & Mfg. Co.

141-155 EAST 25th STREET

New York

...OVER 50,000 VAN DORN COUPLERS ...IN USE

The only Automatic Coupler for Street, Electric and Elevated Roads now on the Market.



Above cut represents a shipment of cars by the Wason Mfg. Co. to Long Island R. R. Co. of Brooklyn, N. Y. The cars are equipped with our Standard No. 3 Automatic Coupling with improved draft rigging, and shows that their capacity is equal to more than four times the requirement.

Van Dorn Automatic Couplings are adapted for all classes of cars and all kinds of service, from the very heaviest to the very lightest. Special sizes for mining cars. ....Send for price list and new catalogue.

W. T. VAN DORN CO.

Monadnock Block...
...CHICAGO

EUROPEAN REPRESENTATIVES
ROBERT W. BLACKWELL & CO., 39 Victoria St., Westminster, London; 50 Boulevard Haussmann, Paris



...THE...

"New Haven" Fare Registers

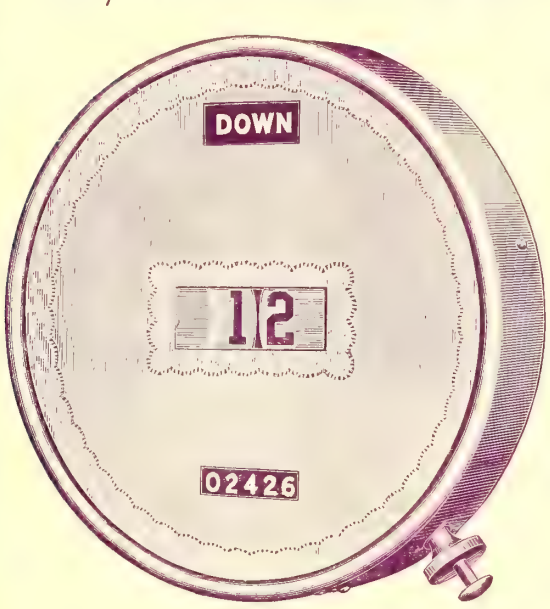
SINGLE. DOUBLE. TRIPLE.

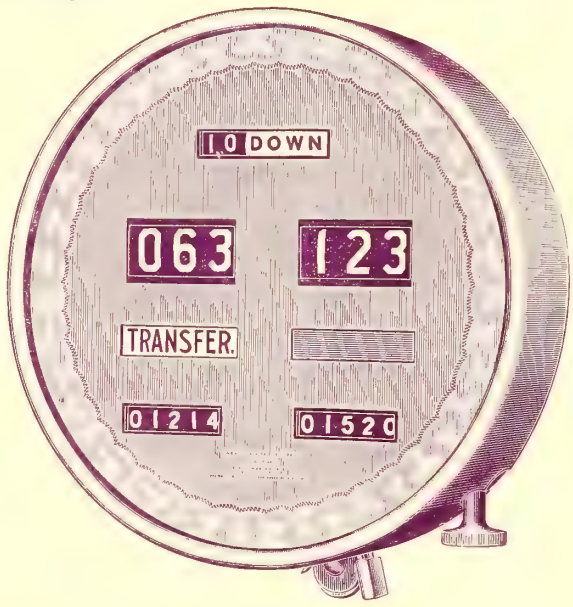


Note Our Full Line. The Most Complete on Earth.

ACCURATE. RELIABLE. DURABLE.

They Do the Work and Do It Right. We Guarantee It.





Our New Round Single and Double Registers.
Note Their Completeness. They Are Right.
Compare Them With All Other Round Registers.
See Them at Chicago Convention.

WE ARE NOW AT WORK ON LARGE CONTRACTS FOR THE FOLLOWING ROADS:

BOSTON ELEVATED R. R. THIRD AVENUE R'Y, NEW YORK.
HAVANA ELECTRIC RAILWAY. And On Many Smaller Ones.



Full Exhibit Chicago Convention

SPACE 77.

THE.....

NEW HAVEN CAR REGISTER CO.

NEW HAVEN, CONN.



THE...

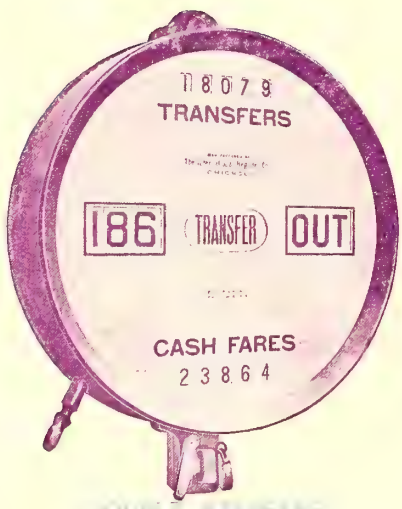
International Register Co.

133-139 SOUTH CLINTON STREET

...CHICAGO...

Single and Double Car Registers

Rod & Cord Fittings Portable Registers



O[illegible] ring a cash fare or a transfer with the [illegible] apparatus necessary for operating a double register. [illegible] n car, so that either kind of fare can be rung from either [illegible] her side, thus avoiding unnecessary friction.

SALES AGENTS

FRANK RIDLON CO.
200 Summer Street, BOSTON

JOSHUA HENDY MACHINE WORKS
38 Fremont Street, SAN FRANCISCO

MAYER & ENGLUND
10 South Tenth Street, PHILADELPHIA

LESTER, DEAN & CO.
Old Colony Building, CHICAGO

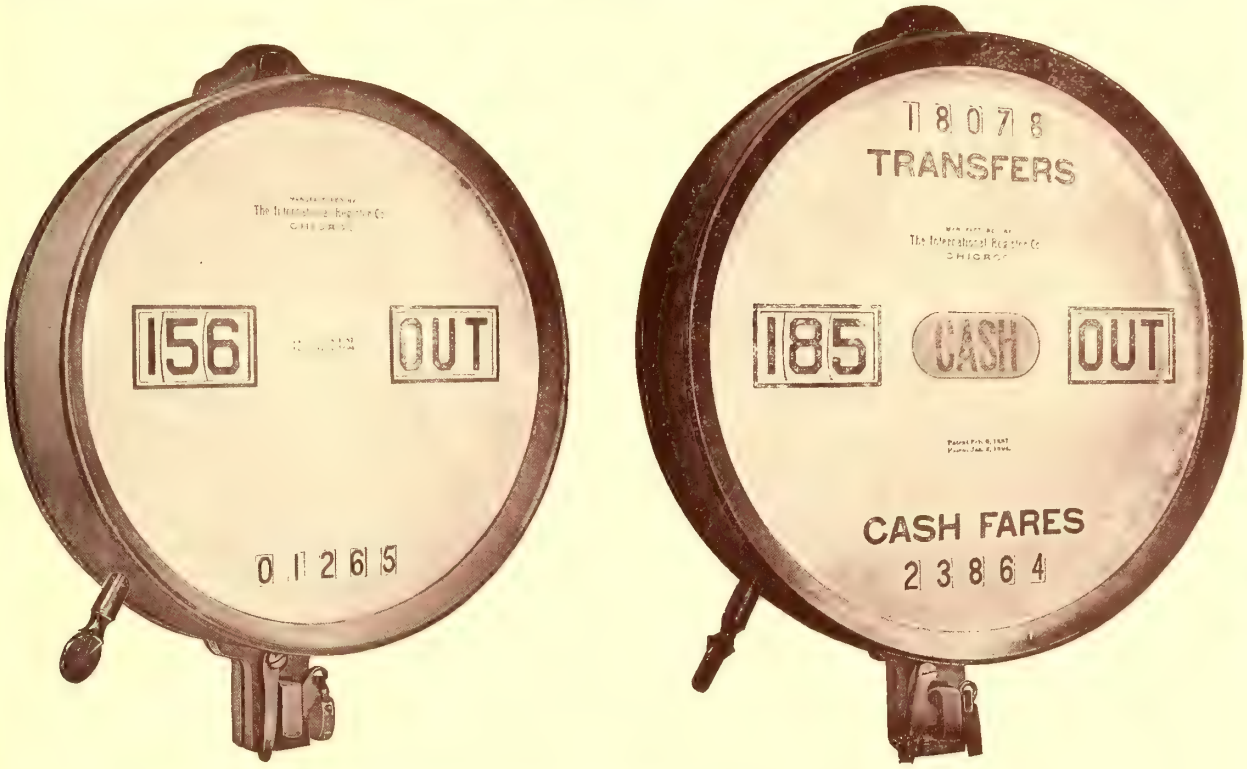


[illegible] ING HOD BAGS

The

International Register Co.

133-139 South Clinton Street, CHICAGO



A FEW OF THE ROADS USING INTERNATIONAL REGISTERS

The Albany Railway, Albany, N. Y.
Boston Elevated Railroad Co., Boston, Mass.
Brockton Street Railway Co., Brockton, Mass.
Brooklyn Heights Railroad Co., Brooklyn, N. Y.
Capital Traction Co., Washington, D. C.
Charleston City Railway Co., Charleston, S. C.
Chicago General Railway Co., Chicago, Ill.
City and Suburban Railway Co., Washington, D. C.
Fairmount Park Transportation Co., Philadelphia, Pa.
Fall River and Newport Street Railway Co., Portsmouth, R. I.
Lowell, Lawrence and Haverhill Street Railway Co. Lawrence, Mass.
Lake Street Elevated Railroad Co., Chicago, Ill.
Lynn and Boston Railroad Co., Lynn, Mass.
Metropolitan Street Railway Co., Kansas City, Mo.
The Milwaukee Electric Railway and Light Co., Milwaukee, Wis.
Newport News, Hampton and Old Point Railway Co., Portsmouth, Va.
Portland Railroad Co., Portland, Me.
San Francisco and San Mateo Electric Railway Co., San Francisco, Cal.
San Juan and Rio Piedras Railroad Co., San Juan, Porto Rico.
Sutro Railroad Co., San Francisco, Cal.
Wilmington City Railway Co., Wilmington, Del.
Worcester and Suburban Street Railway Co., Worcester, Mass.

SALES AGENTS:

FRANK RIDLON CO.,
200 Summer Street, BOSTON.

JOSHUA HENDY MACHINE WORKS,
38 Fremont Street, SAN FRANCISCO.

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10 South Tenth Street, PHILADELPHIA.

LESTER, DEAN & CO.,
Old Colony Building, CHICAGO.

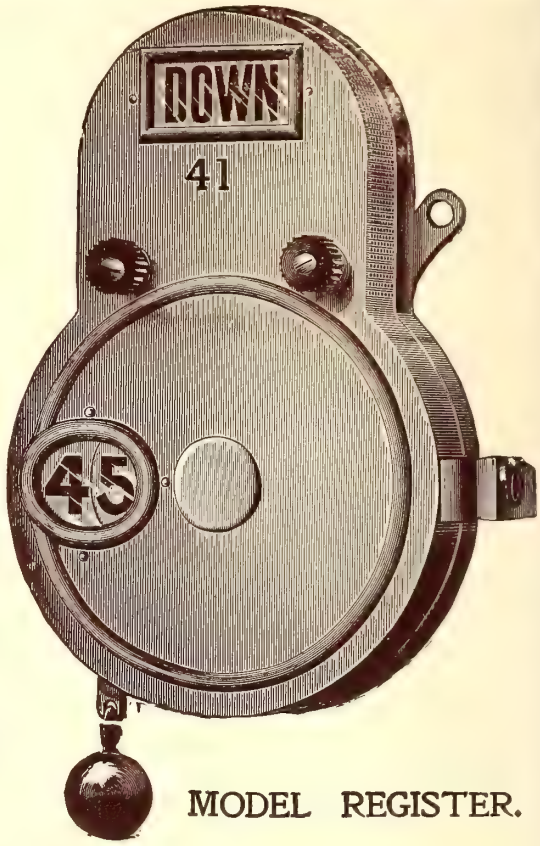
RAILWAY REGISTER MFG. CO.

MANUFACTURERS OF ALL STYLES OF ...

PORTABLE and STATIONARY REGISTERS

.. ALSO FULL LINE OF ..

Brass Fixtures, Leather Goods, Etc., Etc.

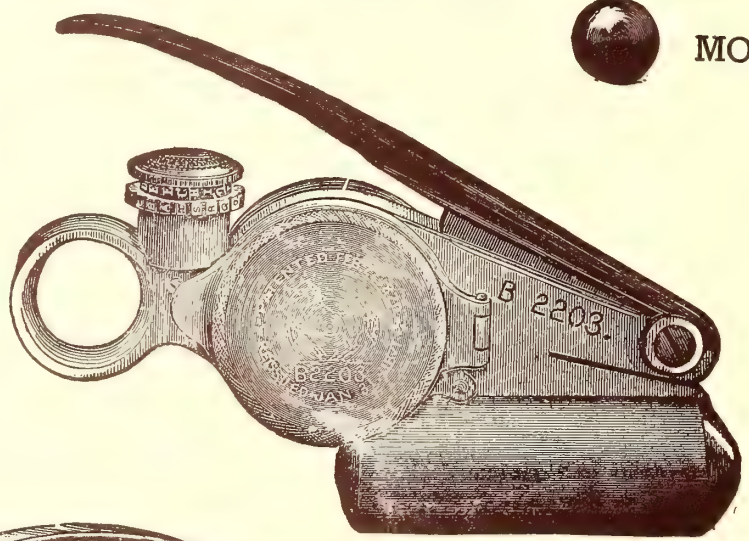


MODEL REGISTER.

ALARM REGISTERING PUNCH

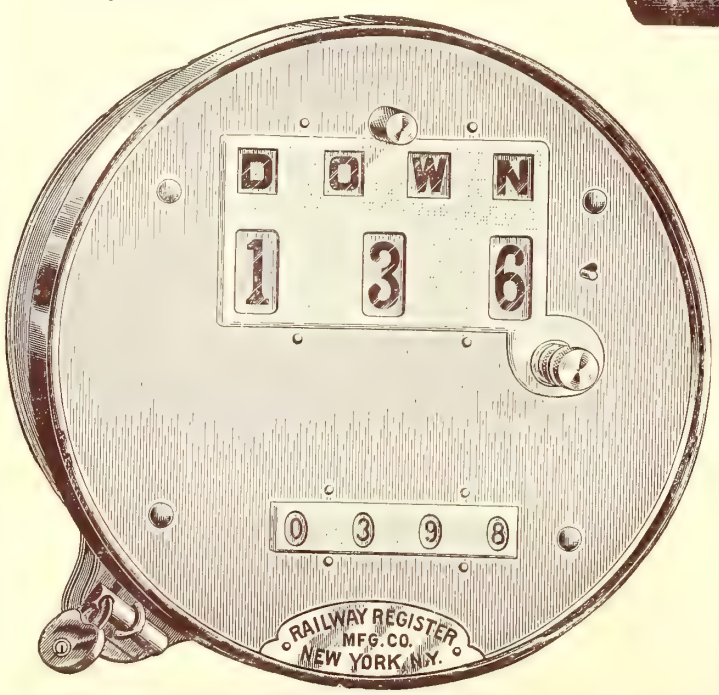
Especially adapted for any number of cash fares, tickets and transfers.

Adopted by the Melbourne Tramway & Omnibus Co., of Melbourne, Australia, for their entire system.



Thousands of these registers in use in this country and Canada, and have stood the test for years.

No matter what system or different rates of fares you have on your road we can furnish you with a register that will meet your requirements.



MONITOR REGISTER.

.. OUR ..

MONITOR REGISTER

Shows the Largest Figures yet introduced on any Register.

SPECIAL ATTENTION PAID TO EXPORT ORDERS.

For Prices and full particulars, address

EDWARD BEADLE, Manager,

1193 Broadway, New York City, N.Y.

Full line of samples at our Pacific Coast Office, 1630 Market Street, San Francisco, Cal., F. T. HULL, Agent.

THE NEW MEAKER REGISTER

Is a Radical Departure in Construction, as it is in General Scheme of Operation.



This Register, combining all the essential features of the ordinary type of Register, possesses the added advantage of having a totalizer composed partly of letters and partly of figures, the figures only being used in the ordinary taking of statements (read the same as a 10,000 totalizer). The complete reading can be taken by those only who are allowed by the management to know the value of the several letters.

The Objects Accomplished are these:

An additional check is placed on the conductor, who is unable to read the grand total.

Your competitors or other interested persons are unable to keep a record of your business.

The manager is able to easily check the bookkeeping of the office.

Registers totalizing to 100,000 all in figures (that is, without the letter symbol) are furnished if desired.

The mechanism so completely interlocked that, even with the case off, the figures cannot be moved, either in totalizer or trip number, except in the regular way.

They cannot be manipulated in any way. As they can only be assembled with figure nines at the window position, it is impossible to take them apart and then put them together at a lower number.

They are practically without springs, only three being used. All motions are positive, absolute and beyond question.



OUR PORTABLE REGISTER.

Complete Descriptive Catalogue, showing construction in detail, mailed on request.

OUR REGISTERS ARE IN USE IN ALL THE PRINCIPAL CITIES.

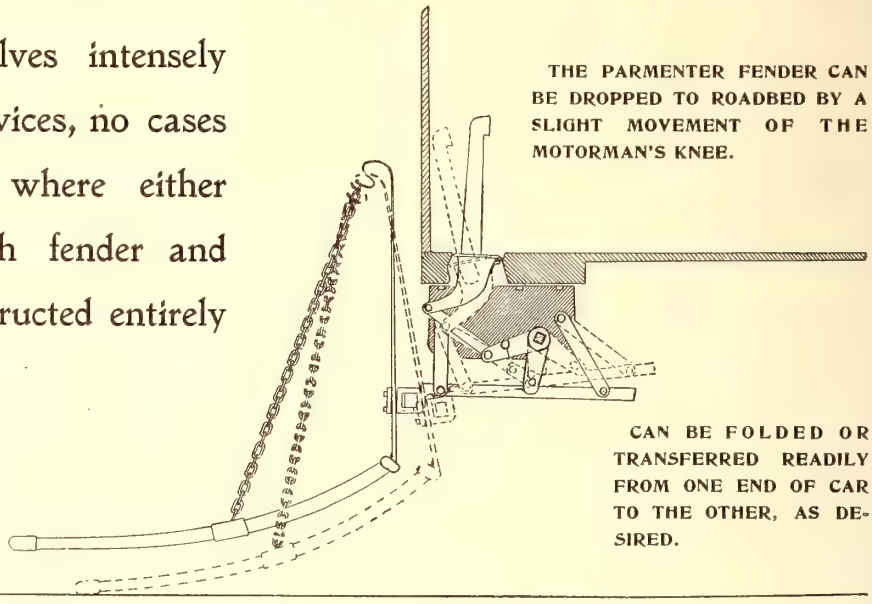
REFERENCES ON APPLICATION.

Meaker Manufacturing Co.

NORTH CHICAGO, ILL.

PARMENTER FENDERS AND WHEEL GUARDS

Have proved themselves intensely practical life-saving devices, no cases having been reported where either one has failed. Both fender and wheel guard are constructed entirely of metal, easy to adjust and easily maintained.

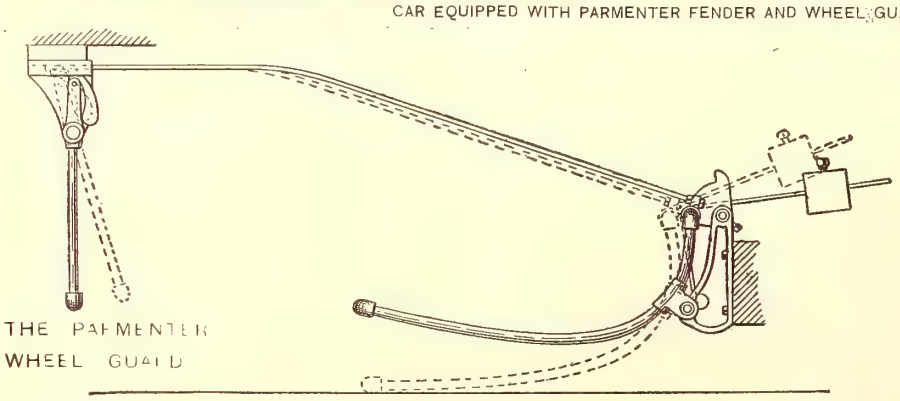


THE PARMENTER FENDER CAN BE DROPPED TO ROADBED BY A SLIGHT MOVEMENT OF THE MOTORMAN'S KNEE.

CAN BE FOLDED OR TRANSFERRED READILY FROM ONE END OF CAR TO THE OTHER, AS DESIRED.



CAR EQUIPPED WITH PARMENTER FENDER AND WHEEL GUARDS



THE PARMENTER WHEEL GUARD

The wheel guards can be used in connection with fenders or independently.

THE FULLEST INVESTIGATION IS EARNESTLY SOLICITED.

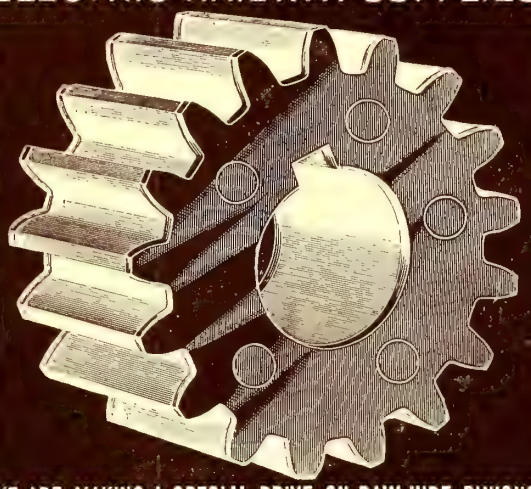
GEORGE A. PARMENTER, CAMBRIDGEPORT, MASS.

J. H. McGILL J. W. PORTER

McGILL, POMEROY & CO.

317 Dearborn St., Chicago

ELECTRIC RAILWAY SUPPLIES



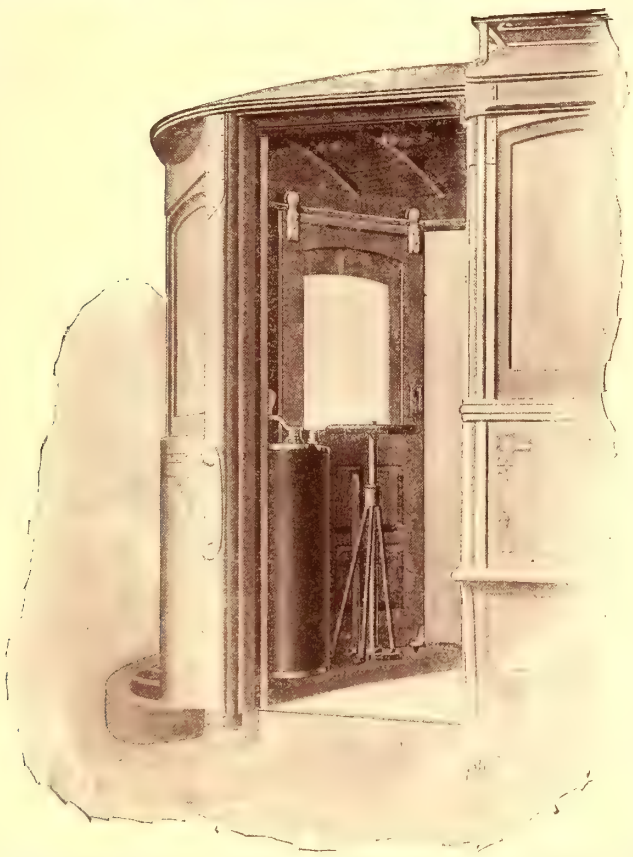
WE ARE MAKING A SPECIAL DRIVE ON RAW HIDE PINIONS

EXCLUSIVE TERRITORIAL REPRESENTATIVES

THE OHIO BRASS CO., Overhead Material, - - Mansfield, Ohio
THE CUTTER ELEC. & MFG. CO., I-T-E Circuit Breakers, Philadelphia, Pa.
THE FOREST CITY ELEC. CO., Commutator Bars, - Cleveland, Ohio
WAGENHALS MFG. CO., Slow Feed Controller Handle, Cincinnati, Ohio
COLUMBUS HANDLE & TOOL CO., Construction Tools, Columbus, Ind.

EVERYTHING IN CHICAGO STOCK

AGARD'S PATENT VESTIBULE SLIDING DOOR FIXTURE



Door Hung on Swivel Hangers, follows angle of Vestibule; requires least possible space

Manufactured Exclusively by

JAMES L. HOWARD & CO., - Hartford, Conn.



DAMAGE TO HARPS

and overhead construction due to the trolley leaving the wire, often causes great expense for repairs and ties up the line.

It can be prevented absolutely by using the **Wilson Trolley Pole Catcher** which costs but eight dollars per car.

It is easily attached to the car, is small and never in the way, and will hold the pole surely and safely whenever it leaves the wire.

The hand of the conductor will be more free to jerk the rope leading to the cash register if he doesn't have to spend so much time pulling at the trolley rope.

The Wilson Trolley Pole Catcher means more money to every street car line. It lessens the expense for repairs on the overhead construction. It lessens the distraction of the conductor's mind from the collection of his fares and consequently he runs less chance of missing them.

Our book entitled "**A Big Leak Stopped,**" tells all about it. Send for one. It is free.

FRANK RIDLON CO.

200 Summer Street, Boston, Mass.

Address all foreign orders to

WILSON & CO., 315 Fulton St., Brooklyn, N. Y., U. S. A.

...THE...

Hipwood=Barrett Fender

See
Our Exhibit
at the Street
Railway
Convention,
Chicago



FENDER IN NORMAL POSITION

See
Our Exhibit at
the National
Export
Exposition,
Philadelphia



FENDER DISPOSED OF UNDER REAR END OF CAR

.....SEE OPPOSITE PAGE

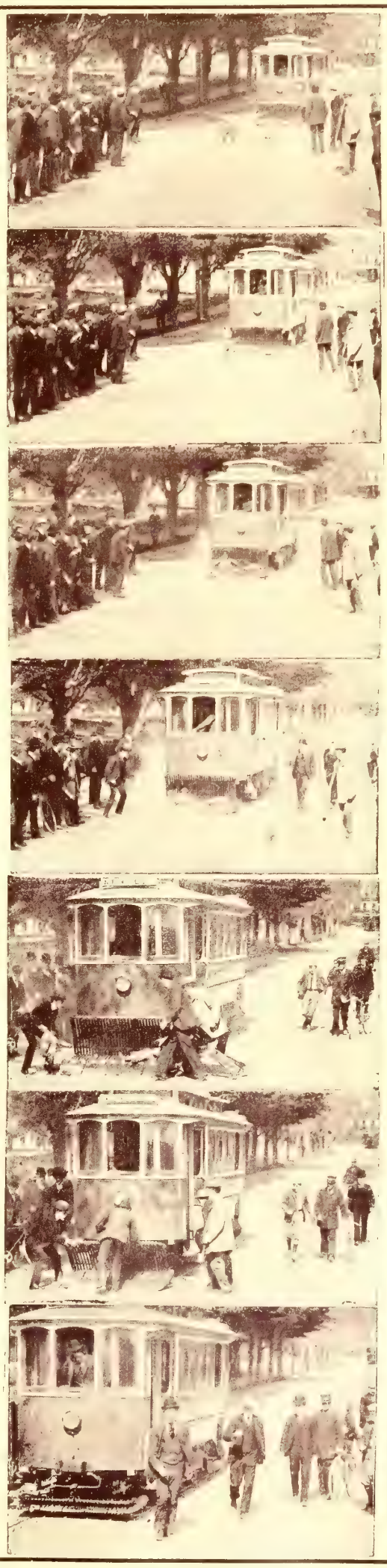
THE

Hipwood-Barrett Fender

THE accompanying cuts were made from a series of 1200 Mutoscopic pictures taken at the rate of 40 per second by the American Mutoscope Company for use on the Biograph and in the Mutoscope to show the practical working of the only efficient street car fender. The pictures show the car running at the rate of 15 miles per hour, over an uneven road-bed, and performing its life-saving work under conditions which actually exist. The rapidity with which this fender is operated can be judged by the fact that the car covered a distance of two blocks, the fender was dropped, dummies picked up and carried some 50 feet, then removed, and the fender disposed of under car, all within 25 seconds.

Repeated tests have proved this fender to be in every way efficient, and its PERFECT ADAPTABILITY TO UNEVEN SURFACES, UNIMPAIRMENT OF EFFICIENCY BY OSCILLATION OF CAR, INSTANTANEOUS OPERATION BY MOTORMAN, NON-INTERFERENCE WITH USE OF CAR AND EQUIPMENTS, AND ACTION UNAFFECTED BY ICE OR SNOW, make it the only practical fender suitable for street railways. These features, together with its ready disposal under the car in 3 seconds, when not in use, commend it at once to practical street railway men.

The unique shape of this fender, particularly when painted to match the dasher, tends to add to, rather than detract from, the symmetrical lines of the car.



The Hipwood-Barrett Car and Vehicle Fender Co.,

66 BROADWAY,
(TEL. 2782 CORTLANDT.)

NEW YORK.

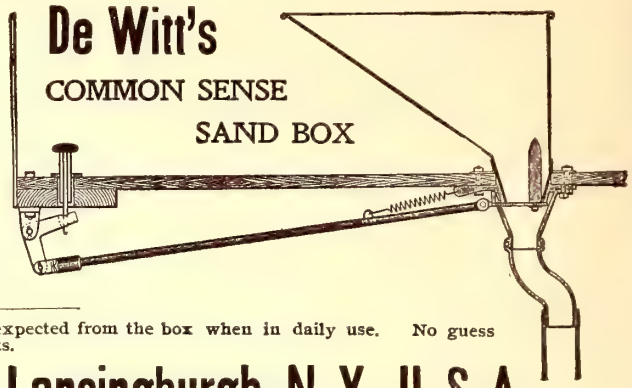
SOLE AGENT FOR EUROPE
Mr. FERDINAND ROMÜNDER
KÖLN, GERMANY

Western Office, Marquette Building, CHICAGO, ILL.

THE ONLY ABSOLUTELY RELIABLE SAND BOX OFFERED TO THE TRADE

There is no other box on the market that can show a six years' record without repairs on box proper, or refusal to work. In use all over the world. Made to outlast the car body to which it is attached. Delivers the sand instantaneously and as much of it as desired.

De Witt's COMMON SENSE SAND BOX



Write us for testimonials from the trade. They will inform what is to be expected from the box when in daily use. No guess work about it, only facts.

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HAM'S SAND BOX

NO VALVE. FEW PARTS. CHEAPEST TO APPLY.

Sample Pair sent for trial to any road.

Price, $3.50 Each,

Includes Hopper, Foot Lever and Hose.

CAN NOT RUST LEAK WASTE SAND DRAW MOISTURE

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Eastern Agent, FRANCIS GRANGER, 26 Cortlandt St., New York.

REG. TRADE MARKS "Phosphor-Bronze" DELTA

THE PHOSPHOR BRONZE SMELTING CO. LIMITED, 2200 WASHINGTON AVE., PHILADELPHIA.

"ELEPHANT BRAND PHOSPHOR-BRONZE" INGOTS, CASTINGS, WIRE RODS, SHEETS, ETC.

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What's the Use



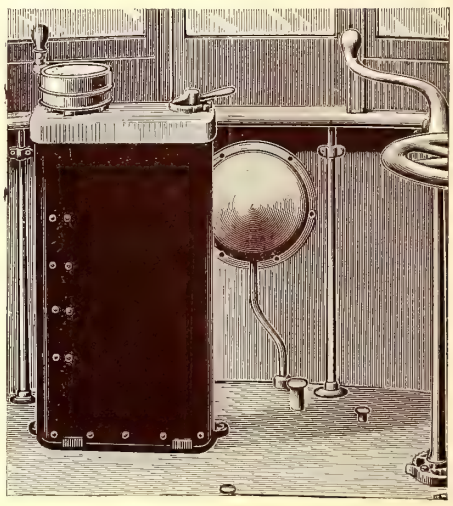
Of Spending thousands in your Power Stations to reduce the cost of power production, when a few Dollars invested at the Consumer (the Controller) will give you 50 per cent. better returns.

THE WAGENHALS "SLOW FEED" CONTROLLER HANDLE

is a mechanical device which COMPELS the Motorman to apply the Power Economically, thereby saving your Coal, Motors and Generators, as well as giving you an increased capacity.

No change necessary in your present controllers. Lift off the old handle and put on the new. It's being adopted by all the best lines. Write for circulars and prices.

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Every Genuine Roller has the name of manufacturer, STEWART HARTSHORN, in script on label.

Special rollers for street and steam railway cars. Brackets suitable for all classes of fittings. Used all over the world wherever cars are run.

STEWART HARTSHORN CO.

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Office and Factory, E. NEWARK, N. J.

BENT GLASS FOR **RAILWAY CARS.**

Largest exclusive Glass Bending Works in the World.

Oriel Glass Company,
ST. LOUIS, MO.

... THE ...

PROVIDENCE CAR FENDER

SAVES HUMAN LIVES.



. . MANUFACTURED BY . . .

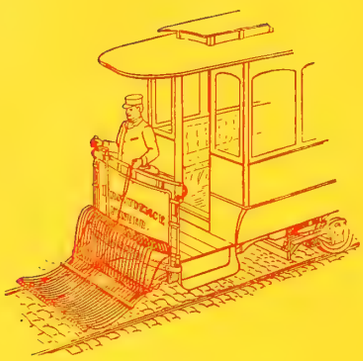
THE CONSOLIDATED CAR FENDER CO.

PROVIDENCE R. I.

The Slaughter of the Innocents

Is Being Stopped.

THE GREAT LIFE SAVER



THE PROVIDENCE FENDER

IS DOING ITS GRAND WORK OF SAVING HUMAN LIVES.

ALREADY THE PROVIDENCE FENDER IS IN USE ON MORE THAN SIX THOUSAND CARS IN NEARLY ONE HUNDRED CITIES AND TOWNS.

LOOK AT THIS RECORD!

97 per cent. of all persons struck by the Providence Fender have been saved.

99 per cent. of those saved were not injured.

100 per cent. of all lives placed in jeopardy have been saved when the full equipment, viz., front fender and wheel guards, has been used.

WE CAN SUBSTANTIATE THESE FIGURES

IS NOT THIS A GRAND RECORD? HAS ANYTHING EQUAL TO IT BEEN KNOWN?

CATALOGUES AND FURTHER INFORMATION UPON APPLICATION.

THE CONSOLIDATED CAR FENDER CO.

PROVIDENCE, R. I.

LIVERMORE & KNIGHT CO. PROVIDENCE.

.. The Providence Car Fender ..

is Used on the Following Street Railways:

Metropolitan Street Railway Co.,	New York City.
The Albany Railway,	Albany, N. Y.
Utica Belt Line Street R. R. Co.,	Utica, N. Y.
Syracuse Rapid Transit Ry. Co.,	Syracuse, N. Y.
Syracuse & East Side St. Ry. Co.,	Syracuse, N. Y.
Syracuse, Lakeside & Baldwinsville Ry. Co.,	Syracuse, N. Y.
Binghamton R. R. Co.,	Binghamton, N. Y.
Lake Ontario & Riverside Ry. Co.,	Oswego, N. Y.
Troy City Ry. Co.,	Troy, N. Y.
Auburn City Ry. Co.,	Auburn, N. Y.
Middletown-Goshen Traction Co.,	Middletown, N. Y.
Staten Island Midland R. R. Co.,	Stapleton, N. Y.
Staten Island Electric R. R. Co.,	New Brighton, N. Y.
Van Brunt St. & Erie Basin Ry. Co.,	Brooklyn, N. Y.
Consolidated Traction Co.,	Jersey City and Newark, N. J.
Plainfield Street Ry. Co.,	Plainfield, N. J.
Passaic & Newark Electric Traction Co.,	Passaic, N. J.
Suburban Traction Co.,	Orange, N. J.
The New Jersey Electric St. Ry. Co.,	Hoboken, N. J.
Union Depot Railroad Co.,	St. Louis, Mo.
Central Ry. & Electric Co.,	New Britain, Conn.
Waterbury Traction Company,	Waterbury, Conn.
Fair Haven and Westville R. R. Co.,	New Haven, Conn.
Hartford & West Hartford H. R. R. Co.,	Hartford, Conn.
The New Haven Street Ry. Co.,	New Haven, Conn.
New Haven & Centreville St. Ry. Co.,	New Haven, Conn.
Winchester Ave. St. Ry. Co.,	West Haven, Conn.
Hartford Street Ry. Co.,	Hartford, Conn.
Meriden Electric R. R. Co.,	Meriden, Conn.
Norwalk Tramway Company,	South Norwalk, Conn.
San Diego Electric Ry. Co.,	San Diego, Cal.
Georgetown & Tenalleytown St. Ry. Co.,	Washington, D. C.
City Street Car Company,	Staunton, Va.
Richmond Traction Company,	Richmond, Va.
Richmond Ry. & Electric Co.,	Richmond, Va.
Port Norfolk Electric Ry. Co.,	Portsmouth, Va.
Fitchburg & Leominster Street Ry. Co.,	Fitchburg, Mass.
Fall River Street Ry. Co.,	Fall River, Mass.
Citizens Rapid Transit Ry. Co.,	Nashville, Tenn.
Cleveland, Painesville & Eastern R. R. Co.,	Cleveland, Ohio
Cleveland, Berea, Elyria & Oberlin Ry. Co.,	Cleveland, Ohio.
Akron, Bedford & Cleveland R. R. Co.,	Cleveland, Ohio.
Cleveland & Chagrin Falls Electric Ry. Co.,	Cleveland, Ohio.
Lorain & Cleveland Ry. Co.,	Cleveland, Ohio.
Dayton & Western R. R. Co.,	Dayton, Ohio.
Cincinnati & Hamilton Electric Ry. Co.,	Cincinnati, Ohio.
City Electric Ry. Co.,	Port Huron, Mich.
Consolidated Street Ry. Co.,	Grand Rapids, Mich.
Alton Ry. & Illuminating Co.,	Alton, Ill.
St. Louis & East St. Louis Electric Ry. Co.,	E. St. Louis, Ill.
Olympia Light & Power Co.,	Olympia, Washington.
Altoona & Logan Valley Electric Ry. Co.,	Altoona, Pa.
The Ottawa Street Ry. Co.,	Ottawa, Ontario.
South Chicago City Ry. Co.,	South Chicago, Ill.
North Hudson County Street Ry. Co.,	Hoboken, N. J.
Des Moines City Railway Co.,	Des Moines, Iowa.
Omaha Street Railway Company,	Omaha, Neb.
Tri-City Railway Company,	Davenport, Iowa.
Superior Rapid Transit Company,	West Superior, Wis.
Cleveland Electric Railway Company,	Cleveland, Ohio.
Paterson Railway Company,	Paterson, N. J.
Rutland Street Railway Company,	Rutland, Vt.
Peekskill Traction Company,	Peekskill, N. Y.
Ohio Central Traction Co.,	Galion, Ohio.
Jackson Light & Power Co.,	Jackson, Mich.
Elizabeth City Horse R. R. Co.,	Elizabethport, N. J.
Citizens Street Railway Co.,	Fishkill-on-Hudson, N. Y.
Bennington & Hoosick Valley Ry. Co.,	Hoosick Falls, N. Y.

Costa Rica Electric Light & Transportation Company,	San Jose, Costa Rica.
Buenos Ayres & Belgrano Tramways Co.,	Buenos Ayres, Argentina.
Colombo Tramway Company,	Colombo, Ceylon.
Sao Paulo Railway, Light & Power Co.,	Sao Paulo, Brazil.

14 Points of Advantage Possessed by the Providence Fender.

FIRST. The device is such that it **will remove the endangered person from the track** if the motorman should fail to stop the car in time.

SECOND. This removal is effected by a **projecting cradle** on which the person may fall, and which at the time of using touches the ground.

THIRD. It being impracticable to carry such a cradle touching the ground all the time, **it is possible for the motorman instantly to drop it,** while at the same time his hands are free for other purposes.

FOURTH. The mechanism is such that the motorman, after dropping his fender, **can again raise it without stopping his car** or leaving the front platform.

FIFTH. The front edge of the cradle is furnished with such rolls, and the cradle itself is of such form, that it **may be dropped on any ordinary road surface without risk of breaking.**

SIXTH. **The front edge of the cradle is yielding,** so as to cushion the blow against the foot or body, if the person has fallen.

SEVENTH. The front end of the car is furnished with **a resilient shield,** covering all the rigid projecting parts of the car, such as the bumper, the draw bar, and the fixtures by which the fender itself is attached to the car.

EIGHTH. The fender is strong enough and elastic enough to serve as **a substantial buffer** in colliding with other vehicles, so as, within a considerable limit, to receive all the damage itself, and prevent injury to both colliding vehicles.

NINTH. It is **detachable from the car,** so that in case of accident the conductor and motorman may readily remove it without the use of tools.

TENTH. It is **foldable against the dash,** so that if fenders are attached to both ends of the car, the rear fender, and in the car house both fenders, may be turned up.

ELEVENTH. It has a breaking part **inexpensive to repair.**

TWELFTH. It is **easily transferable** from one end of the car to the other, so that, if necessary, it may be quickly so transferred by the conductor and motorman at the end of each trip.

THIRTEENTH. It is **of simple construction and easy to repair,** and to that end all the parts are interchangeable.

FOURTEENTH. All fenders for cars of the same company are **interchangeable.**

IT is not enough to say that a fender "is constructed entirely of metal." A cheap fender, constructed of gas pipe and hoop iron, could be thus described, and so deceive the reader and purchaser.

***The Providence Fender** is not only "constructed entirely of metal," but is made of the **best quality of spring steel,** and the attachments are made of the **best malleable iron.** There is no gas pipe, hoop iron, rope netting, or **other cheap material** used in its construction.*

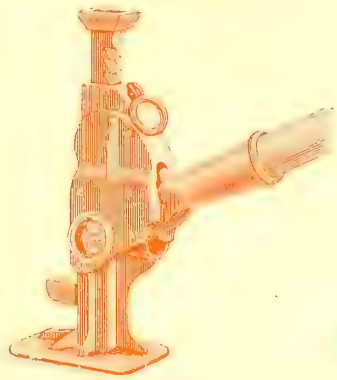
*No expense is spared either in material or labor, to make the **Providence Fender** the **best life saving device** ever attached to an electric or cable car. In fact, it is the only car fender made that, when properly used, saves 100 per cent. of all lives placed in jeopardy.*

The following Table of Speed Run by Electric and Cable Cars may be of Interest to Railroad Men:

1 mile per hour	88 ft. per minute	1.466 ft. per second
2 " "	176 " "	2.933 " "
3 " "	264 " "	4.4 " "
4 " "	352 " "	5.866 " "
5 " "	440 " "	7.333 " "
6 " "	528 " "	8.8 " "
7 " "	616 " "	10.266 " "
8 " "	704 " "	11.733 " "
9 " "	792 " "	13.2 " "
10 miles per hour	880 ft. per minute	14.666 ft. per second
11 " "	968 " "	16.133 " "
12 " "	1056 " "	17.6 " "
13 " "	1144 " "	19.066 " "
14 " "	1232 " "	20.533 " "
15 " "	1320 " "	22. " "
20 " "	1760 " "	29.333 " "
25 " "	2200 " "	36.666 " "

POWERFUL

LIGHT



AUTOMATIC LOWERING JACK No. 2



TRIP JACK No. 12

BARRETT

Lifting Jacks

.. FOR ..

ELECTRIC AND CABLE CARS

The only Jacks with an automatic lowering device, by which any load can be gradually lowered by the same movement of the lever as in raising.

By carrying a "Barrett" Jack in at least every other street car, the Jack would be instantly at hand in case of derailment and the line would not be blocked and passengers inconvenienced. Just one experience of this kind would more than pay the cost of Jack in the fares saved. One car off the track stops all others. The "Barrett" Jack reduces such risks to a minimum and in a year's traffic will save thousands of dollars.

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THE DUFF MANUFACTURING COMPANY

ALLEGHENY, PA.



TRIP JACK No. 1



AUTOMATIC LOWERING JACK No. 5.



BALLAST GANG TRIP JACK No. 6



AUTOMATIC LOWERING JACK No. 19

QUICK

POSITIVE



AUTOMATIC LOWERING JACK No. 4



AUTOMATIC LOWERING JACK No. 3

CROUSE-HINDS ELECTRIC CO.

New York = SYRACUSE = Chicago



...The

"Syracuse Changeable" Electric Headlight

Is the

Standard Electric Headlight

For Trolley Cars
the World Over

We Guarantee our Lamp to be

The Best Made Lamp
To Give the Best and Strongest Light
To Give Satisfaction

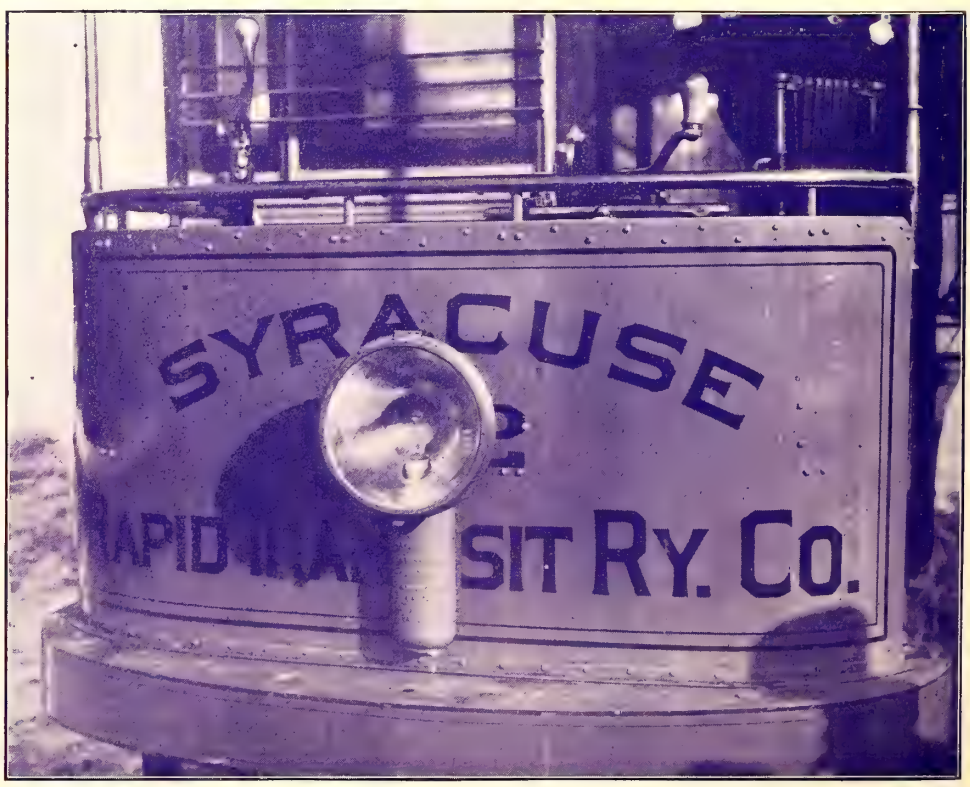
HAVE you seen our Publication

"Official Endorsements"?

We will send a Complete Equipment of the

"Syracuse Changeable" Electric Headlight

on 30 days' trial at our own expense.



CROUSE-HINDS ELECTRIC CO.

New York = SYRACUSE = Chicago

THE...

"Syracuse Changeable" Electric Headlight

Is Changeable from End to End of the Same Car

And is Changeable from One Car to Any Other Car



REMEMBER —

...YOU CAN EQUIP TWO CARS WITH THE "SYRACUSE CHANGEABLE" AT THE COST OF EQUIPPING ONE CAR WITH ANY OTHER LAMP MADE.. .. .. ..



A Postal Card request will bring you by return mail a copy of...

"JUST A FEW FACTS"

Containing all information in regard to the...

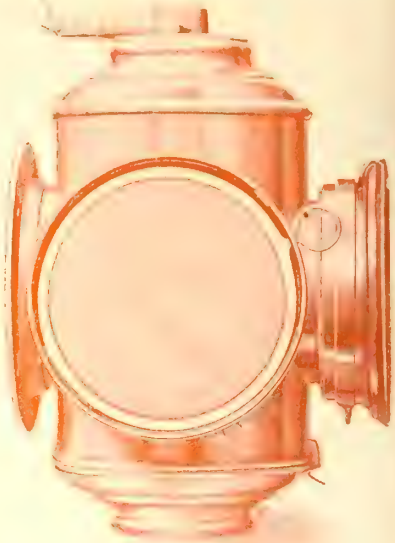
"Syracuse Changeable" Electric Headlight

LET US HEAR FROM YOU. WE CAN SAVE YOU MONEY...



No. 41. DASH ELECTRIC HEADLIGHT.
Malleable Iron.

Headlights FOR Street Railways AND Locomotives



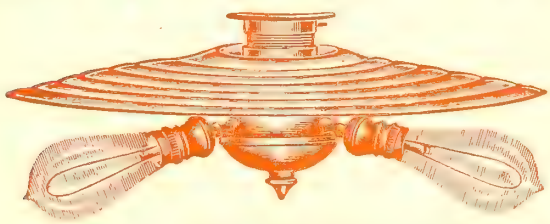
No. 50. "FASSETT" ELECTRIC SIGNAL LAMP.
Albany Ry. Pattern.

The Dressel Railway Lamp Works

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NEW YORK

934 MONADNOCK BLOCK
CHICAGO, ILL.

SMITH OF NEW YORK



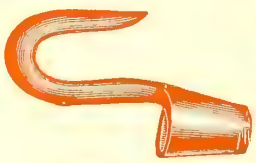
No. 51. Three Light Centre Cluster.



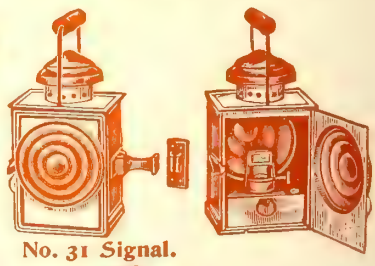
No. 53 Bracket.



Brass Bell Cord Couplings.



Brass Bell Cord Hooks.



No. 31 Signal.

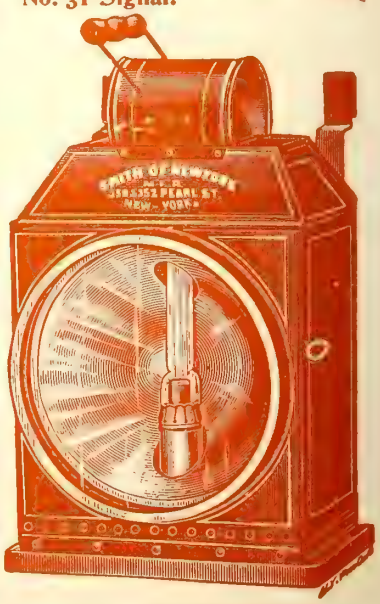


Smith's Automatic Torch.

No. 54
Candle Bracket.



No. 50 Hood, Headlight (Bronze).



No. 25 Oil Headlight.

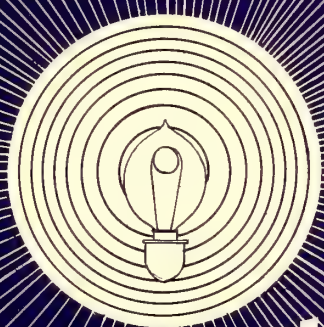
Chas. G. Smith,

350 & 352 Pearl St., N. Y., U. S. A. **Lighting Supplies of All Description.**

European Agent, ROBT. W. BLACKWELL, 39 VICTORIA ST., WESTMINSTER, LONDON, S. W. AND 50 BOULEVARD HAUSSMANN PARIS.

Multiplex Reflectors

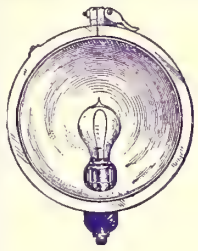
ARE THE MOST POWERFUL ON EARTH
ARE GUARANTEED ON COMPARATIVE TEST TO BE 300% STRONGER THAN ANY OTHER MAKE OF REFLECTOR PLAIN OR PARABOLIC ON THE MARKET TODAY



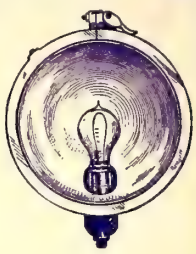
OUR MULTIPLEX REFLECTOR

The Multiplex Reflector Co
CLEVELAND, O.

GENERAL ENG. CO CLEVD O



C. A. Knowles



STREET RAILWAY SUPPLIES

To Meet All Requirements

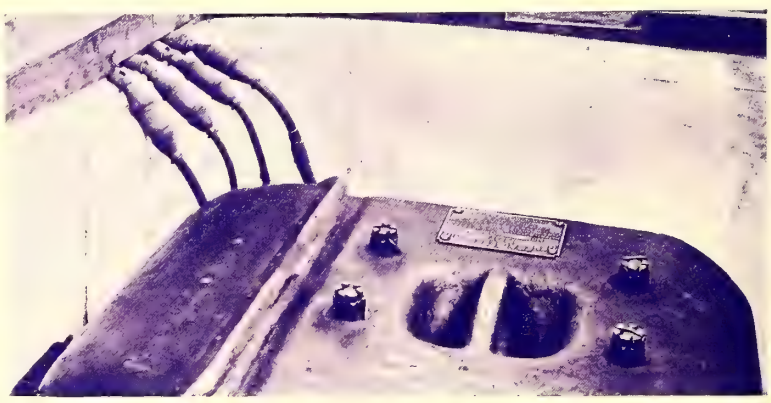


SAMPLE FREE.....

HERE is a **NEW INSULATING CONNECTOR** which is a permanent, adjustable device for doing away with the old fashioned method of taping the connections between motor and cable leads. Time is valuable! All railway men know perfectly well that the old method of taping the two-way connectors of the motor leads, is a time waster. This device will save you time and money.

It is water-proof, absolutely indestructible and costs but little. A sample and full particulars are yours for the asking.

Try it and be convinced.



THIS SHOWS INSULATING CONNECTOR IN USE

WE ARE HEADQUARTERS FOR ...

COTTON & LINEN HOSE FOR CAR CABLES — HEADLIGHTS, (ELECTRIC AND OIL)
RED ROPE PAPER AND PRESS BOARD FOR INSULATING PURPOSES
TAPE AND SPLICING COMPOUND — GLASS AND PORCELAIN INSULATORS
INCANDESCENT LAMPS — TROLLEY WHEELS — CARBON BRUSHES — WIRES AND CABLES

AND SUPPLIES OF ALL KINDS



J. Arch Sh. Boston.

120 Broadway, New York.



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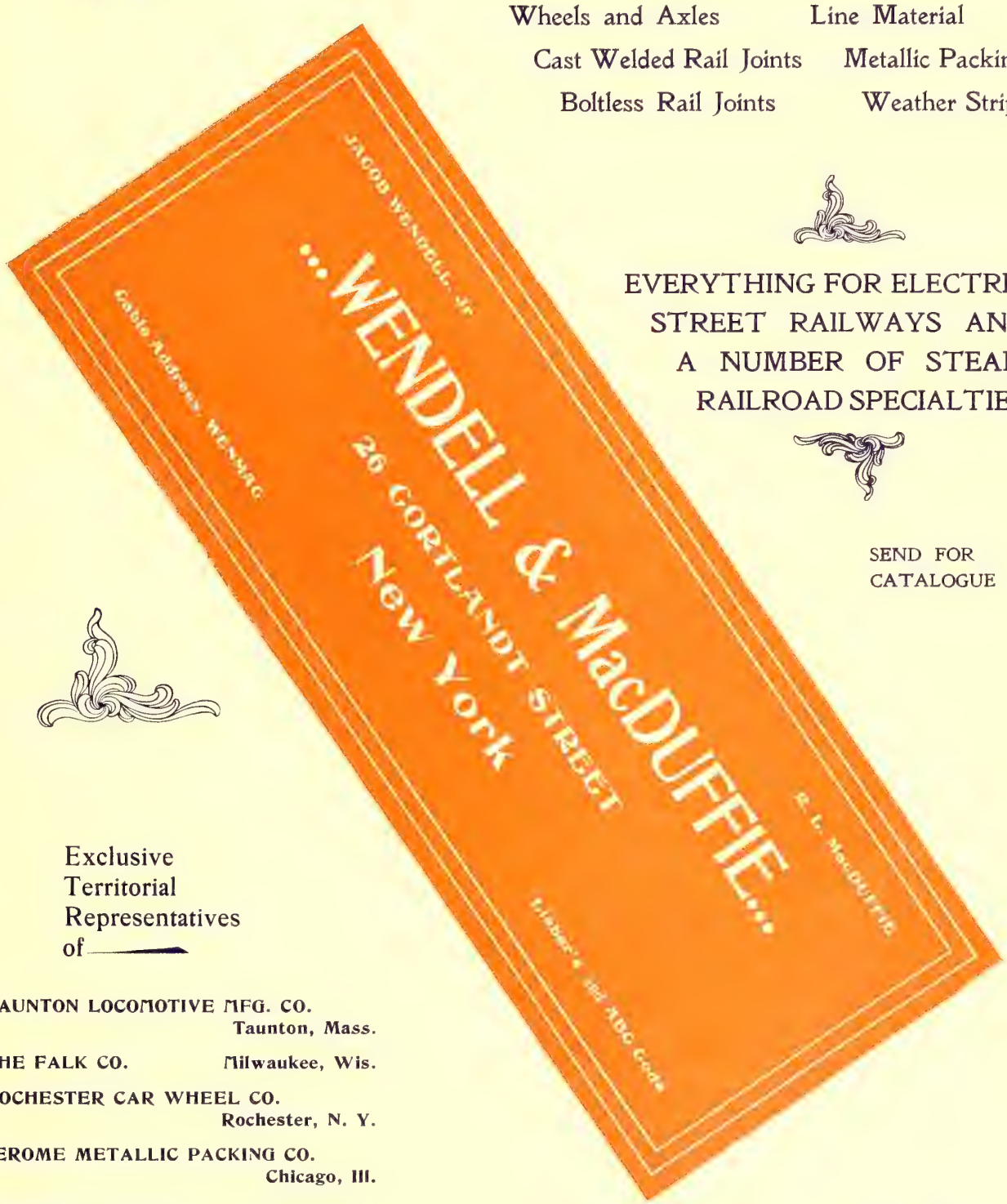
W. R. GARTON COMPANY

MANHATTAN BUILDING, CHICAGO

MENTION "STREET RAILWAY JOURNAL"

W

Snow Plows
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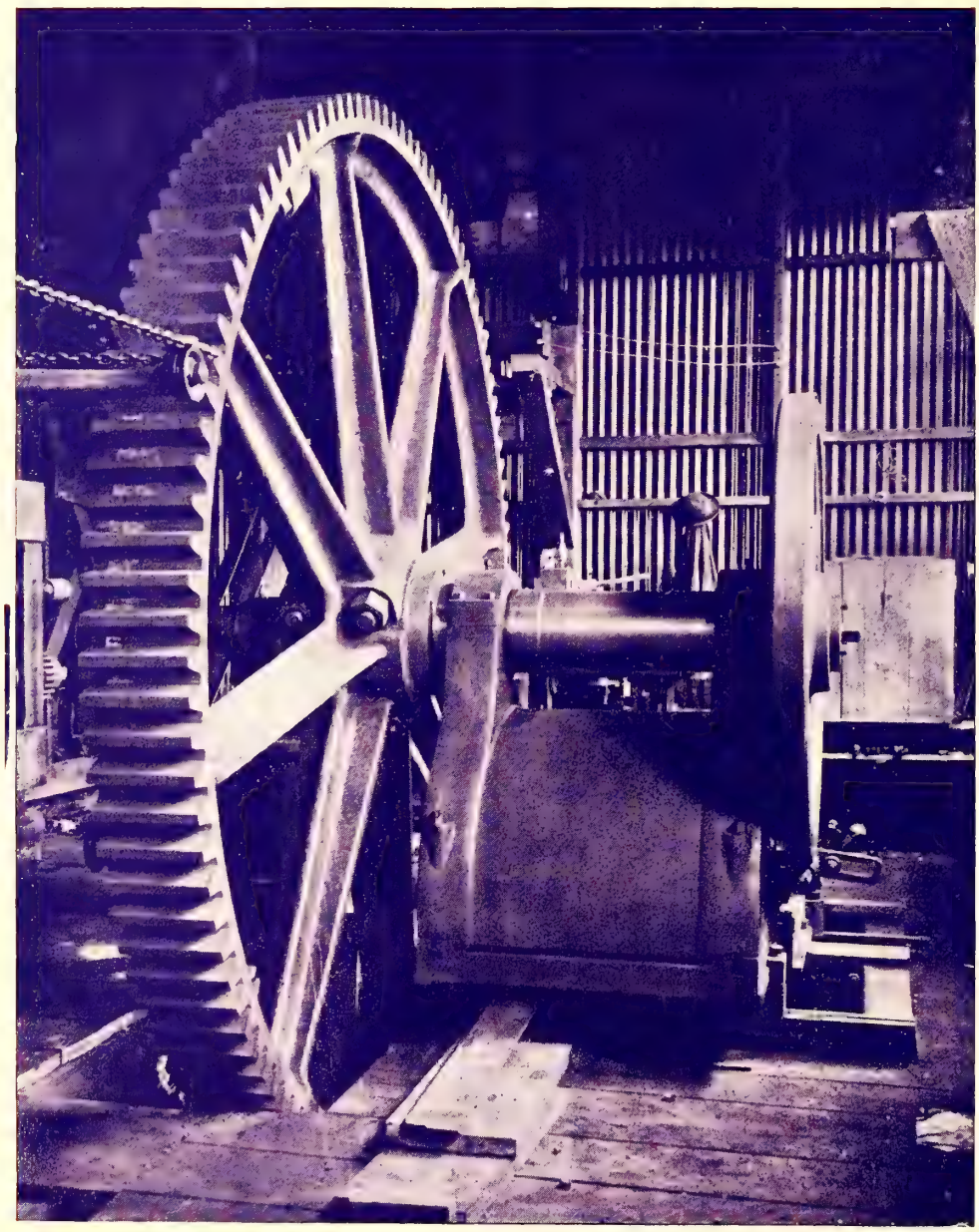
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TAUNTON LOCOMOTIVE MFG. CO. Taunton, Mass.
THE FALK CO. Milwaukee, Wis.
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JEROME METALLIC PACKING CO. Chicago, Ill.
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M

This is not....

A WATCH CHARM!

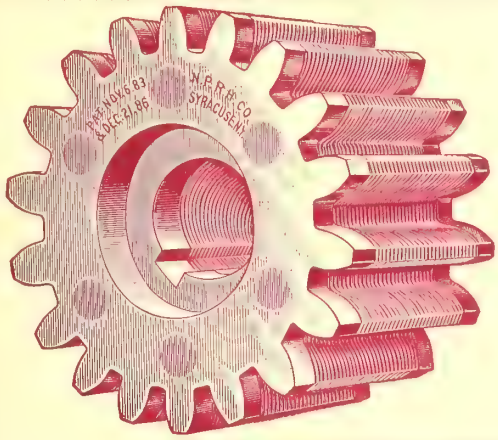


But a gear 12 feet in diameter, 12 inch face, weighing about ten tons; cut in a side room of our Works, being a small part of our motor gear cutting plant, and very nice work.

We will be represented in the Exhibition Hall at the Convention, and shall be glad to give you a line of gear and pinion talk, with good reasons why you should order now and from us.

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NEW PROCESS

RAW HIDE PINIONS

For Electric Motors and all High Speed Machinery.
TRIED AND TRUE.

The New Process Raw Hide Co.,

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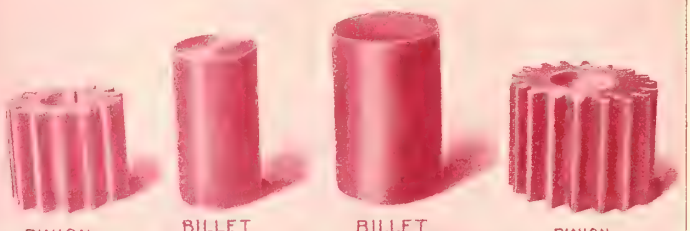
...AS NOW MADE OF...

HIGH CARBON STEEL

ARE THE MOST DURABLE PINIONS PRODUCED

?

SHOWING APPROXIMATE SIZE OF BILLET TO PINION.

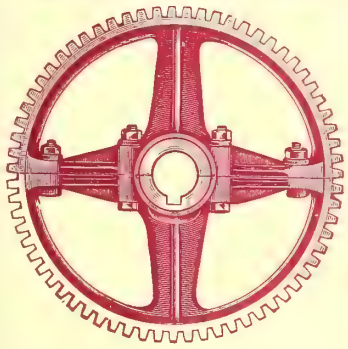


USED ON 150 ROADS IN U. S. AND CANADA } FOR 7 YEARS

The HIGH CARBON combined with our solidifying process (over 1,000,000 lbs. pressure used) insures LONG LIFE to the pinion

Manufactured by... **The United States Projectile Co.** BROOKLYN, N. Y.

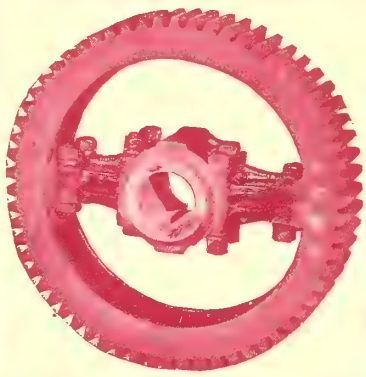
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Uniform in Quality, Stronger, Lighter and Easier Adjusted. Accurately Cut and No Higher in Price than the Best Steel Castings.

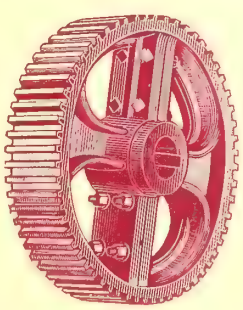
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MOTOR GEARS AND PINIONS.

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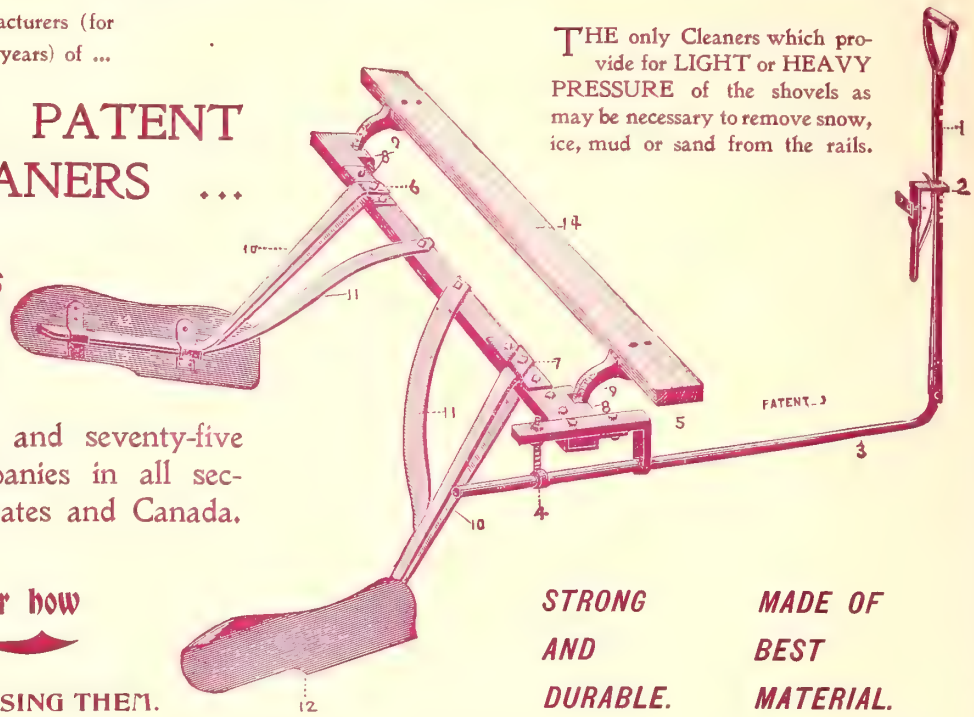
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THE only Cleaners which provide for LIGHT or HEAVY PRESSURE of the shovels as may be necessary to remove snow, ice, mud or sand from the rails.



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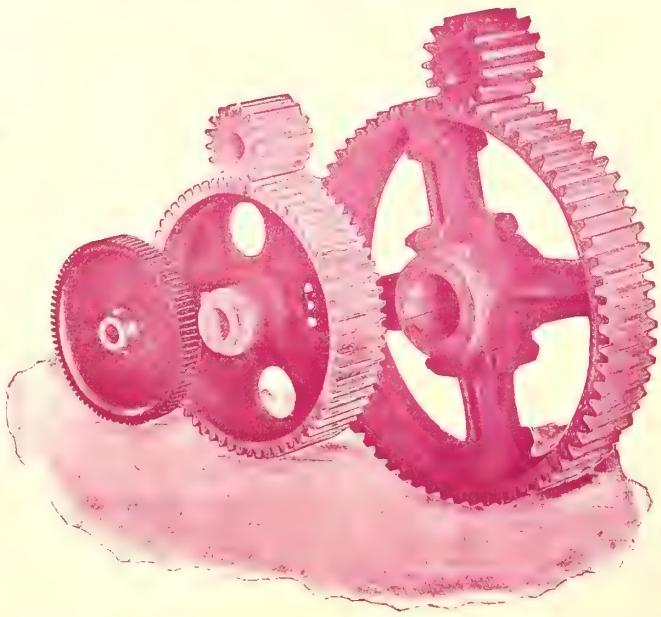
YOU WILL FIND HIM USING THEM.

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...Gears made of Steel, Malleable Iron and Cast Iron...



...Pinions of Steel and Rawhide Combination..

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OF GREAT STRENGTH

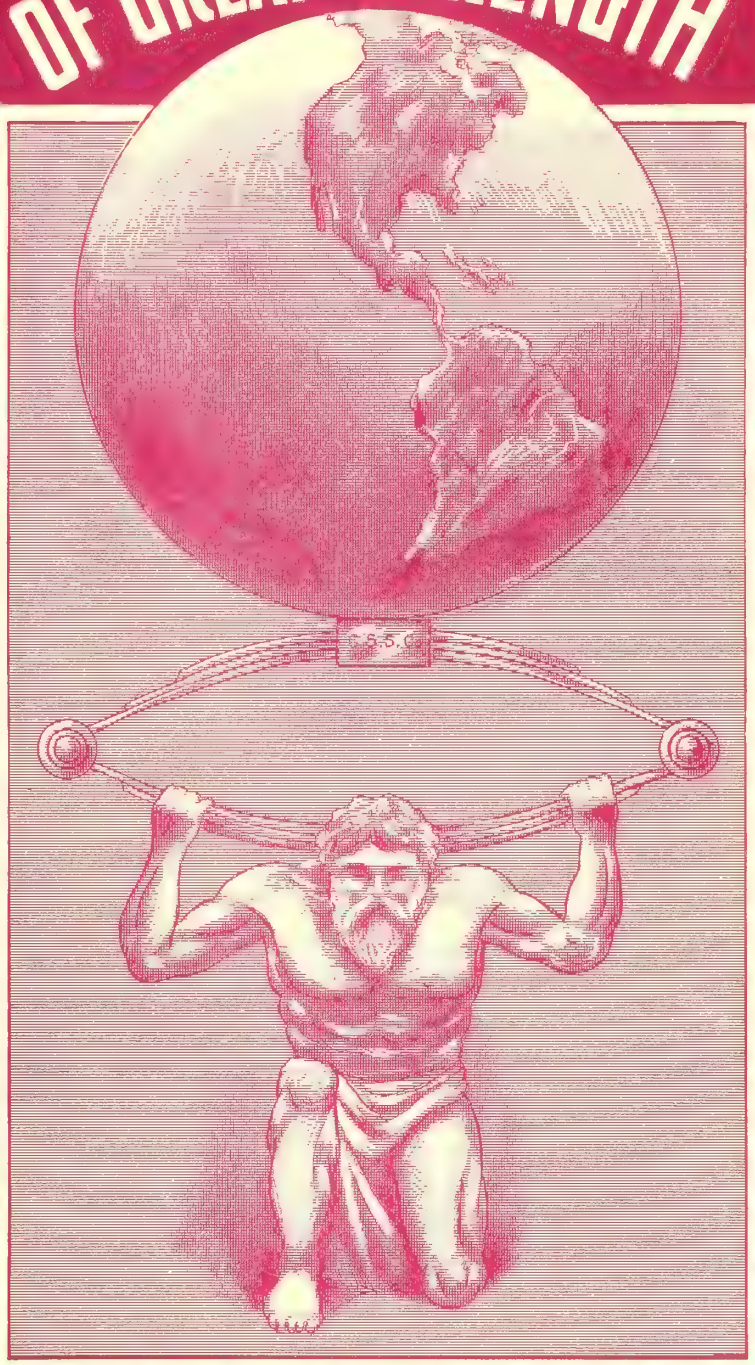
AND OF EVERY DESCRIPTION SUITABLE FOR EVERY NEED. ANNUAL ... CAPACITY 10.000 TONS



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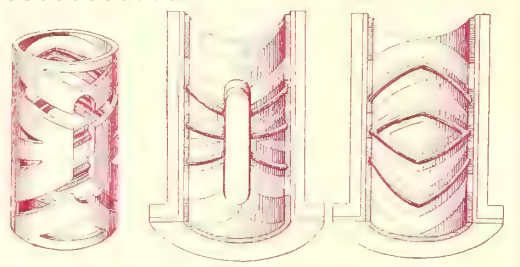
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SPIRAL MOTOR AND ... TRUCK ... BEARINGS

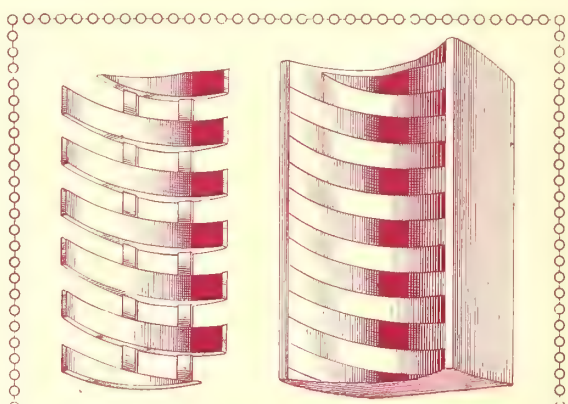
The **SPIRAL MOTOR BEARING** consists of an iron shell, lined with two dissimilar metals, viz: a skeleton bronze lining, cast in the form of a "reversed spiral," held in place by anti-friction metal, which also forms part of the bearing surface. The anti-friction metal lessens any liability to heat; the bronze acts as a check on the wear of the softer metal. The combined wear of the bronze and babbitt gives the remarkable showing which the Spiral Bearing is making. The oil grooves, cast in the bronze lining, carry the oil from the dope hole to the ends of the bearing and back again, thus insuring perfect lubrication and preventing any waste of oil. The saving in lubricants is an important feature of the Spiral Bearing.



Skeleton Bronze Lining — Finished Bearing Shown in Half Sections

The **SPIRAL TRUCK BEARING** consists of an iron shell, in which a skeleton bronze lining, in a "spiral" form, is held in place by anti-friction metal. To assist in meeting the decrease in bearing surface when a new bearing is placed on a much worn journal, the anti-friction metal is poured so as to form a coating over the whole surface of the bearing, about one-sixteenth of an inch thick.

Spiral Bearings do not cut the journals but insure an even and minimum wear.



Skeleton Bronze Lining — Finished Bearing

A special feature of the Spiral Bearings is their absolute safety. In the event of the heating of an armature bearing, from any cause, **the bronze lining prevents the letting down of the armature.**

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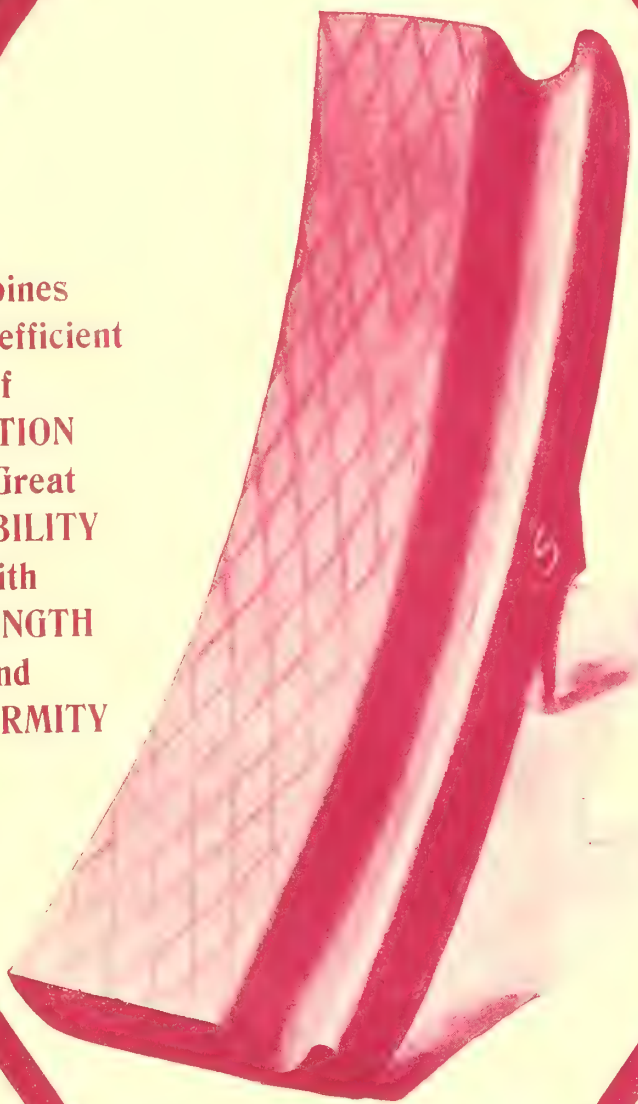
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A... Reinforced Shoe for Quick Acting Brakes

The... DIAMOND "S" SHOE

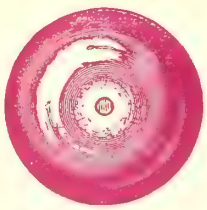
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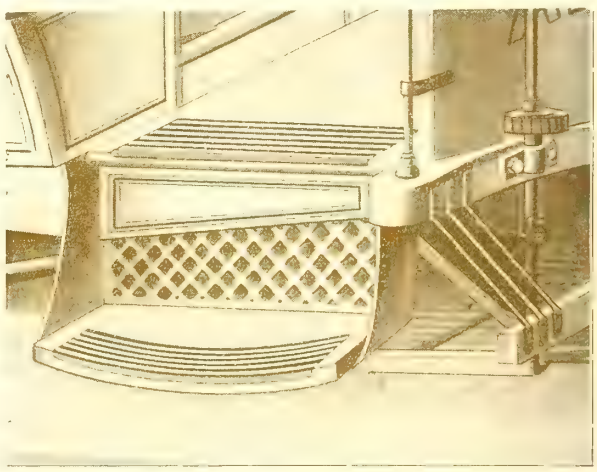
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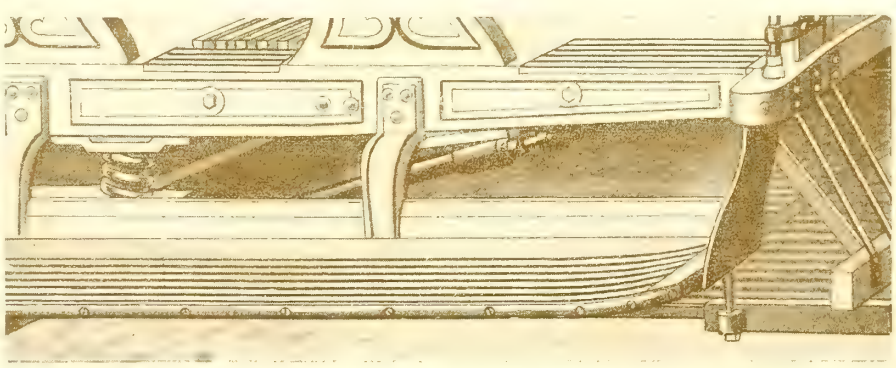
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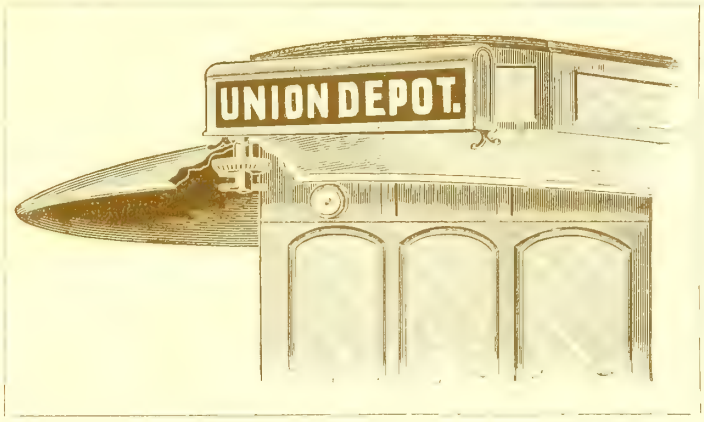
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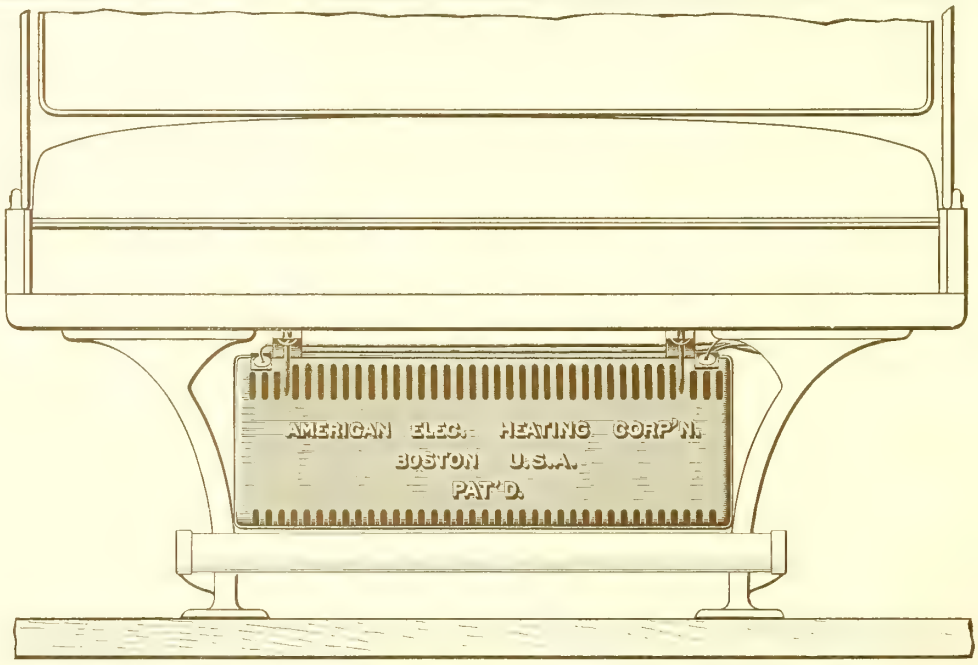
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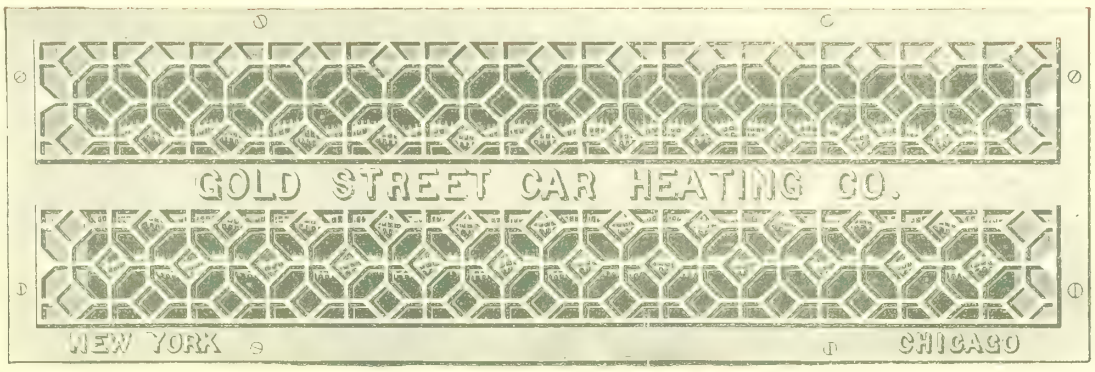
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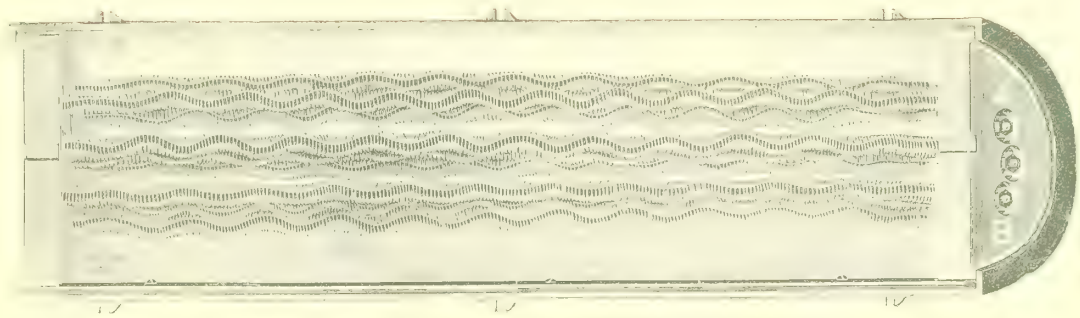
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Gold's Improved (3 Degree) Panel Electric Heater

The Gold Electric Heaters

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of our Improved Electric Heater with any other on the market, in the following very essential features:

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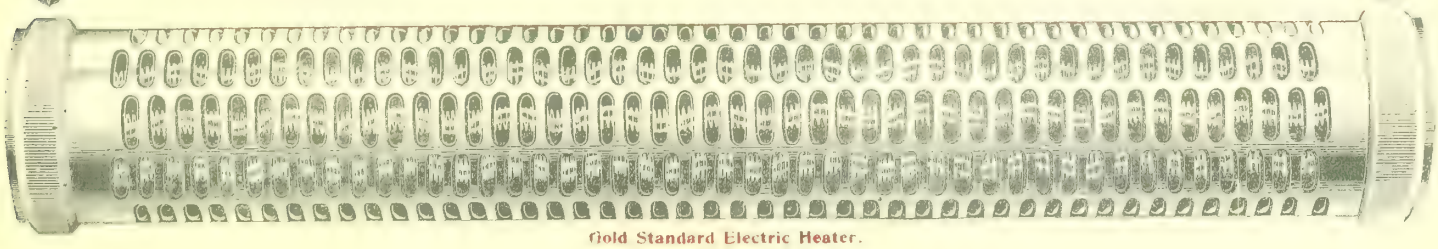
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in construction of the heaters, arrangement for connecting to the regulating switch, and installation.

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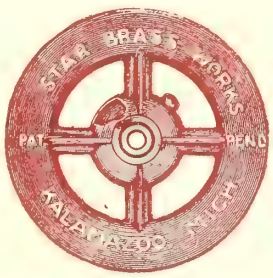
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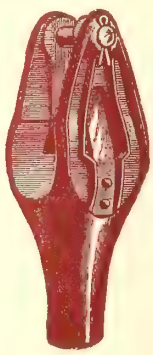
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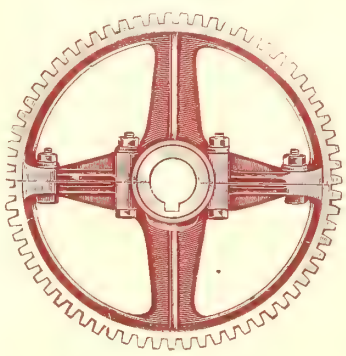


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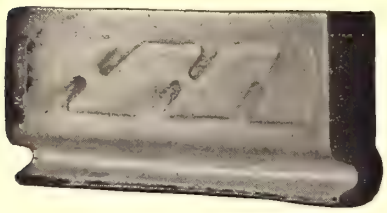
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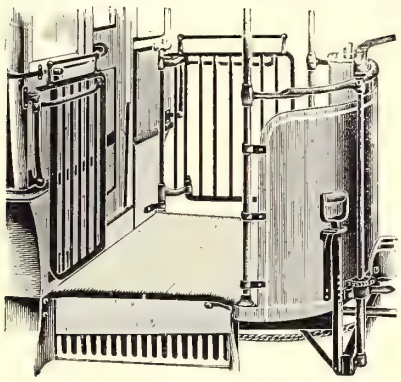
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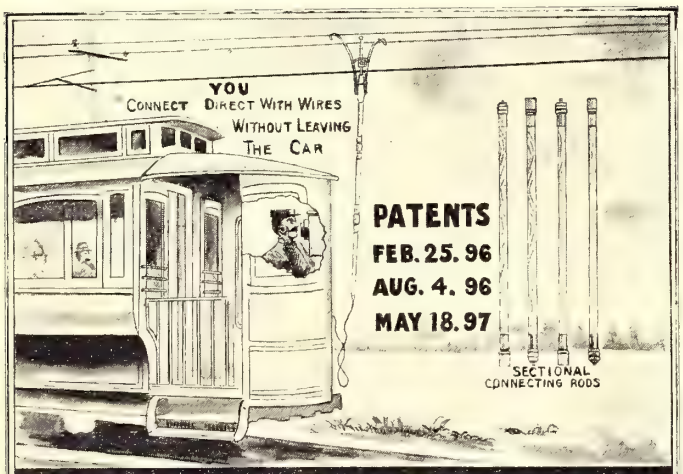
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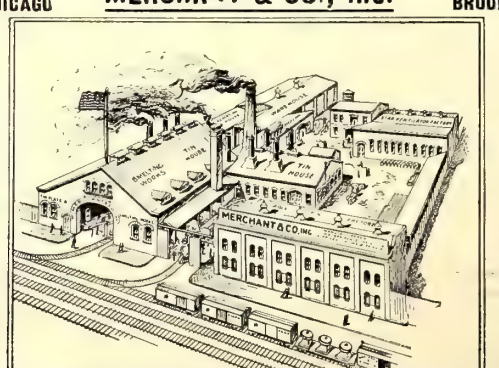
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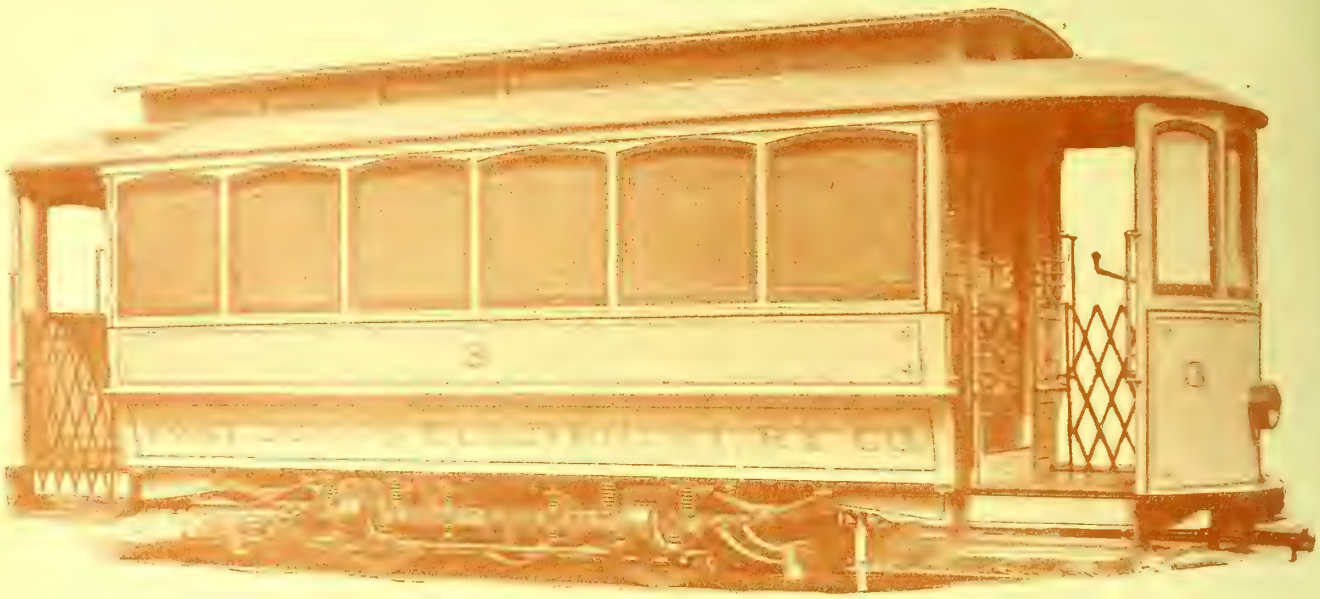
Street Railway Journal
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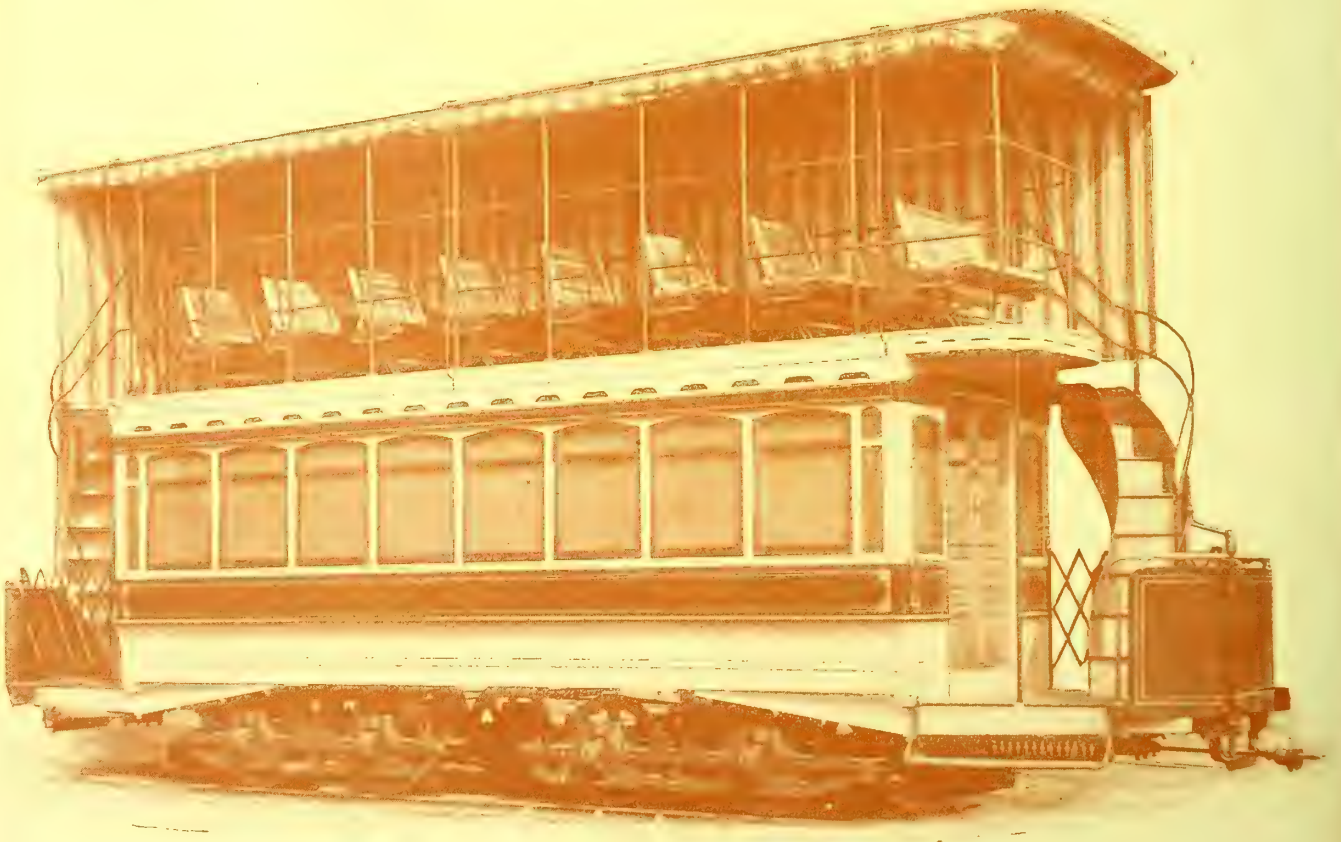
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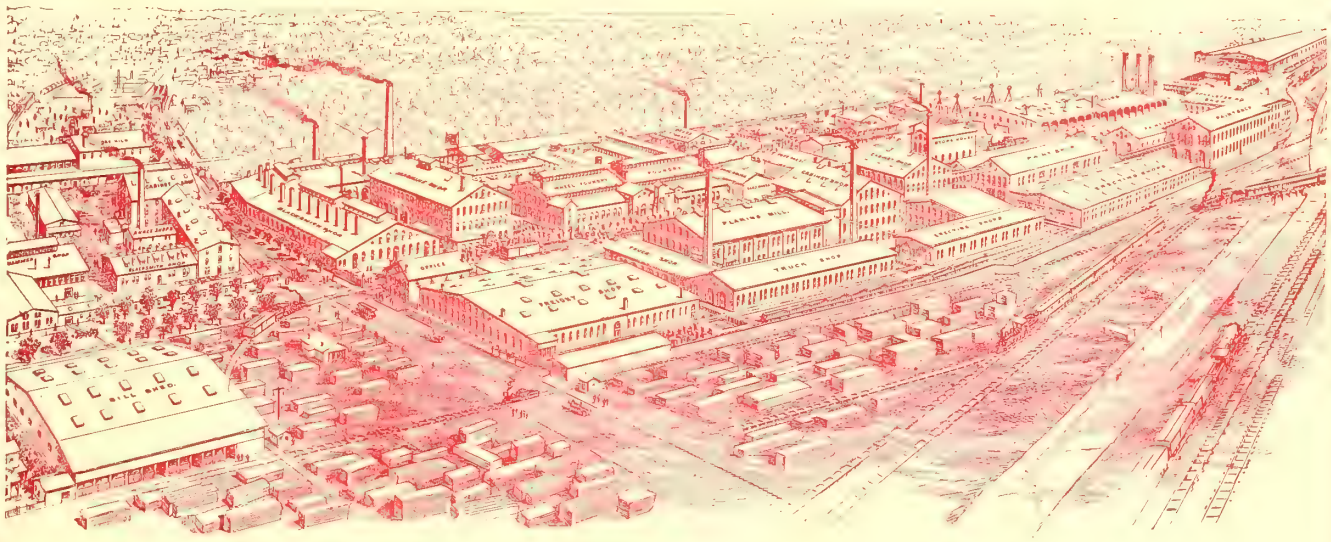
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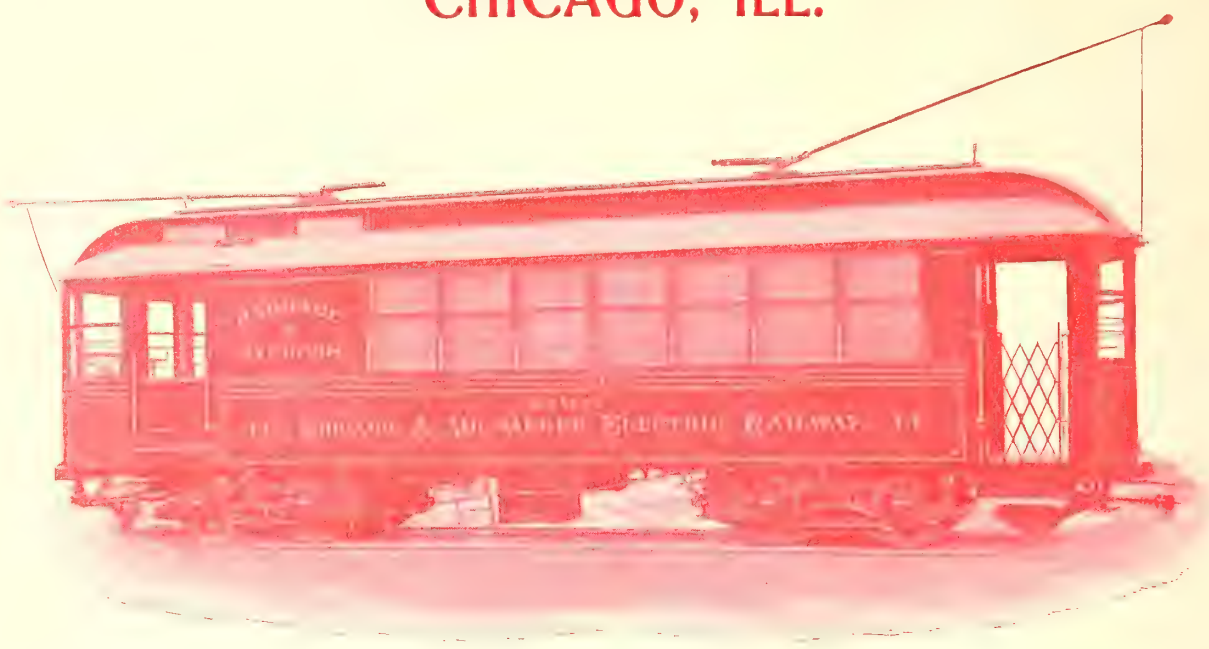


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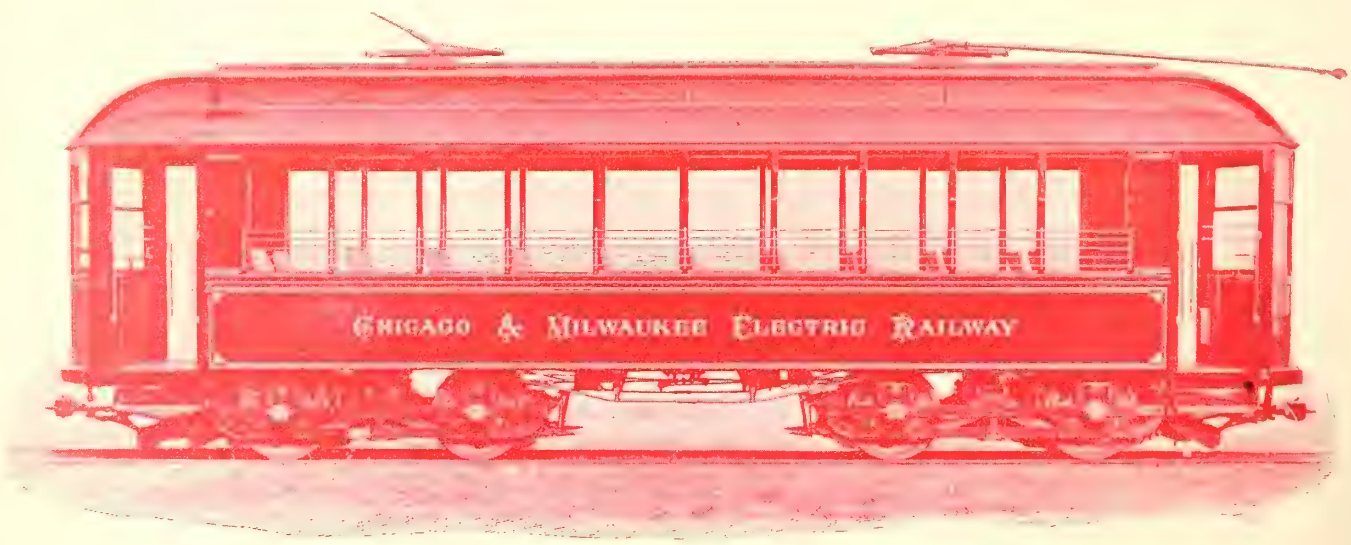
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Blue Hill Street Railway	1 "
Terre Haute Electric Railway	2 Plows
Bridgeport Traction Co.	5 "
Exeter, Hampton & Amesbury St. R'y	2 "
White Line Traction Co.	1 Plow
Citizens' St. R'y of Newburyport, Mass.	2 Plows
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Bay City Consolidated Street R'y	1 "
North Jersey Street R'y Co.	10 Sweepers
Ohio Central Traction Co.	1 Plow
Worcester & Webster St. R'y	2 Plows
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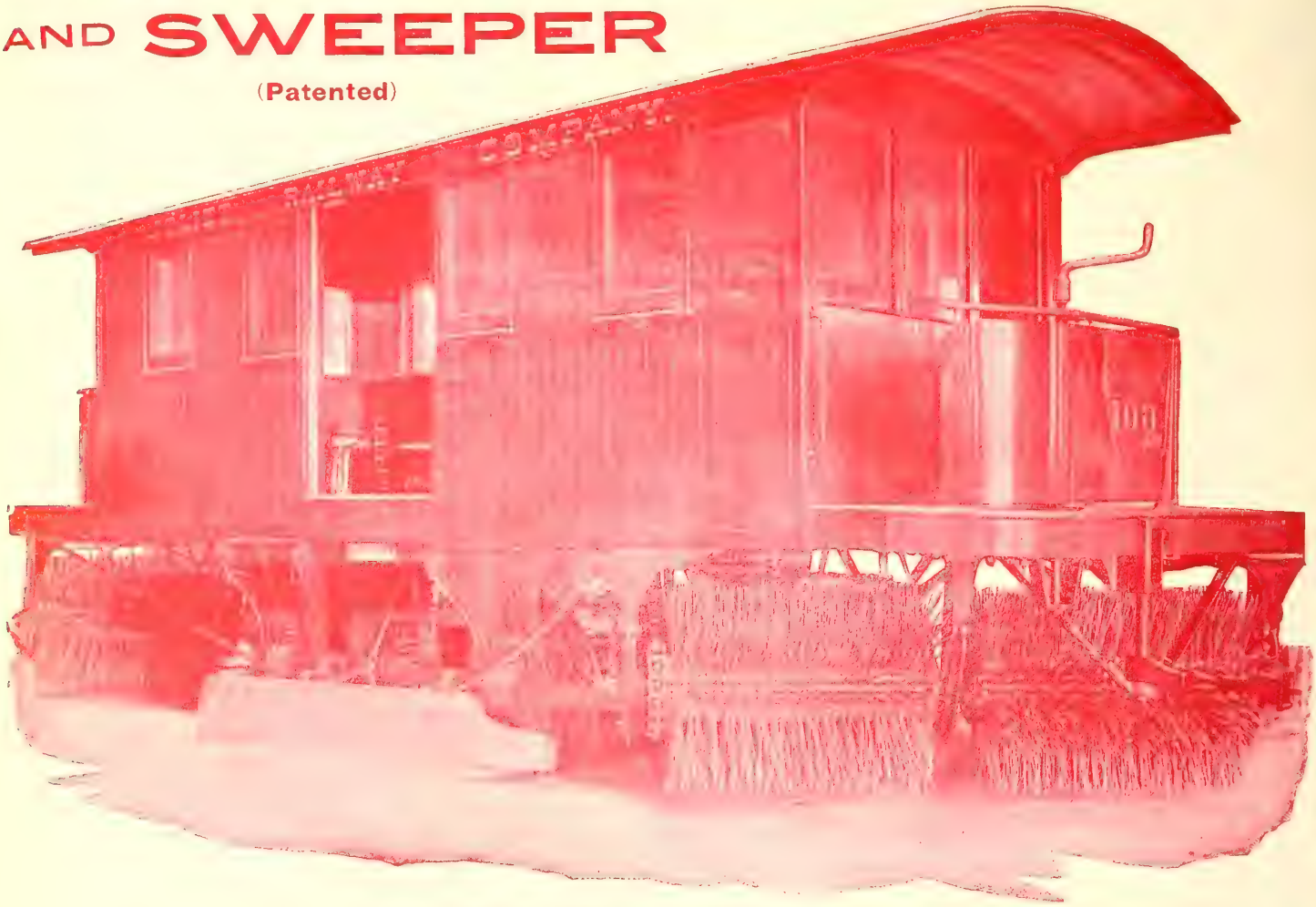
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(Patented)

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CLEANS THE TRACK IN ONE OPERATION

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Beaver Valley Traction Co., Beaver Falls, Pa.
Consolidated Traction Co., Pittsburg, Pa.
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Union Ry. Co., New York, N. Y.
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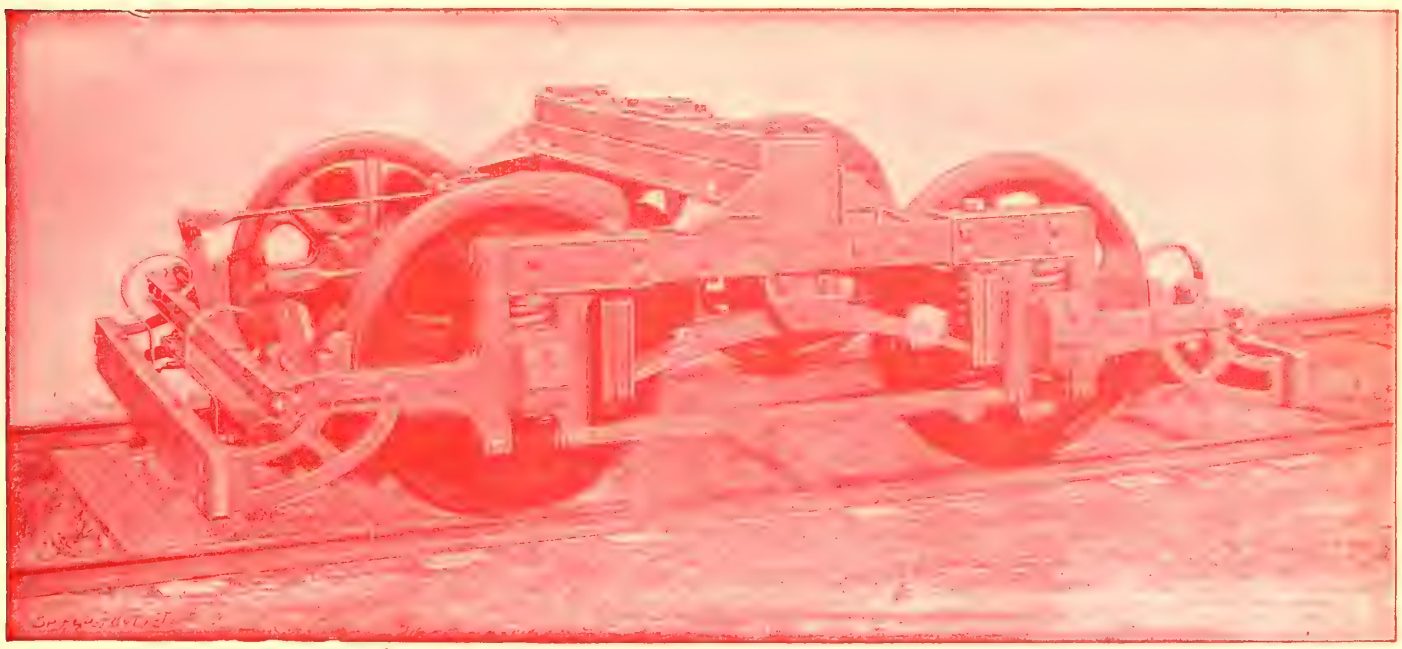
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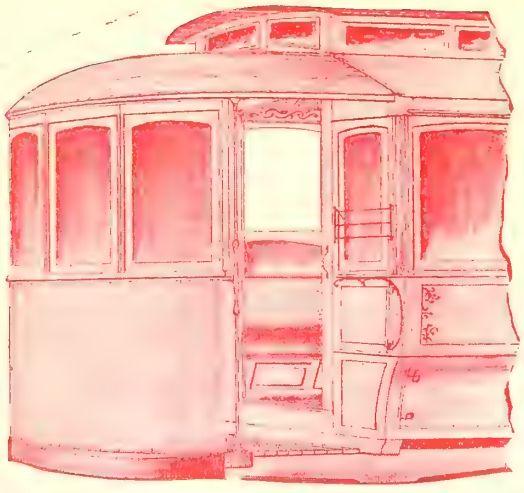
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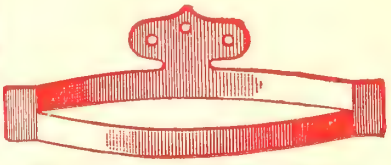
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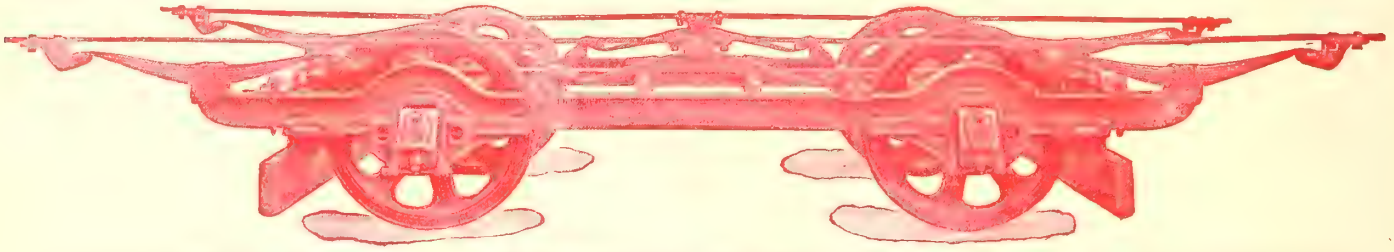
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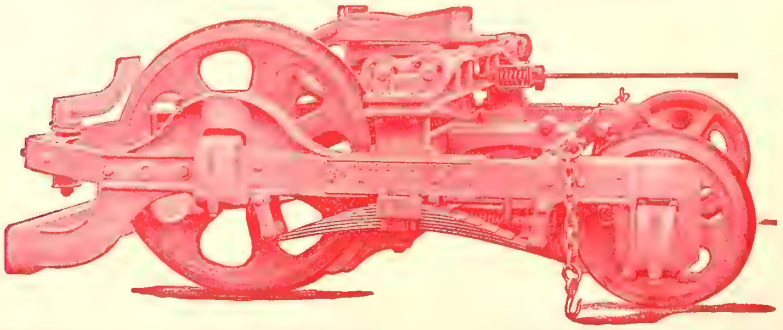
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Coney Island & Brooklyn Railway Company, Brooklyn, N. Y.	"
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North Hudson County Railway Company, Hoboken, N. J.,	" " "
New York & Queens County Railway Company, Long Island City,	" " "
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Metropolitan R. R. Co., Washington,	"
City & Suburban Railway Company, Washington,	" " "
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Cincinnati Street Ry. Co., Cincinnati, O.	"
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Charleston City Railway Company, Charleston, S. C.	"
Richmond Traction Co., Richmond,	"
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Walton-on-Naze Tramways, Walton-on-Naze, Eng.	Single
Guernsey Tramways, Guernsey, Eng.	Single and Double
Ashton Tramways, Ashton, Eng.	"
Dudley Tramways, Dudley, Eng.	"
Dubin Tramways, Dublin, Ire.	Single and Double
Cork Tramways, Cork, Ire.	"
London United Tramways, London,	Double
Marseilles Tramways, Marseilles, Fr.	Single
Chezelles Tramways, Chezelles, Fr.	"
Brest Tramways, Brest, France,	"
Paris-Aparjon Tramways, Paris, Fr.	Double
Brussels Tramways, Brussels, Belg.	"
Brisbane Tramways, Brisbane, Aus.	Single
New South Wales Tramways, Sydney, N. S. W.	Single and Double
Zurich Tramways, Zurich, Swit.	"
Hamburg Tramways, Hamburg, Germ.	"
Colombo Tram's, Colombo, Ceylon,	"
Kyoto Traction Co., Kyoto, Japan,	"
Niati Electric Railway, Niati, Japan,	"
Nagoya Elec. Ry. Co., Nagoya, Japan,	"
Odawara Elec. Ry. Co., Odawara, Jap.	"
Buenos Ayres & Belgrano Tramways, Buenos Ayres, S. A.	Single and Double

Q.—Why was Dewey so successful at Manila?

A.—Because of the most thorough preparation covering a long period of years of both men and ships.

A Chapter on Experience and Skill.

Q.—Were not the Spaniards as brave as Dewey and his men?

A.—Possibly so, but they lacked the thorough training and drill which is necessary to make a marked success in any direction.

EVERYONE KNOWS THAT A PERFECT MACHINE—

whether it be a Locomotive, a Steam Engine, a Man-of-War, or a modern Trolley Car —must be the result of careful and painstaking effort directed by a high order of engineering skill.

We have had the long experience.

We have the trained men to do the work.

We have the best special machinery and the best material the market affords.

We have developed a complete system of both Single and Double Trucks.

We are prepared to fulfill every possible requirement.

Our methods and workmanship have never been questioned by anyone using Our Trucks.

CORRESPONDENCE SOLICITED

Q.—When did the Peckham Company begin to build trucks?

A.—At the time that electricity was first used as motive power.

PECKHAM TRUCK COMPANY,

26 Cortlandt St., - New York.

Works, Kingston, N. Y.

Q.—Why are Peckham Trucks known the world over?

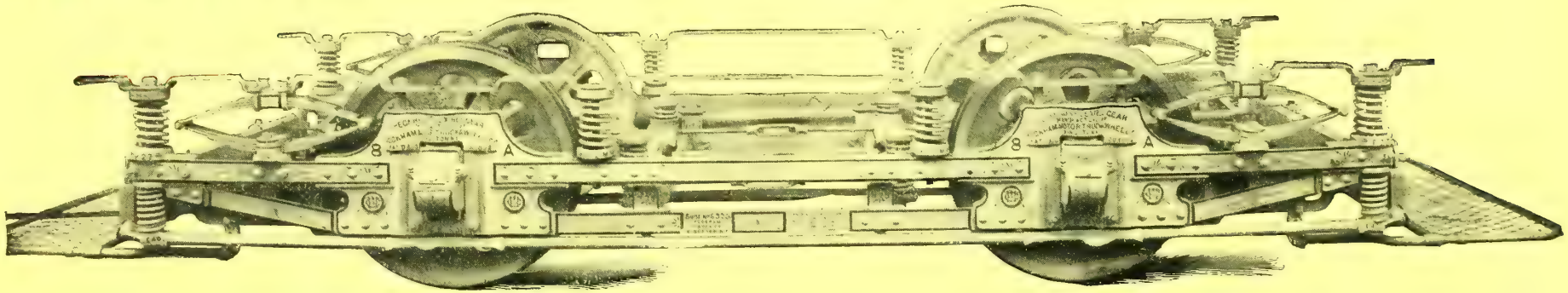
A.—Because more than TWELVE THOUSAND Peckham Trucks are in use in America and Europe, and are giving entire satisfaction.

PECKHAM'S Counter-balanced Cantilever Extension Trucks.

ESPECIALLY ADAPTED FOR "HIGH SPEED" AND "DOUBLE-DECKED" CARS.

STANDARD,

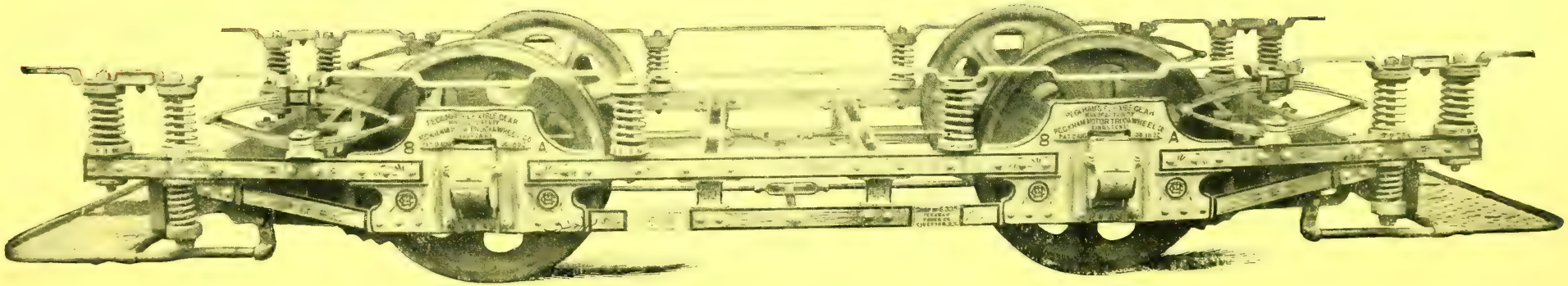
Designed for 18 and 20 feet closed, and 28 to 30 feet open cars.



EXTRA LONG

"BROADWAY" STANDARD.

Designed expressly for 20 to 24 feet closed, and 28 to 35 feet open cars.



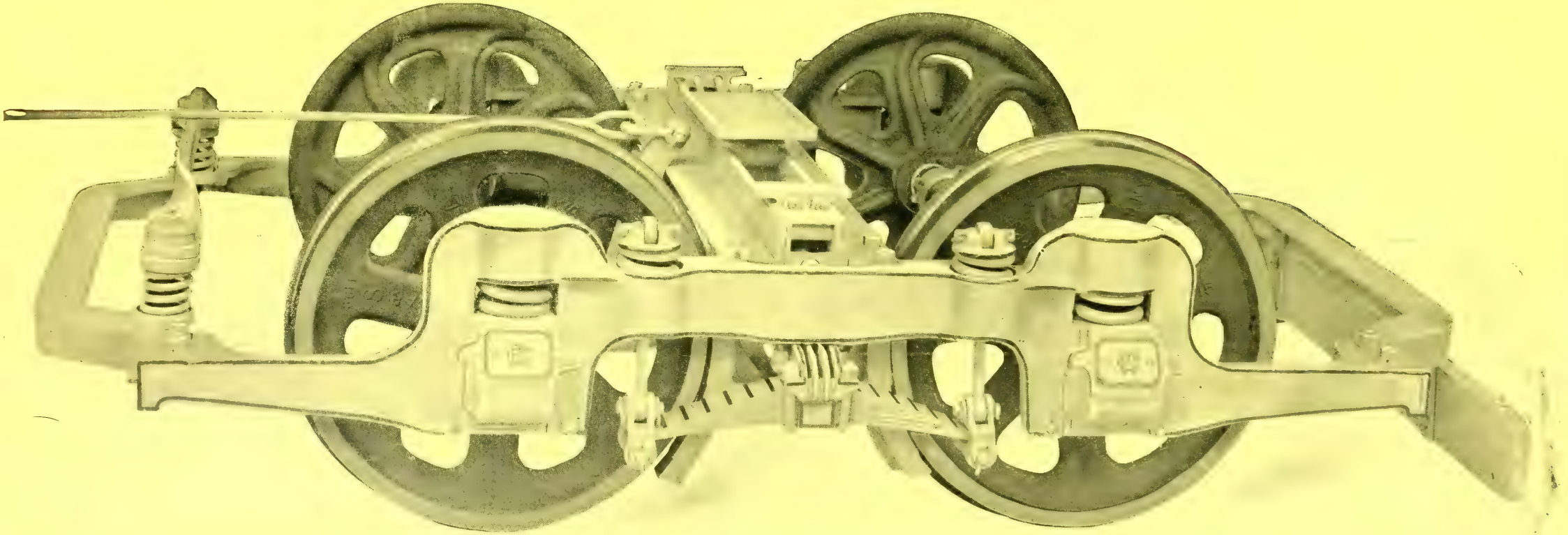
THE LONGEST AND STRONGEST SINGLE ELECTRIC TRUCKS IN USE.

OVER **10,000** IN USE IN AMERICA AND EUROPE.

See List of Electric Railways using PECKHAM'S TRUCKS, on Page 266.

PECKHAM'S ALL STEEL Short Wheel Base "Swing Bolster" Double Truck TRADE MARK 14 B-3

FOR RAILWAYS WITH SHORT RADIUS CURVES.
70 PER CENT TRACTION ON DRIVING WHEELS.
WHEEL BASE 4 ft. TO 4 ft. 6 in.
ADAPTED FOR EITHER ONE OR TWO MOTORS.



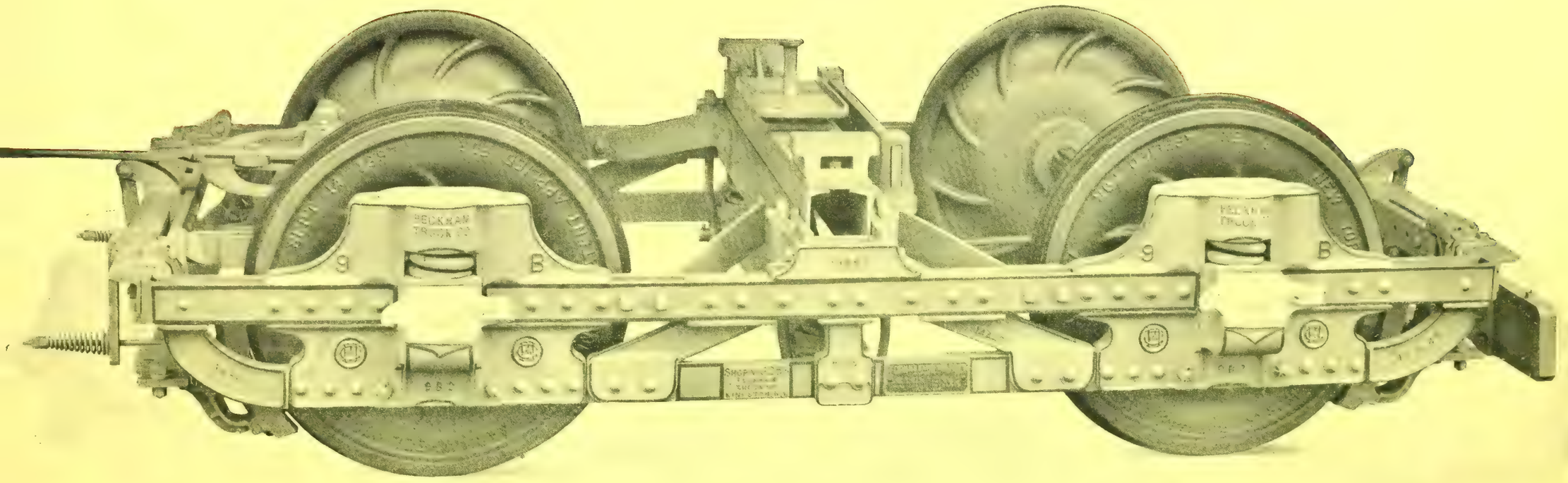
The Short Wheel Base reduces height of car bodies by allowing wheels to radiate between car sills, and requires less power on short radius curves.

Motors suspended outside of wheels give increased traction.

Equipped with inside brakes, guaranteed to be more powerful and efficient than any other in use.

PECKHAM'S "EXTRA STRONG" Center Bearing Swing Bolster Double Truck TRADE MARK No. 14 A EXTRA STRONG.

AS CONSTRUCTED FOR TWO MOTORS.



DESIGNED FOR EXTRA HEAVY "HIGH SPEED" ELECTRIC SERVICE.

AN IDEAL TRUCK FOR ANY KIND OF HEAVY OR SEVERE SERVICE.

FOR BLUE PRINTS, ETC., APPLY TO

THE PECKHAM TRUCK COMPANY,

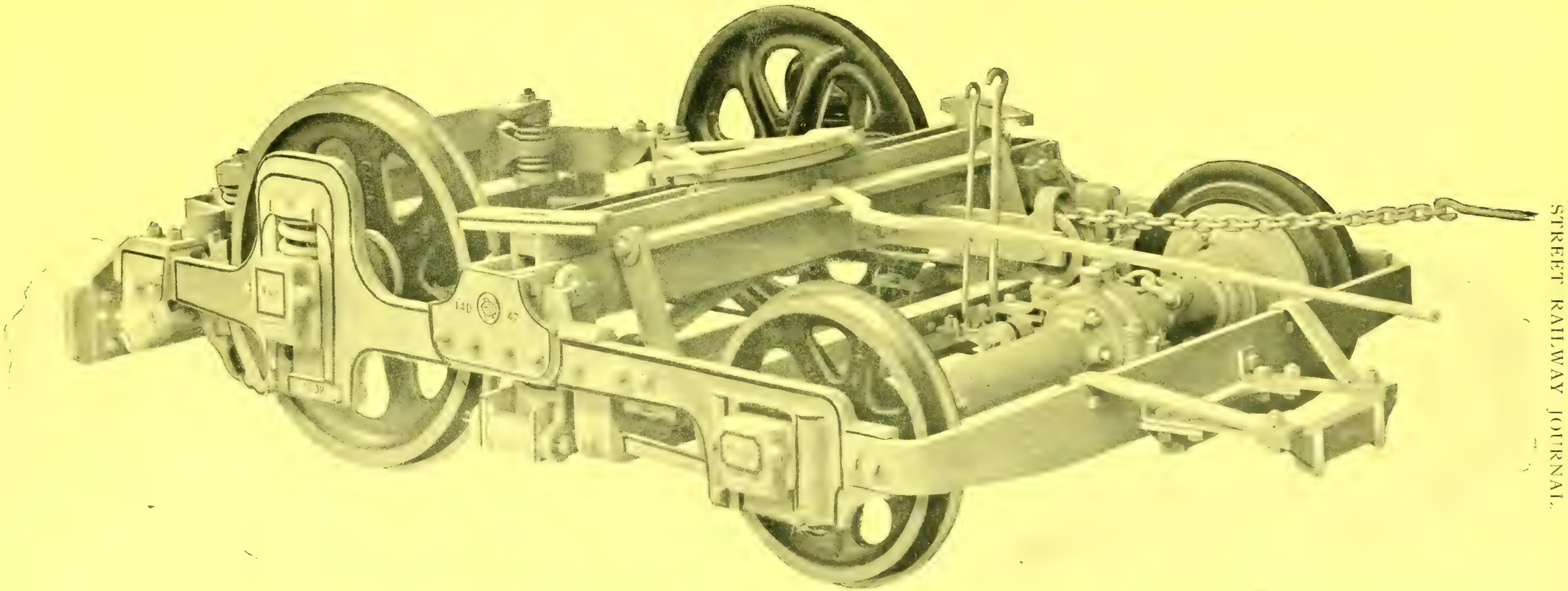
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General Sales Office, 26 CORTLANDT ST., NEW YORK.

PECKHAM'S Centre Bearing Swing Bolster "Maximum Traction" Truck No. 14 D 2.

EQUIPPED WITH THE **PRICE FRICTION BRAKE.** THE MOST EFFECTIVE AND ECONOMICAL POWER BRAKE IN USE. ESPECIALLY ADAPTED FOR DOUBLE TRUCK CARS.



The only "Swing Bolster" Maximum Traction Truck.

8 per cent. more Traction Guaranteed upon driving wheels than any other "Maximum Traction" Truck.

Recent Sales:

30 TO CITY AND SUBURBAN R. R., WASHINGTON, D. C.
120 TO THIRD AVENUE R. R. CO., NEW YORK.
300 TO LONDON UNITED TRAMWAY CO., LONDON, ENG.
260 TO BOSTON ELEVATED RAILWAY CO., BOSTON.

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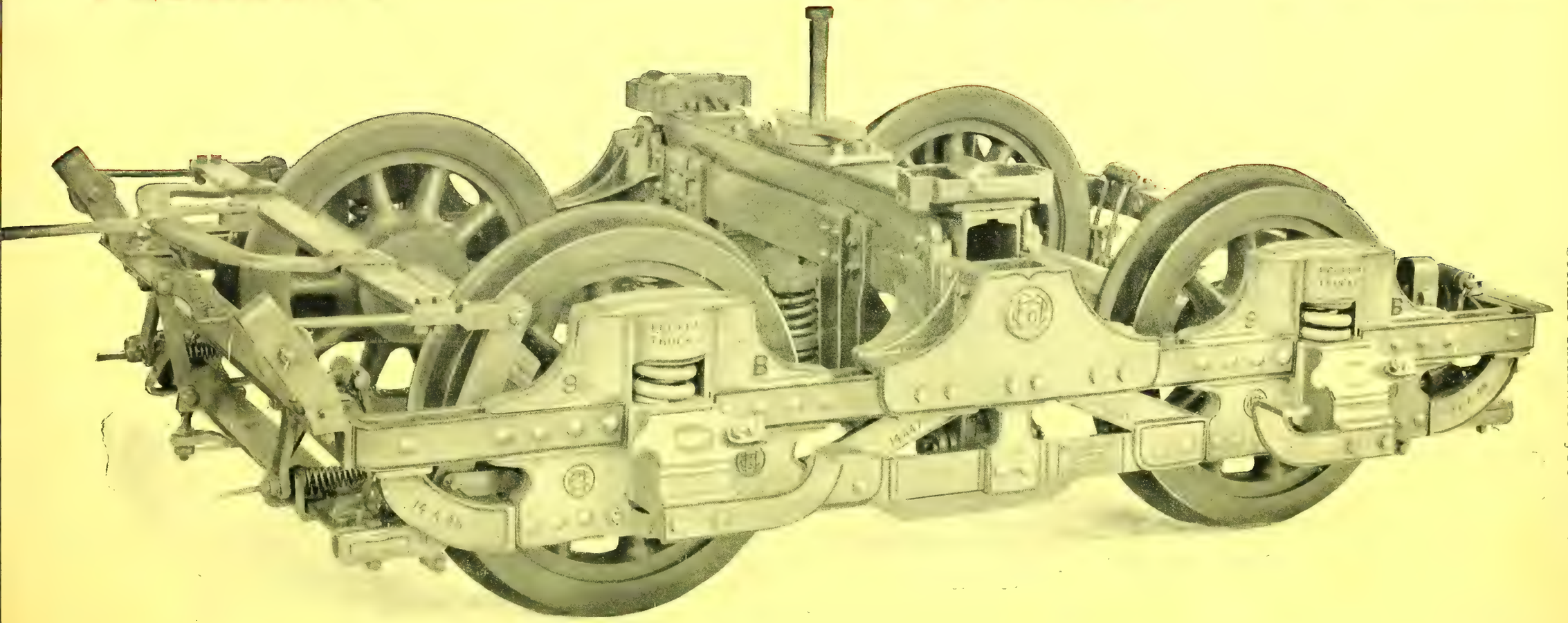
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DESIGNED EXPRESSLY FOR HEAVY HIGH SPEED ELEVATED OR TRUNK LINE SERVICE.

As per test of Robert H. Hunt & Co., Nov. 26, 1898, Breaking strain **OVER 100 TONS**—More than six times the maximum weight of car and load.

FOR BLUE PRINTS, ETC., APPLY TO

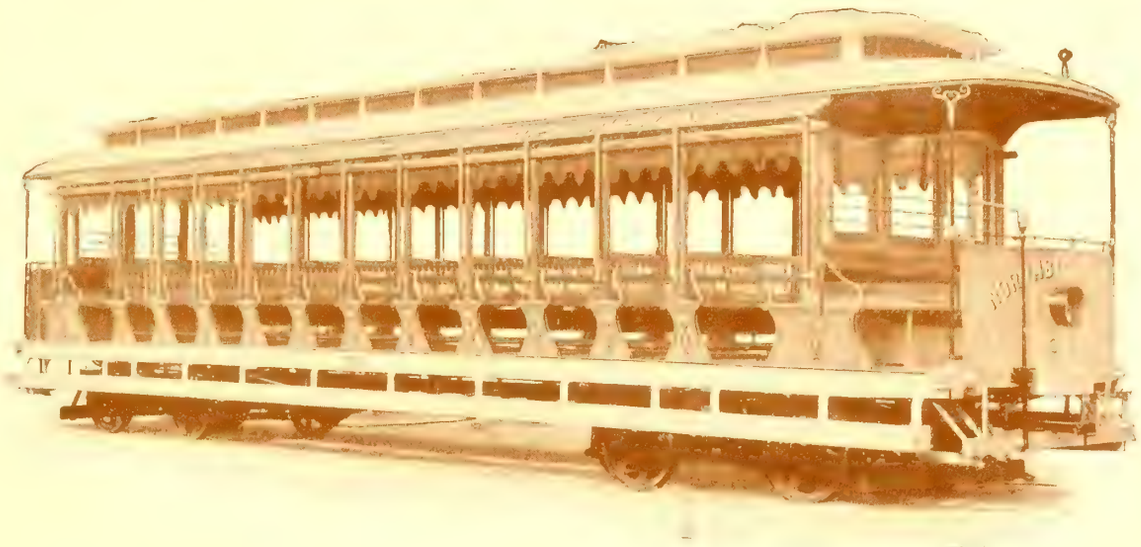
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J. M. JONES' SONS



Some Facts Regarding JONES' CARS

Distinctiveness

"State of being DISTINCTIVE."—*Webster.*

THE DISTINCTIVE FINISH, DESIGN, SYMMETRY of the WHOLE, lines of CONTOUR, etc., are so embodied in our products, that they are easily segregated. The DESIGN, COMPLETENESS and LIBERALITY of our TRIMMINGS and the COMPONENT PARTS of the car, are DISTINCTIVE. Even a WHEELBARROW has SYMMETRY—why not a STREET CAR? Some builders get the length, width and height but do not consider SYMMETRY. Without SYMMETRY there is a due loss of STRENGTH, DURABILITY and BEAUTY. There is a good reason for EVERY LINE, DIMENSION, and SWEEP in our cars.

[TO BE CONTINUED].



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...CAR BUILDERS...

When in need of modern equipment, do not fail to write to the St. Louis Car Company for prices. Special attention given to foreign business.

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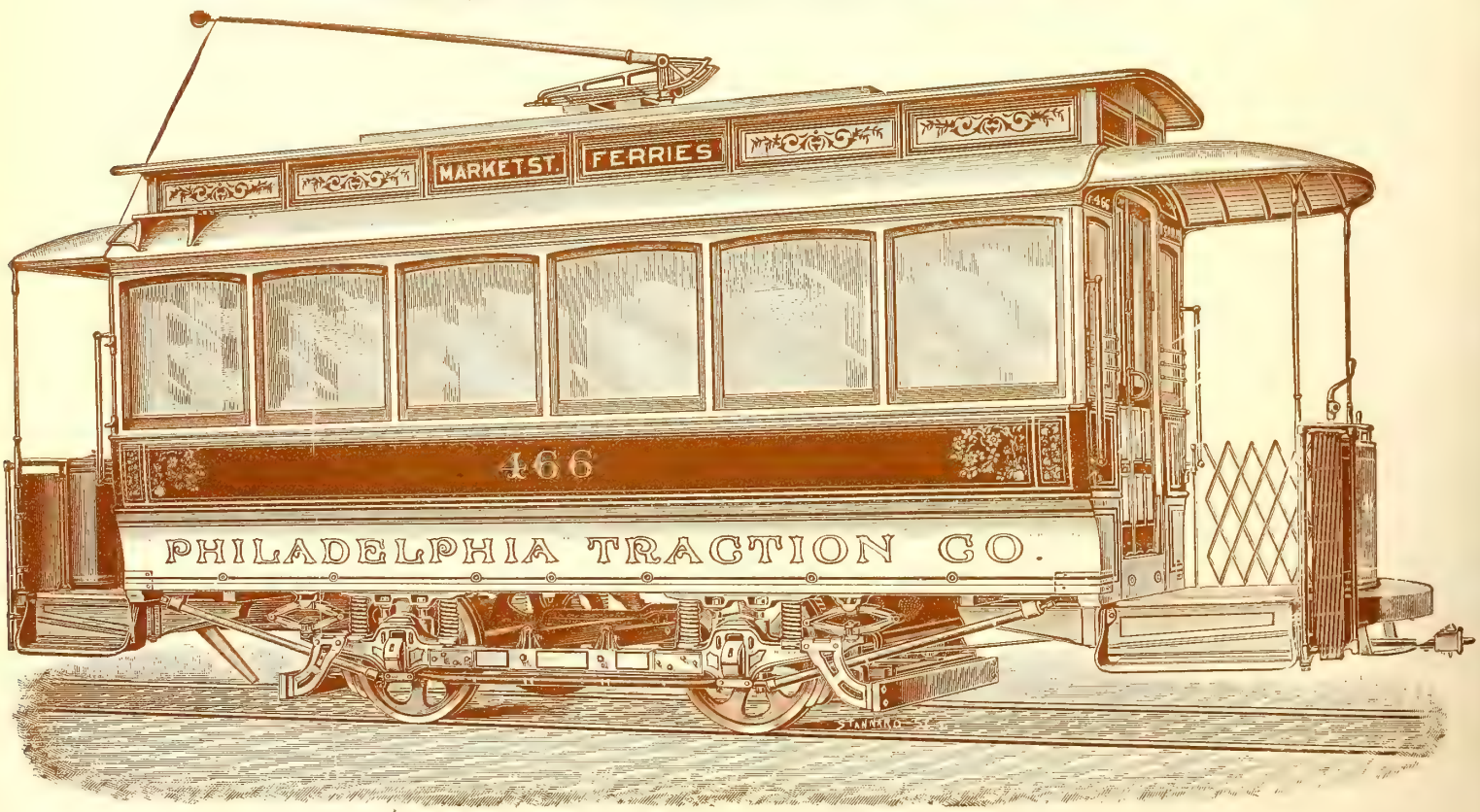
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THIS CUT REPRESENTS ONE OF THE 100 CARS WE FURNISHED THE PHILADELPHIA TRACTION COMPANY FOR THE MARKET STREET LINE.

All Orders Promptly and Carefully Executed.

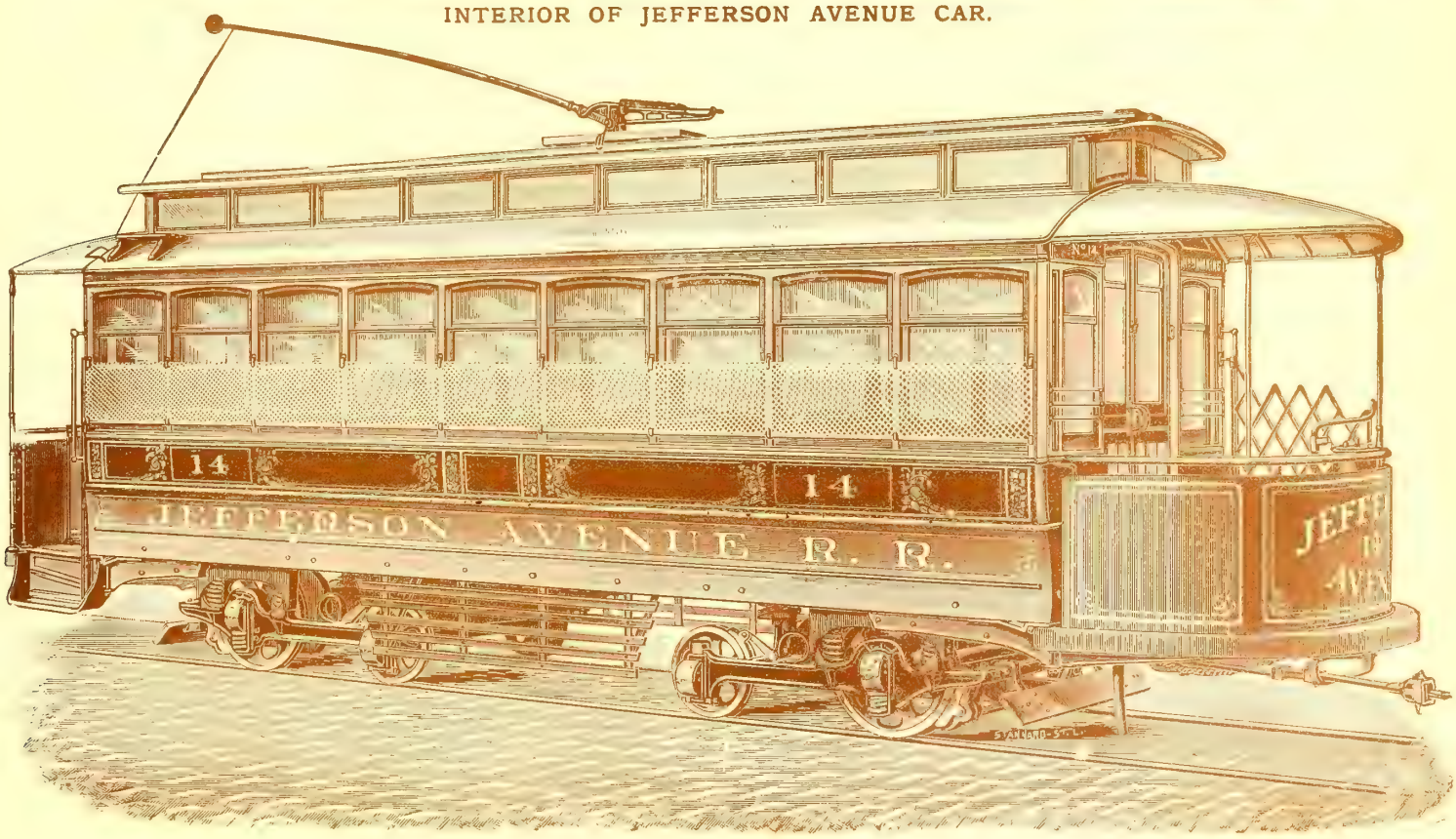
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Everything Needed for Handling Snow on Street Railways



COMBINATION PLOW

Combined Plow and Construction Car. Strong enough for the heaviest work. With four motors may be used as an electric locomotive. When stripped for summer as convenient as any construction car. In winter a perfect plow.



SNOW SWEEPER

Sweepers. Two motors for propulsion. One for driving the brooms. Independent adjustments for each end of each broom. Canvas wings prevent snow from flying. Drop forged sprocket chains. Complete housing and protection of men.

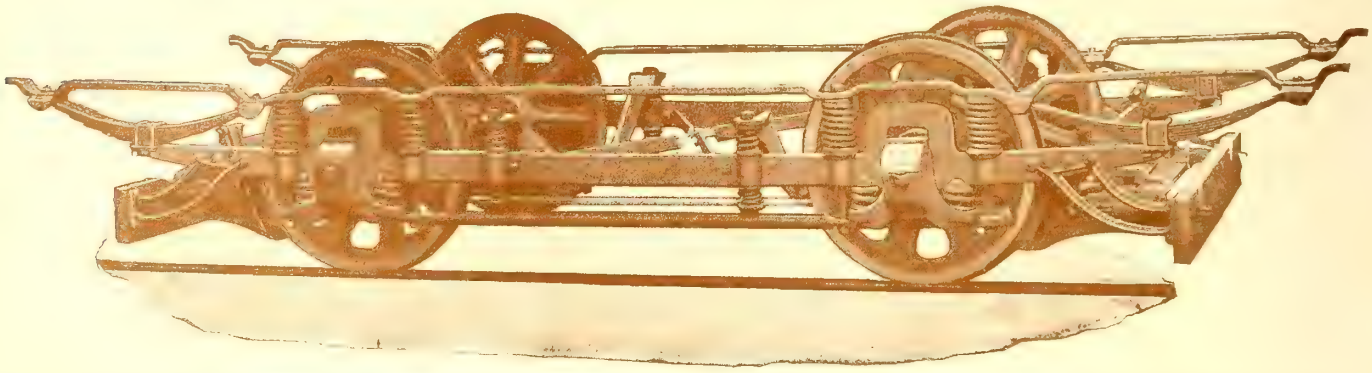
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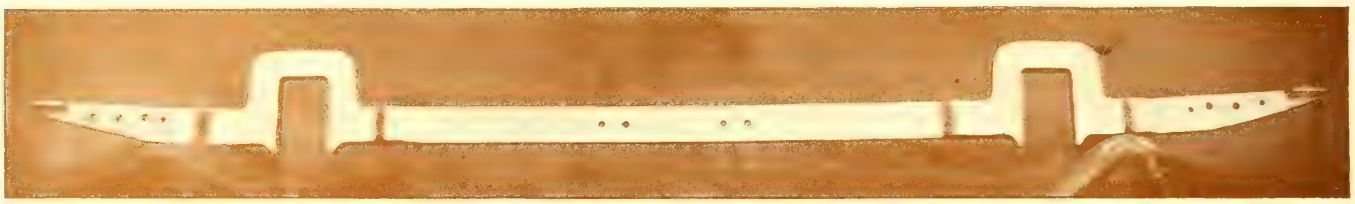
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The 21-E TRUCK === STEADY === EASY.



Has a Frame Forged Solid. Strong Enough to Hold Up the Ends of the LONGEST CARS.

Extended Spring Base. We can furnish a longer or more "extended" spring base than any other truck in the market, while giving the strongest truss for the car end.



SIDE FRAME OF 21-E TRUCK.

A SINGLE PIECE OF METAL.

STRONG, LIGHT and STIFF. A Single Piece that Never Needs Repairs.



Closed Car Mounted Upon 21-E Truck. Long Spring Base. Ends of Car Perfectly Supported. Car Rides Steadily Without Galloping or Pitching

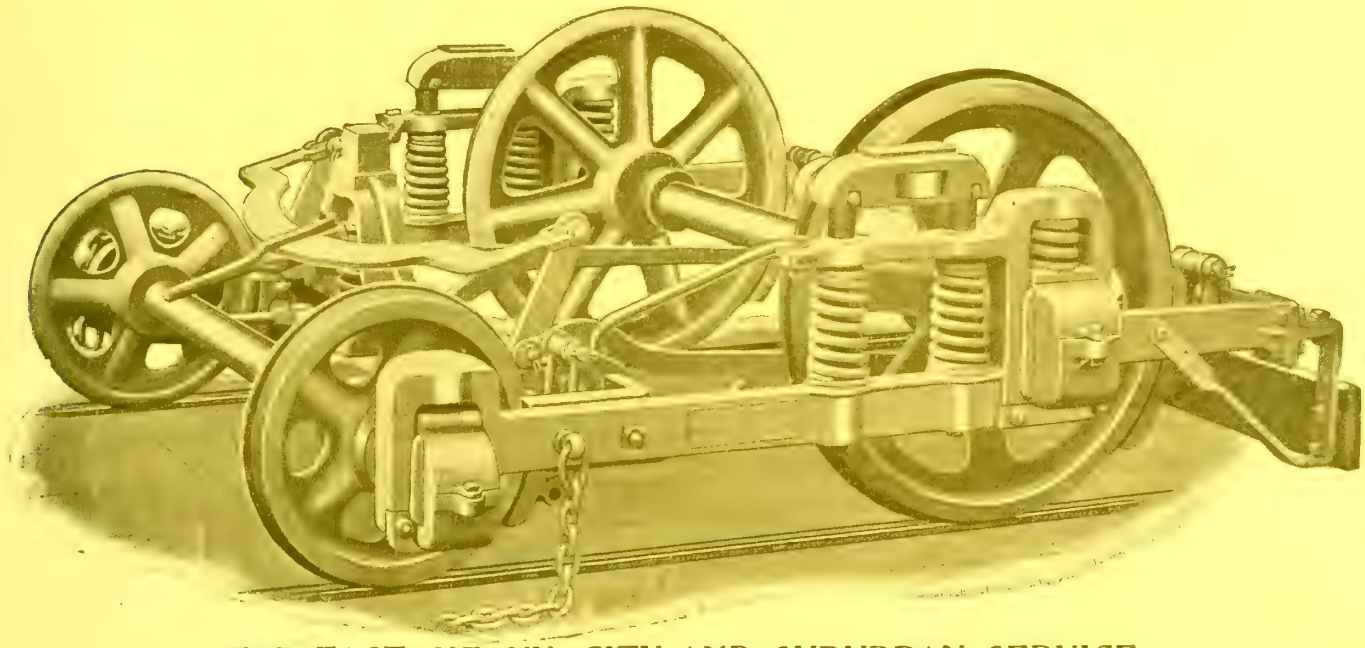
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FOR FAST, HEAVY, CITY AND SUBURBAN SERVICE

Can be used under Open or Closed Cars.

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NO PITCHING.
STEPS LOW.

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Standard Closed Car of the Metropolitan Street Railway of New York City. These Cars are mounted on our Eureka Maximum Traction Trucks.

Repairs on road bed are greatly reduced by the use of Eureka Maximum Traction Trucks. Cars mounted on them can make better headway than those mounted on four wheels. This is especially noticeable in the snows of winter.

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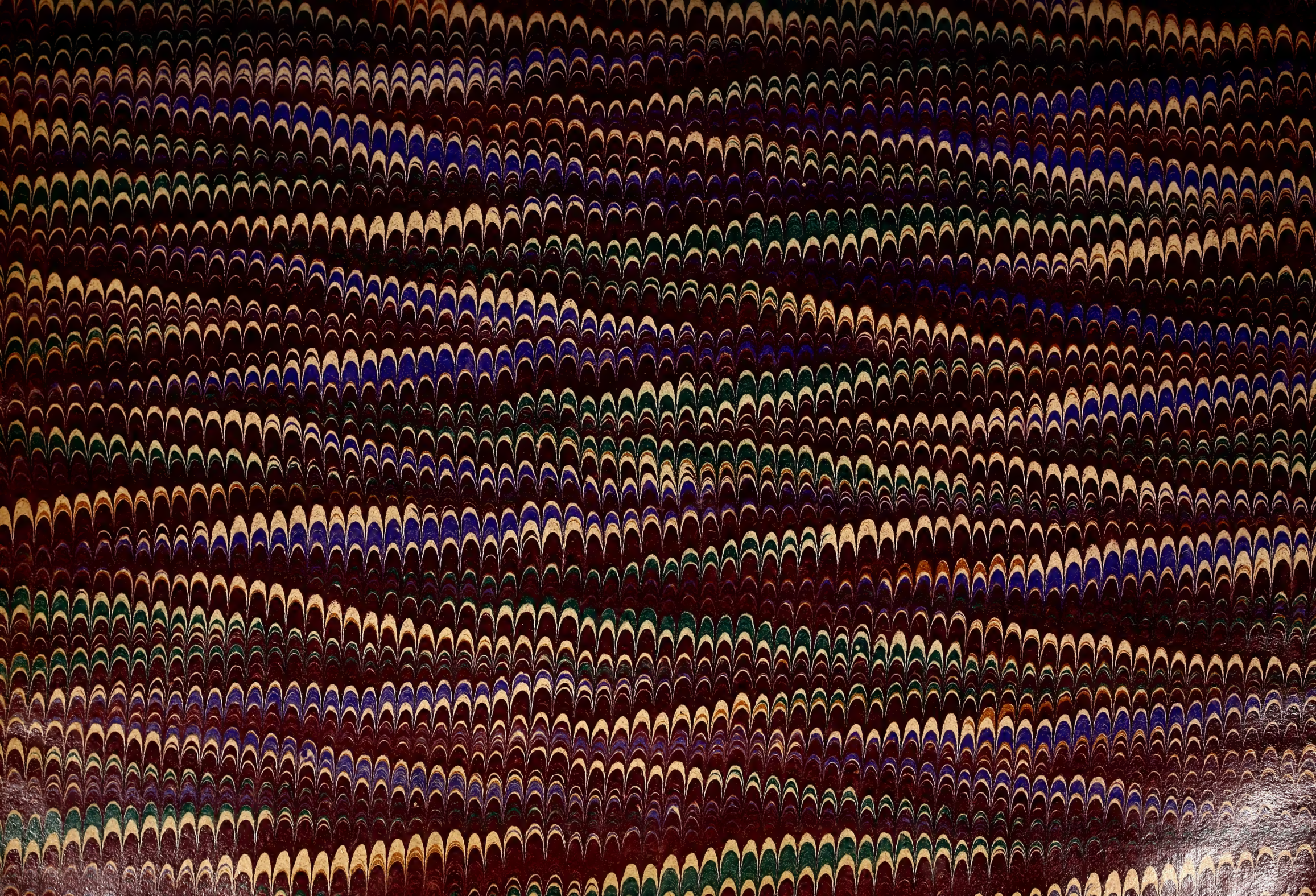
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